Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, January, 1911. No. 1

In a Northwestern Blizzard.

Our frontispiece this month of January, in the year of grace 1911, shows in graphic form some of the hardships which fall to the lot of railroad men when nature wears her most forbidding frown. The excellent picture of a train in a Western blizzard was very kindly given to us by Mr. Warren S. Stone, grand chief of the Brotherhood of Locomotive Engineers.

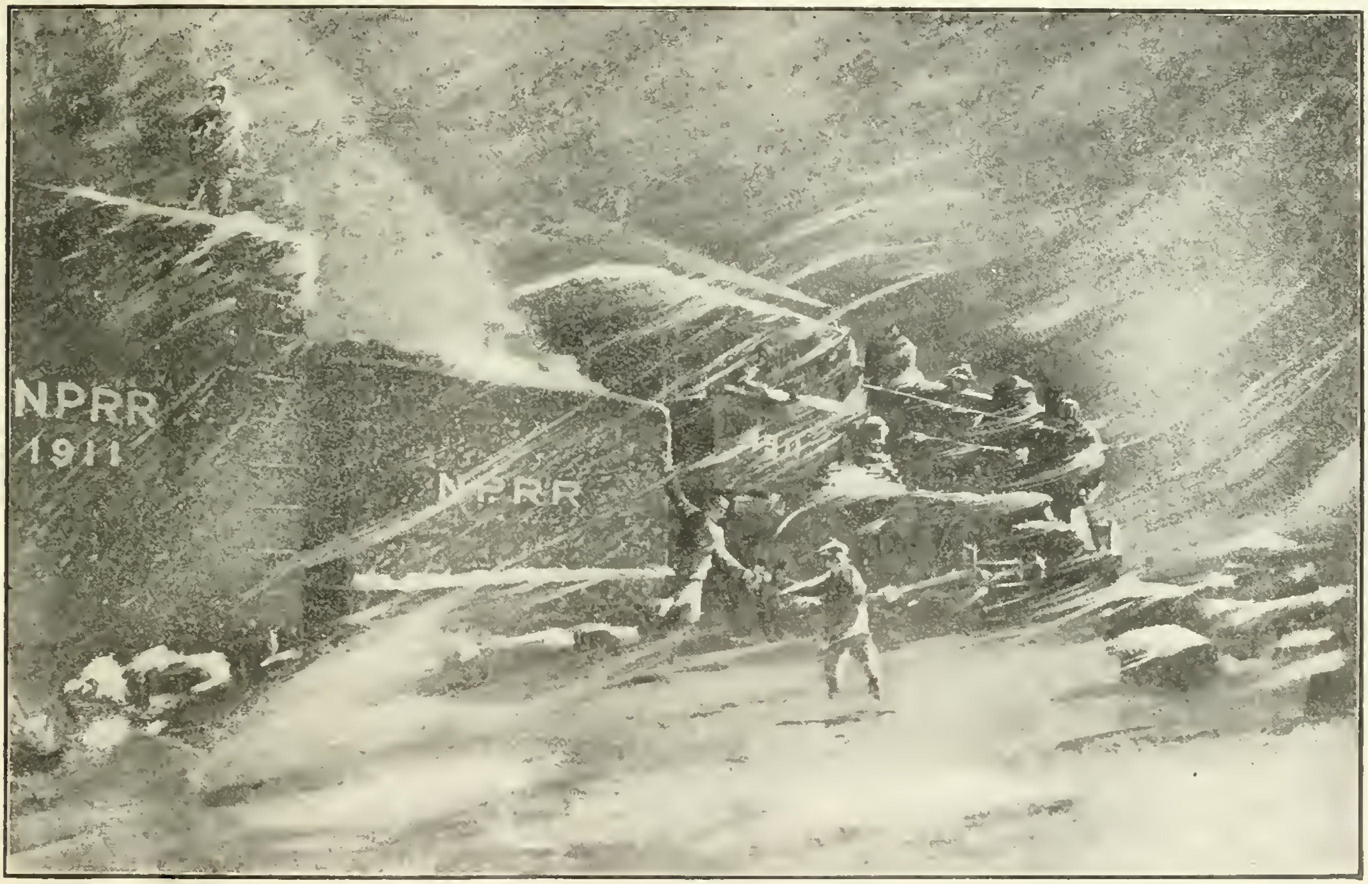
In the early days of his career Dr. Angus Sinclair had some of the trying experiences which present day locomotive engineers have to go through, and while fighting snow and wind are not calculated to sweeten one's temper at the time, they tend to develop some of the best qualities a locomotive runner can have—hardihood and endurance.

Writing of a brisk brush with Jack Frost, Dr. Sinclair says: "A person lost in the pathless forest or cast away in a far reaching desert draws my sympathy more than any victim of misfortune except, perhaps, that of people in a boat on the ocean without compass or other means of guidance. I have always felt that a man sent out to run a locomotive over a strange road was in a condition similar to the cases mentioned, and I hoped that it might never be my lot to go through the experience, but it was.

"I had been running on the road about two months, when on getting out of bed one morning, I found a heavy coating of snow on the ground. Snow had been falling the greater part of the night. There had been no snow of any consequence where my previous railroading had been done, and I felt very much like laying off now, for the boys often spoke about the rough times they had snow-bucking. However, on reflection, I concluded to go out, for I guessed I could do what any other man had done.

"I was boarded to go out in the morning with a freight train over a division that had a bad name as far as snow was concerned. When I went to my engine the fireman advised me to get a heavy overcoat and arctic overshoes. These articles seemed to me to be superfluous in the comfortable cab of a locomotive, so I started without them. I had never been in a Northwestern blizzard.

"Although considerable snow had fallen, the weather was mild and pleasant when we started out and there was no difficulty in taking a full train along.



IN A NORTHWESTERN BLIZZARD.

for frequent trains had kept the track clear. The division I was bound over followed the main line for twenty miles, then struck to the southwest through a country that was thinly settled. We had met with several delays on the main line, and it was about midday when we reached the junction. We were glad to get away from the main line, for we knew that on the branch we would be free from the delays incident to meeting numerous trains on a single track road.

"About the time we got rightly going on the branch the wind began gradually to rise and the temperature to fall—not slowly by any means, but surely enough. At first the light breath of wind seemed to toy with the soft feathery particles on the surface of the snow. The downy flakes clinging to exposed tufts of praire grass and reposing on the leaves of scrub oak would rise on the breeze and be wafted quietly to more sheltered resting places. As the speed of the wind increased, the clumps of light timber passed began to look like fallen dust clouds; then the surface of the prairie snow got in motion. There was nothing tumultous or fear-inspiring about it. It merely looked as if the whole surface of the earth was a stream of snow dust flowing southward.

"There was still no obstruction of a serious nature on the track, but at the first water station, where there was some delay wtih a meeting train, I found that the cold had frozen the axle boxes of my train so badly that I had difficulty in getting away with half of the train. The knowing ones about said a blizzard was coming, and that the sooner we got to the end of the division the better. The train dispatcher gave us orders to push through with whatever train we could safely take. By the time darkness began to close down upon us we had got within thirty miles of the terminus, and was pushing on for all the engine was worth.

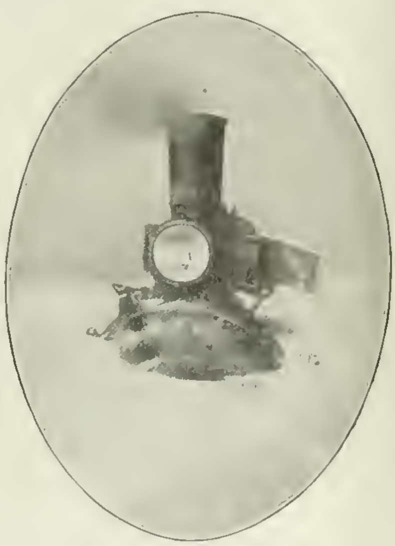
"But the character of the storm had changed. The wind had continued to rise, and the river of snow dust gradually ascended till the surface was away beyond sight, and the whole world seemed to be a cloud of driving snow; above, below, in every direction nothing was to be seen but blinding snow dust.

"I had nothing with which to clear off the snowdrift except a slated pilot and brushes in front of the engine. The snow was now becoming troublesome, and the drifts in the cutting were getting ominously near the rails. As I pushed my head out of the window to get a glimpse ahead, while passing through one cutting, the snowbank had crept so close that it rubbed off my cap, and would have taken off my head, too, had the snow been hard enough.

"It was all I could do to get the train through that cutting, and I stuck outright two miles further on. The place where I stalled was about an eighth of a mile up an ascent, that succeeded a down grade over a mile long. A few miles ahead was a water station, and here we had resolved to ask for orders to remain until morning. Visions of lying comfortably in the side track, with the warm way-car as a shelter, began to be very attractive, for I was beginning to suffer severely with the cold.

"Meanwhile our tender was empty. Seeing that water could not be obtained, the proposal was made to replenish the tender with melted snow. Melted snow can be used to fill a tender, but not the light, unpacked snow that we had to deal with on this night. We tried it, however, but merely succeeded in adding to our discomfort and fatigue.

"All this work was not done without



FAIRLY STALLED AFTER A STIFF FIGHT.

considerable suffering, but a harder job remained to be done which I regarded as my bounden duty to perform. The feed pipes had to be uncoupled and the pump joints loosened. While the fireman attended to the couplings, I crept under the engine with wrenches to loosen the nuts that bound the pump chamber joints. The wrenches would not fit the nuts, so I had to get hammer and chisel to wrestle over the job. Then was the time I properly appreciated what a blizzard meant as the searching winds penetrated my vitals. I remembered trying to steady the lantern on the feed-pipe so that I could see the nut I was trying to loosen, and it seemed that the nut and the lantern got mixed up in some curious way, and got chasing each other round the driving wheel. I became amused with the fun and sat watching it oblivious of the howling wind and my frozen couch. Next that I remember I was lying in the way-car, and the trainmen were rubbing my limbs with rags and pieces of waste.

"I look back on this trip in a Northwestern blizzard with mingled feelings and I can only wish that my many friends who read this fragmentary sketch may be spared a like experience. Work has to be done and some have to face the storm, and while I wish all a happy new year, I especially desire to say "good luck, brave fellows," to those who have to put up a fight with Old Boreas. A. S."

Imported Ties.

Railways are face to face with the rather dismal fact that ties are beginning to be imported to this country. Forest fires, the prodigal waste of forest timber, is in a large measure responsible, and the recent announcement from Washington is very significant that the first consignment of railroad ties from Australia to the United States is on its way to Rodondo, Cal., the ties being 66,000 in number and cut from what is called iron bark wood. Owing to the extension of railways in the Los Angeles section and the constant rehabilitation of established lines, a large percentage of the ties used there are from the California redwood trees; the remainder are of pine.

At one time quantities of oak ties were received from Japan, one steamer alone bringing over 95,000. These were bought at a time when they were obtainable at an unusually low figure, but when prices are normal they cost much more than the redwood ties, freight included, and are no better. The redwood ties cost from 50 to 80 cents each, the prices being subject to wide fluctuation. The life of this tie is from 10 to 30 years, according to the character of the soil in which it is placed. An untreated pine tie lasts from five to six years and one that has been treated from eight to 15 years.

Last year there was an increase of 10 per cent. in the number of ties laid in this country, as compared with the aggregate for the preceding year, the total being 153,754,000, which cost $60,321,000. It is significant that in 1909 16,437,000 ties were bought for new track as against 7,431,000 in 1908 and 23,557,000 in 1907. During the first-named year oak continued to lead by a wide margin all other kinds of wood used for cross-ties.

Lower Freight Rates.

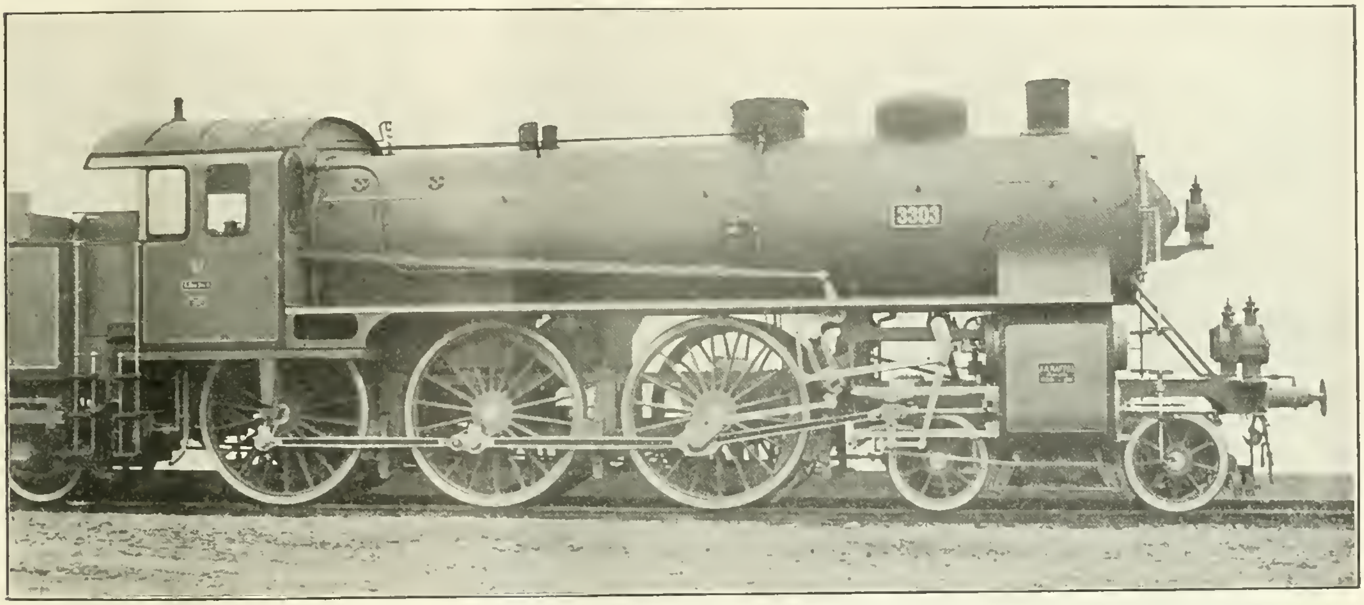
For the last forty years shippers of freight by railroads have been steadily and persistently importuning the carriers to grant reduced rates. At that time the freight charges were not much lower than the charges made by railroad companies in other countries, but they were lower. That, however, did not satisfy shippers, for their ceaseless demand was for still lower rates. Railroad managers meekly yielded, and began introducing heavier locomotives and cars of increased capacity, which cheapened the cost of handling freight; but the carriers never reaped any benefit from the enterprise displayed. The shippers secured all the benefits, and they are still howling for lower rates.

Bavarian 4-Cylinder Compound.

This month we are able to give a little interesting information concerning some 4-cylinder compound engines built by J. A. Maffei, of Munich, for the Royal Bavarian State Railways. They are of the ten-wheel class and have been built to metric dimensions. The cylinders are 13.18 and 22.44 ins. x 25.19 ins., the working pressure 203 lbs. and the tractive effort 13,230 lbs. The driving wheels are 73.62 ins. in diameter and are balanced as is customary with four-cylinder compounds where the connecting rod is attached to the leading driver.

The grades which these engines are called upon to encounter vary somewhat, but the maximum incline is 0.1 per cent., and the sharpest curves have a radius of 590 ft. The boiler is a straight top one, having 160 sq. ft. of heating surface in the firebox; 2,096 in the tubes of which there are 283, making a total of 2,256 sq. ft. in all. The grate area is 35¼ sq. ft., giving a ratio of grate to heating surface as 1 is to 64.

The weight of the engine in working order is 68.6 metric tons. The rigid wheel base is 14 ft. 8 ins., with a total of 29 ft. 3 ins. The length over all of the locomotive in 38 ft. 6 ins. The tender carries 5,800 gallons of water and about 7¾ tons of coal. The engine truck wheels are 31.4 ins., and those under the tender are about 39½ ins. in diameter. The engine presents the neat appearance which is customary among so many of the European machines. It is supplied with Walschaerts valve gear, has piston valves with extension rods. The dome is set very far forward and the smoke box is fitted with the conical front which throws the air well up over the engine when running and so carries the smoke high over the cars, and prevents its settling down on the train. A revolution counter is attached to the right-hand rear driver.



FOUR-CYLINDER COMPOUND FOR THE BAVARIAN STATE RAILWAYS.
H. Ashton, Chief, Locomotive Construction. J. A. Maffei, Munich, Builder.

Glass, Ancient and Modern.

We have seen reports made frequently that some inventor has succeeded in devising a means for making flexible glass, but we wait in vain for specimens of such a valuable material. Its brittleness is the principal fault of glass. If it could be bent and twisted like a piece of leather, or even bent like isinglass, it could then be used for many purposes from which it is now debarred.

Glass is one of the ancient inventions that contributed immensely in promoting human comfort. The chemical analysis of glass shows a more complex substance in the material, for it is composed of silicates of potash soda, lime, magnesia, alumina and lead in various proportions. Much interest has been displayed, as it is popularly believed that the Phoenicians discovered glass-making by accident, some pilgrims having built a fire on a beach where lay the elements of crude glass, and pieces of glass were found in the ashes of the fire. That is a likely enough story, but glass was largely used by the Egyptians when the tribes from which the Phoenicians sprang were aimless wanderers.

The Egyptians made sham jewels of glass 6,000 B. C. In some of the ancient tombs scarabs of glass have been found, imitation rubies, emeralds, sapphires, and other precious stones, and it was usual for pioneer traders to pass off glass beads and brooches of glass upon innocent barbarians as being jewels of great value. We never heard that the subjects of the Pharaohs manufactured wooden nutmegs, but it probably was because nutmegs were not in demand. If they had been, Egyptian merchants would have monopolized the business.

Flying Machines.

The papers are so full of aerial machine news that flying might now appear to be the most important business of the world. We have watched aerial machines speeding through the air like huge swallows, as they fly with wonderful fleetness, but we can see nothing about them to justify the prediction so often heard that locomotion of the future will be carried on by flying machines. So far the flying machine is nothing better than an expensive toy. It is a good enough vehicle of sport with more real sporting attributes than a racing automobile, but it is lacking in utility as a passenger or a freight carrier.

We understand that the United States War Department has recommended the building of an aerial squadron for war purposes. By carrying its load of dynamite an aerial machine might cause much destruction of life and property, but as a peaceful carrier it is never likely to compete with steamships and locomotive engines.

The McConway Wheel.

A very interesting form of wheel construction has recently made its appearance. It is called the McConway wheel, and is handled by the well-known McConway & Torley Company of Pittsburg, Pa. The wheel is of the built-up type, the tire being the usual steel rolled tire, the wheel center being a steel casting, and the hub is cast iron. The reason for using a cast iron hub is for the purpose of obtaining the maximum of security in fit with the minimum pressure for application.

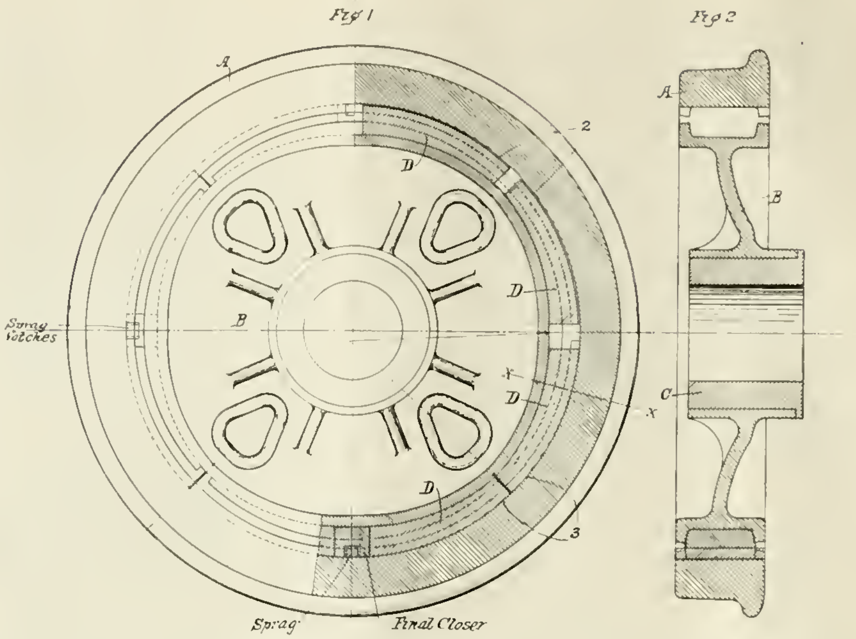
The wheel center and the tire are made with internal flanges, as shown in our illustration. This leaves a space or cavity between the outside of the wheel center and the inside of the tire, and it is in this space, partially enclosed by the flanges, that the locking wedges are inserted and held fast. The inside surface of the tire is turned in a lathe, and is circular, but the wheel center is cast so as to vary in diameter, the variation being so arranged that the space between wheel center and tire is divided into eight segments, and the tire is adjusted on the wheel center by means of temporary wedges.

As soon as tire and center are adjusted, the wheel is laid flat and the space between tire and center is filled with molten cast iron, poured through the annular opening left between the internal flanges of tire and center. This forms a series of locking wedges in the space between flanges; these wedges lie point to point, their small ends being separated by the temporary adjusting wedges. These wedges are withdrawn and the cast iron locking wedges are driven up point to point. This operation closes the space between the points of each pair of permanent locking wedges and doubles the space between the butts.

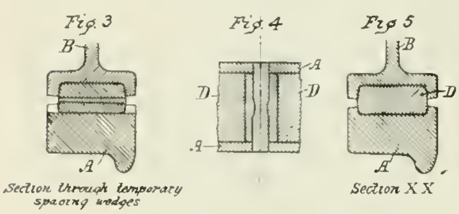
The enlarged spaces between the butts have to be filled in order to hold the locking wedges in place, and this is accomplished by the use of what are called "sprags," or supports, which are steel wedges, and when these are put in place in the inner flanges of the tire, final closers are cast around them, and the whole is a solid tight fit.

In order to take off a worn tire it is only necessary to cut the tire in two places and the whole falls apart most easily. The salvage in the scrap value of the old tire is more than enough to pay for the cost of renewal. One of the reasons why this form of wheel construction will appeal to mechanical men is that there is not much machine work involved. There is, of course, some rough turning on the tire to insure its being round, and as the wheel centers are cast and are not perfectly circular, a little grinding or perhaps a little rough turning is all that is necessary. There are no bolts to work loose or break, and the tire is not fused or shrunk on. It is simply wedged firmly in place on the wheel center, and the cast iron wedges are held permanently in place by means of the sprags at the large end of each wedge, and these sprags prevent the tire turning on the wheel center, and the sprags are incapable of movement, as they are permanently secured by being imbedded in cast iron.

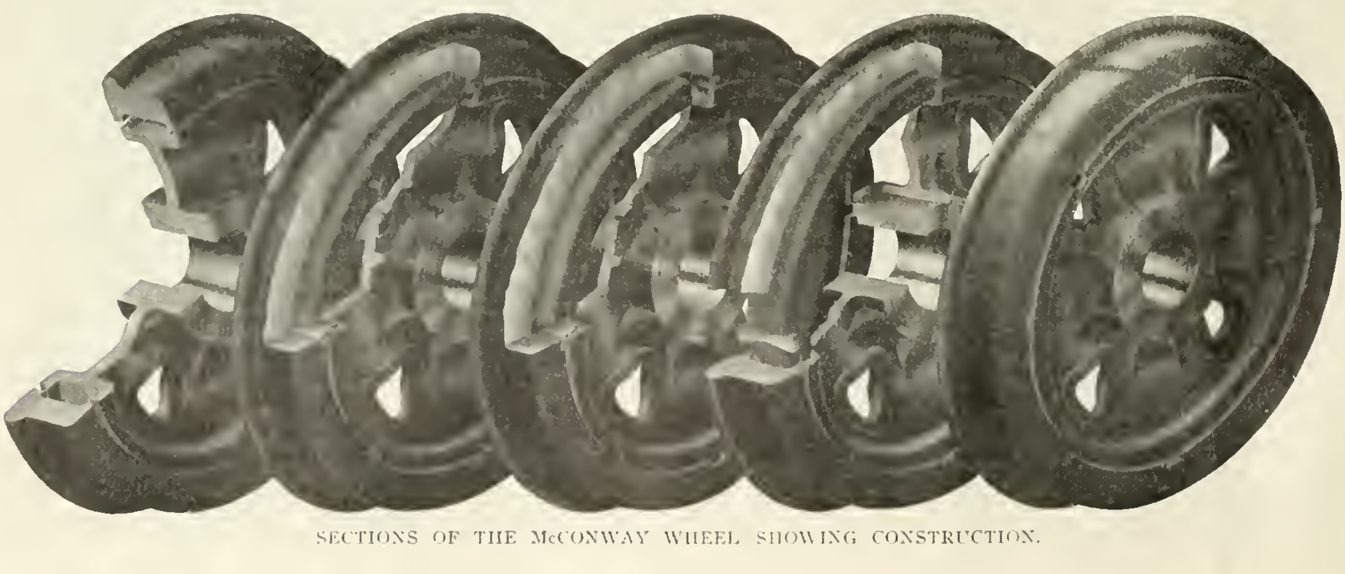
The application of a new tire can be made without the aid of special machinery, and unskilled labor may be employed on the job. The cast steel wheel center does not wear out and may receive a new hub or a new tire.



SECTIONAL VIEW OF THE McCONWAY WHEEL.



SECTION OF TIRE FASTENING.



SECTIONS OF THE McCONWAY WHEEL SHOWING CONSTRUCTION.

General Correspondence

Test for Loose Wheels.

Editor:

I see a note on page 452 of your November number about "Test for Loose Wheels." I think that the enclosed photograph and brief description of the press we use at Doncaster for a similar purpose may be of interest to your readers. The photograph shows a simple rig used at the Doncaster Works of the Great Northern Railway of England for testing carriage wheels. The press was designed and made at Doncaster. It applies a back pressure of 50 tons, the diameter of ram being such as to give this pressure when supplied from the shop hydraulic main at 1,500 lbs. per square inch. The pressure gauge is used as an indication that the full pressure is "there" for each test.

The wheels are turned on the table shown in front of the press and as soon as they get to the taper part of the trestles they roll upon their journals up to the stops, and so center themselves. The provision of a special rig for this purpose leaves the regular wheel press free for its particular work, and is at the same time much quicker. Two men can test a pair of wheels in two minutes, or less if they hustle. You will note on the turntable the wheels rest on their flanges when being turned and the table does not cut the road.

H. A. Ivatt,

Locomotive Engineer, G. N. Ry.

Doncaster, Eng.

[Mr. H. A. Ivatt is what we would call in this country superintendent of motive power of the Great Northern. The English title of his office may not be very well understood by some of our readers, hence the explanation. The method of securing a back pressure of 50 tons as a matter of safety is very ingenious.—Editor.]

Slide Valve Trouble.

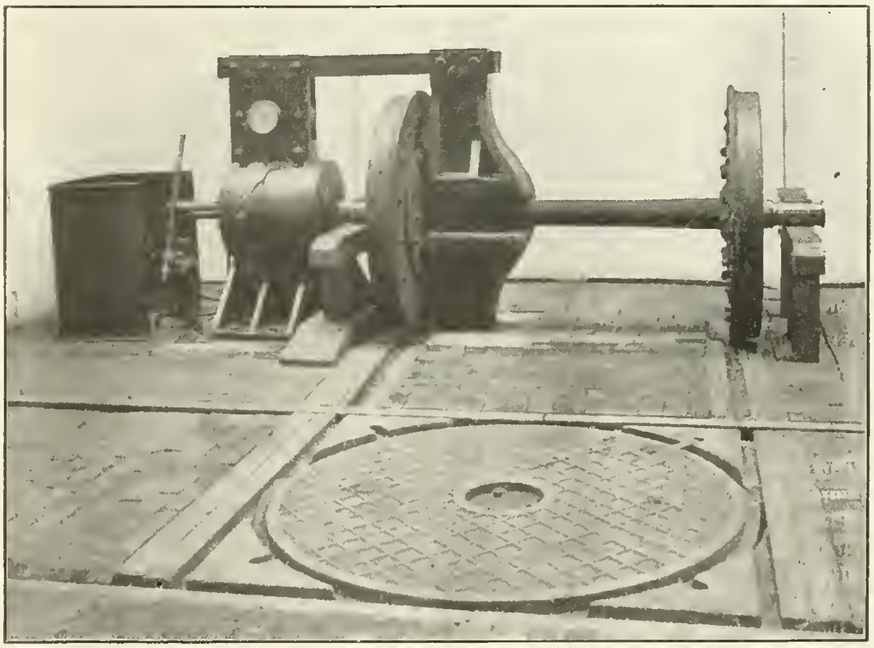
Editor:

In a late number of the Railway and Locomotive Engineering I noticed that a subscriber of Covington, Ky., was having trouble with a slide valve blowing. During my twenty-eight years of engine running I had one case similar to the one mentioned. I was running a 4-6-0, or ten-wheel Schenectady engine. The eccentric rods were long and curved around the front driving axle. This curve made a weak place in the rods, and at times they would kink or bend at this point. On one occasion I had arrived at the end of my run, stopped, reversed the engine to back the caboose onto siding. I gave her steam but she did not move. I tried to reverse her ahead to get slack in train, but found I could not get the lever in forward motion. I got down on the ground to find the cause and discovered the forward motion eccentric rod bent.

As I could not move the engine in this condition, I had a yard engine tow my engine to the shop. The machinist who made the repairs on the rod did a poor job in putting it up quite a lot too short. When I put the reverse lever in full gear forward there would be a terrible blow when the valve reached its full stroke on that side. The eccentric rod had been put up so short the valve traveled far enough ahead to slightly uncover the exhaust port, in full travel. By hooking the reverse lever back one notch, the blow would cease. Curious to say, the valves did not beat out of square to be noticed very much.

Fred Nihoof.

White Sulphur Springs, W. Va.



MACHINE FOR TESTING WHEELS, DONCASTER SHOPS, GT. NOR. RY.

Dimensions of Slide Valve.

Editor:

As per your request, I hereby correct the dimensions of the "Troublesome Slide Valve." It should be 11¾ ins. over all, as suggested by our friend from Medicine Hall.

Subscriber.

Covington, Ky.

Old Time Railroad Reminiscences.

Editor:

In the June number of Railway and Locomotive Engineering I promised to relate some of my experiences and observations on the Union Pacific Railroad, then being built across what was known as the "Great American Desert," but, as a prelude, I propose giving a brief history of the inception, construction and early operation of this pioneer trans-continental highway.

The passengers who today travel over the road with its splendid equipment and surrounded by all the luxuries of modern railway travel, little realizes what the engineers and men who laid out and built the road and those who operated it had to contend with while forging their way across plain and mountain, through a country still in its primeval wildness, mostly inhabited by Indians, and its products only game and grass.

The project of building a railroad to the Pacific Coast had been to some extent considered for some twenty-five years before the "Civil War," but it was not until that event that President Lincoln advocated the passage of a bill by Congress authorizing the construction of a railroad across the United States, west of the Missouri River, "not only as a military necessity, but as a means of holding the Pacific States to the Union."

This bill became law in 1862, and the sentiment that the building of the railroad would hold the Union together was generally recognized as the reason for giving it the name of the Union Pacific. This bill also authorized the president to fix the eastern terminus of the Union Pacific Railroad, and as a feasible line had already been surveyed from the Missouri River, near Council Bluffs, to the Platte River Valley, that town was designated as such terminus.

For several years prior to the building of the Union Pacific there had been a keen rivalry for the control of the vast immigration crossing the plains, Kansas City, Fort Leavenworth, St. Joseph and Council Bluffs being the points of concentration. From these points the trails converged in the Platte River valley, near Fort Kearney, some 190 miles from the Missouri River, and from there passed up the Platte valley to its forks, then up the south fork to the mountains and Salt Lake.

It is of interest to note that the route was first made by the buffalo, next used by the Indians, then by the fur traders, these were followed by the Mormons, then by the overland immigration to the Pacific slope, and finally on this trail, or close to it, was built the Union Pacific Railroad.

The first surveys from Omaha westward over the hills to the Platte valley, were made by engineers in the employ of the Mississippi & Missouri Railroad Company, now the Iowa Division of the Chicago, Rock Island & Pacific, then being built; the object of the survey being to determine where this road should terminate on the Missouri River, and, perhaps, become a portion of the prospective line west of the Missouri River, should such be built through the Platte River valley.

It can hardly be conceived that at the time the Union Pacific was constructed the territory traversed was designated in text books as "a wilderness designed by nature to be the eternal habitation of the savage and the buffalo."

The chief engineer who located the road had no maps or charts to afford him information of the topography of the country, and it was from Mormons and others and explorations made by himself that the engineer was able to map out and lay out the course of a line from Council Bluffs to Utah.

In the fall of 1863, engineering parties were organized and placed in the field, covering the territory from the Missouri River to Salt Lake, and on December 1 of that year, ground was broken at Omaha for the beginning of the road.

Each of these engineering parties consisted of about twenty men, all armed, and when the party was expected to live upon the game of the country a hunter was added. They were regularly drilled, though after the Civil War this was not necessary, as nearly all of them had been in the army.

Here and there along the proposed right-of-way were hostile bands of Indians, and, as a matter of protection, accompanying each party was a company of United States soldiers, the duty of this escort being to protect the party when in camp.

In the field the escort usually occupied a hill commanding a good view in every direction, so as to head off sudden attacks of the red men.

Following the engineering parties came the graders, also armed. They went to work as soldiers, stacked their arms by the cuts and worked all day, with Indians frequently in view ready to pounce upon, kill and scalp any unlucky person who gave them an opportunity. Along the mountainous sections of the road the work of grading and building of bridges had to be opened up many miles in advance of the end of the track, and as all the supplies for this work had to be hauled from the end of the track the wagon transportation was enormous, there being employed at times 10,000 animals and from 8,000 to 10,000 laborers.

Some conception of the magnitude of the work of getting supplies to the end of the track and the amount required may be gained when it is stated that for more than 500 miles from Omaha west the country afforded no timber, fuel or any material whatever from which to build or maintain the road, and everything, rails, ties, bridging, fastenings, all railroad supplies, fuel for the locomotives and supplies for men and animals on the entire work had to be brought up the Missouri River for many miles, transferred from boat to cars at Omaha, then transported to "the front" or end of the track by rail. As the river was navigable but about three months of the year it severely handicapped the prompt furnishing of material, rail and equipment, and it was not until the summer of 1867, when the Chicago & North Western Railway reached Council Bluffs, that rail communication was established with the East, by which most of the supplies could be more promptly delivered and continued throughout the year.

When the track had reached the Black Hills, timber for ties and bridges could be obtained by cutting and floating it down the mountain streams and then hauling it from 20 to 25 miles, but other than this practically everything was transported from the Missouri River during the entire time the road was under construction.

The track laying was reduced to a science up to that time unknown, averaging from one to three miles daily, and one day there was laid eight-and-one-half miles.

During the building of the Union Pacific Railroad the Central Pacific was also under construction, from Sacramento eastward. For a year or more before the completion of the two roads there had been great rivalry between them, the Union Pacific endeavoring to reach Humboldt Wells, and the Central Pacific having as its goal Ogden. As a consequence, the graders of the respective companies lapped, and the two lines were graded alongside each other some 225 miles between the points mentioned. When it was discovered that neither could reach their objective point an agreement was made to join the tracks at the summit of Promontory Mountain, and the tracks of the two roads were built to the summit, leaving a gap of about 100 ft. to be filled in when the last spike was driven.

On the morning of May 10, 1869, a train from Omaha and another from San Francisco arrived, rails were laid across the gap, the golden spike was driven, the two locomotives moved forward until their pilots came in contact, the engineers each broke a bottle of champagne on the other's engine, and the Union Pacific had reached the goal of its projector's ambition. It was, in fact, a rail connection to the Pacific Ocean.

The first rail had been laid and 40 miles of road built in 1865; 260 miles were built in 1866, 246 miles in 1867, including the ascent of the first range of mountains to an elevation of 8,255 ft. above the sea, and from April, 1868, to May, 1869, 555 miles of road was built, exclusive of temporary track and sidings, of which 180 miles were built in addition.

The dangers and hardships encoutered while building the road can hardly be conceived. The Indian troubles commenced in 1864, and continued until the road was finished. Every mile of road had to be surveyed, graded, tied and bridged under military protection. An Indian attack was looked for at any moment, and when such occurred the men dropped their tools, picked up their guns, and, with the soldiers on guard, fought it out until the redskins retired then the men resumed their work.

The operating department, too, had their troubles from the depredations of the noble redman, and some of the schemes they resorted to indicated that they were not so very far behind their white brother in resource. As an instance, a bridge over a culvert was torn up near Plum Creek, the ties cross piled with the rails leading up to the top of them and all firmly fastened together with telegraph wire. The first train that came along mounted the pile of ties, the engine diving into the culvert just beyond. The operation of the road through the mountains the first year following its completion, and before snow sheds had been erected, was fraught with peril from snow to an extent that could not be anticipated. As a precaution, however, trains starting from Omaha were provided with a box car having a stove in it, the car being loaded with provisions, so as to be prepared for any emergency. How well this served the purpose is illustrated, when six trains were stalled for several weeks in the snow between Laramie and the divide, but the supplies and an opera company who happened to be on one of the trains, fed and entertained the passengers until the blockage was lifted.

Many obstacles confronted the management of the road during the early years of its operation as a through line, but methods of correction gradually suggested themselves and were adopted to a degree that this new, hastily constructed railroad was soon in a condition to handle its business with facility and to the satisfaction of its patrons.

For several years following the completion of the road the Union Pacific had no physical connection at Omaha with railroads east of the Missouri River, and it was not until 1872, when the first bridge across the "Big Muddy" was completed, that a continuous rail line was established from the Atlantic to the Pacific Ocean.

New York, N. Y. S. J. Kidder.

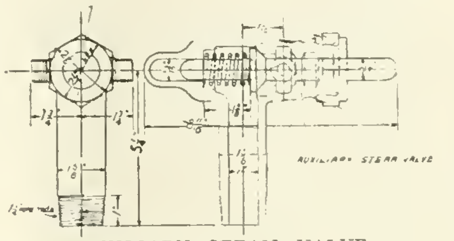
Lubrication With Superheated Steam.

Editor:

The accompanying sketches show the general arrangement and principal details of a device which is being very successfully used for the lubrication of valves of locomotives using superheated steam on the Lake Shore Railroad.

Every locomotive runner knows, from experience, the impossibility of lubricating valves successfully when the locomotive is being run in short cut-off and with full throttle, especially on up grades. Of course, the trouble on this account is greatest with slide-valve locomotives; but it has been sufficient even with piston-valve locomotives to cause a great deal of trouble for the runner, and materially reduce the efficiency of locomotives running for long distances at a sustained high speed. Since the advent of superheated steam this trouble has become more serious, inasmuch as the successful lubricating of the valves of locomotives using superheated steam is more difficult and at the same time more important.

The failure to lubricate the valves under these conditions, as is well known, is on account of the fact that the high steam-chest pressure prevents delivering the oil continuously to the steam chest. The lubricators have been well designed

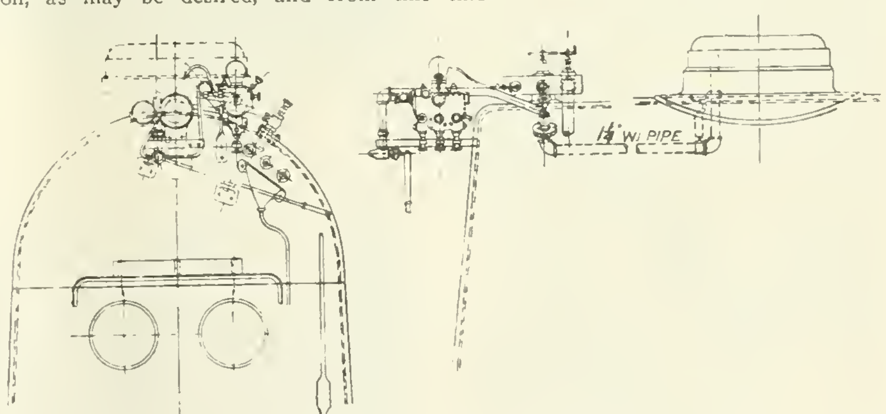


AUXILIARY STEAM VALVE.

to deliver the oil from the lubricator to the oil pipe, but it has not been found possible to deliver the oil from the oil pipe to the steam chest.

This device is designed to overcome this difficulty and the results are accomplished, as will appear from an inspection of the sketches, by maintaining a current of live steam of high pressure through the oil pipes to the steam chest, or valve chamber. The steam is taken through a special dry pipe from the steam dome to a valve on the boiler head, where it can be shut off or turned on, as may be desired, and from this valve to the auxiliary steam valve, so called, which is operated by the throttle lever, so arranged that the auxiliary steam valve is opened and steam delivered to the oil pipes, after the throttle valve has been opened enough to maintain a steam-chest pressure sufficiently high to prevent the delivery of oil to the steam chest by the ordinary lubricator and oil-pipe arrangement.

The steam, as will be noted, is admitted to the oil pipe through a special tee fitting, located immediately ahead of the lubricator, and so designed as to direct the current of steam forward in the pipe. The usual choke in the steam-chest oil plug is, of course, omitted, the opening in this plug being full size, or ⅜-in. in diameter throughout. By the use of this device it has been found that the valves of a superheated steam locomotive can be lubricated continuously with a full throttle and short cut-off. In fact, the lubrication, under these conditions, is even more satisfactory than with the ordinary locomotive using saturated steam. The device is patented.



SUPERHEATER LUBRICATION DEVICE USED ON THE LAKE SHORE.

O. M. Foster.
Master Mechanic L. S. & M. S.
Elkhart, Ind.

Early Days on the Sullivan.

In regard to my railroad work, I hardly know how to write the reminiscences of what I have seen and done that would make it interesting reading matter. I was born in Ohio. My parents moved to Windsor, Vermont, when I was but one year old. I went to school there until I was twelve years old, when my father died. In a short time after his death I went on the Sullivan Railroad in New Hampshire, running between Windsor and Bellows Falls, Vt., as train boy, and selling any and everything I thought the passengers would want, including the Boston *Daily Bee* and *Times* and delivered these papers to my customers after returning home at night.

The Sullivan Railroad Company at this time had four locomotives, the "Charleston," a Hinckley engine with one pair of drivers; the "Claremont," a Taunton engine with two pair drivers; the "Skitchauag," a Hinckley engine with two pair drivers. The "Sunapee," I think a Hinckley engine, with two pair drivers, was inside connected. Wood was used for fuel in these engines.

I do not remember the names of but two engines running into Windsor from the north on the Vermont Central road, the "Ethan Allen," a Hinckley engine with four drivers, and the "Gouenos Payne," a Baldwin engine with one pair of seven-foot drivers. This engine was not a success, and they put smaller drivers under it in a short time.

After serving my time as a machinist's apprentice, an engineer from the Sullivan Railroad had gone to Charleston, S. C., to run on the South Carolina Railroad, between Charleston and Augusta, Ga., wrote he would get me a job in the shop if I would come there. When I arrived there I found my engineer friend had died and was buried several days before. I got a job in the shops at this place, where I worked for some time until I went on what was called, at that time, the Georgia State Road. I worked at Athens where they had an engine house and small shop. From this road I went back to Vermont for a short time, then to the Detroit Locomotive Works.

In my former letter I wrote you about working in the Detroit Locomotive Works and several railroad shops before going to the C., B. & Q. When I commenced with this company, their largest engine was 16 x 24-in. cylinders. Nearly all their engines had copper fireboxes, with water arches, designed by Mr. C. F. Jarinett, the general master mechanic. Some of the engines were named, but the majority were numbered. They had 119 engines in all, and about thirty of them were inside connected. While on this road as engineer, I ran one engine five years, every trip it ran. During that time I ran this engine three different times eighteen months and over each time without it laying in the shop a day, or having a cylinder head or steam chest cover removed. This was on way-freight ninety-three miles a day and switching.

While master mechanic of the Kansas City, St. Joseph & Council Bluffs road, which was a part of the C., B. & Q., the first year I put new driving wheel tires on twenty-four engines out of thirty-eight, and eight new steel fireboxes. Part of these new fireboxes were made twelve inches longer than the old ones, while the others were twenty-four inches longer. All of these fireboxes but two had the Jarinett water arch, they being made to have twelve inches of water space between the sheets instead of six inches as formerly. During the first six years I built six new locomotives, these being the only ones ever built in St. Joseph.

Soon after being made general master mechanic of the fine C., B. & Q. lines in Missouri it was decided to build new shops at Hannibal, Mo. I made the ground plan of these shops, including the store house, which was quite a difficult problem on account of the lay of the ground. The tracks and Mississippi River being on one side and a rock bluff being about two hundred and fifty feet high on the other side. The machinery in these shops was run wholly by electricity. These are a few incidents connected with my long and varied career of railroad work. F. A. Chase.

Los Angeles, Cal.

Silver Spike Ceremony.

Editor:

Yesterday, Nov. 22, being the birthday of Guatemala's President, don Manuel Estrada Cabrera, one of the features of its celebration was the driving of the silver spike which signified the inauguration and commencement of the Guatemala Central's new line, which is to connect Guatemala with Mexico by rail. The spike was driven at Las Cruces, a station on the Occidental division of the Guatemala Central, 137 miles from Guatemala City. The celebration was under the direction of acting general manager Col. W. P. Tisdel, and was participated in by members of the president's cabinet, the consul general and

MAZATENANGO STATION, GUATAMALA RAILWAY.

minister of the United States and others of the diplomatic corps. The new line will run from Las Cruces, passing through Coatepeque to Ayutla, a distance of 32 miles, where it will connect with the Pan-American Railroad. A month ago the Central people purchased the Ocos Railroad, a short line running from the Port of Ocos on the Pacific side, inland a distance of twenty-two miles. In April, 1909, the Central purchased controlling interest in the Occidental Railroad, which with the addition of the Ocos gives them three seaports on the Pacific coast.

The opening of the new line between Las Cruces and Ayutla will give Guatemala, N. S., what they have long waited for, connection with the United States and Mexico by rail, and thus give the people a quicker and more direct market for their products. It will also tap a portion of the richest part of Guatemala, and the farmer who has never been able to work his plantation to its fullest limit heretofore, on account of not having a market for his products, will now have the long felt want supplied. The principal product along the new line is coffee, but in addition to that they raise cocoa, rubber, sugar cane, vanilla and an abundance of cattle. The estimated output of coffee for this year is 32,000 quintals, or 3,200,000 lbs., and it is expected that as soon as the new line is in operation it will be increased to one million quintals. Above Coatepeque Quinine, wheat, corn, sarsaparilla, cotton, salt, and cochineal are raised, and zinc, copper, silver and lead are mined. When the new line is completed this will finish the Pan-American line to Santa Maria, a station on the Central railroad twenty miles inland from Port San Jose, and the Central have their lines surveyed from Santa Maria to Santa Ana Salvador, the construction of which they expect to begin as soon as the line to Ayutla is finished. It is expected that the new line will be in operation in eighteen months. The work of construction is under Mr. Charles Gray, who has been for many years with the Central as resident engineer.

In addition to their complement of thirty-two locomotives, the Central have just received, from the Baldwin Locomotive Works, two new ones of the 4-6-0 type, 17 x 20 ins., equipped with the Walschaerts valve motion. The mechanical department is now under the able management of Mr. W. F. Schofield, of Houston, Texas, as superintendent M. P. & M., and through his untiring efforts nearly the full complement of locomotives has had a general overhauling and have been changed to oil burners.

Guatemala. W. W. Collins.

Painting Semaphores.

Editor:

I am sending to you a suggestion relating to semaphores on block signals. I worked a little while painting the block signals, and a very difficult job it is, the trouble being that a man has to be almost an acrobat to paint them. On a railroad that burns soft coal it is impossible to keep them bright for any length of time.

I would suggest this: To be attached to the semaphore blade would be an enameled sign with the railroad design enameled on it, and to be screwed to the blade. Of course, it would cost considerably more to put them on than to paint them, but I think that it would pay in the long run, being that they would keep this color for years.

I am only referring to the large blades. The only trouble is that someone would be required to keep them shining in this color. The lamp trimmer might rub them with a small piece of cotton waste with kerosene. This idea may not be practical, but I am sending it to you for what it is worth.

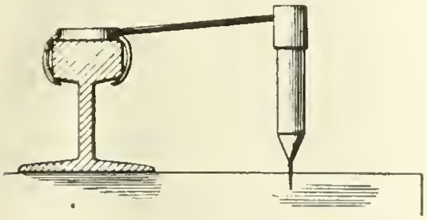
Paterson, N. J. T. J. Pratt.

Torpedo and Fusee Combined.

Editor:

I have invented a new form of safety signal, which is called a safety signal appliance. It is a combination of a torpedo and fusee, connected together by a tube containing a quick fuse.

When the engine or car, as the case may be, explodes the torpedo, the fuse in



TORPEDO AND FUSEE.

the tube is ignited, which lights the fusee, showing a red light, and will burn for the space of from 3 to 15 minutes, depending on the length of the fusee. This safety signal is not only a warning for the train that explodes the torpedo and lights the fusee, but is a protection for the rear end of the train when a train is following on a single track. Inclosed please find phto-lithographic copy of my safety signal appliance. W. A. Woods.

Milwaukee, Wis.

Pacific Coast Logger.

Editor:

I am enclosing a photograph of a typical Washington logging train and locomotive. Note the size of the logs. The engine is an 18 x 24-in. Baldwin, 50-ins. drivers; 80,000 lbs. on drivers; 10-ft. 6-ins. wheel base. She runs on 60-deg. curves, and on as much as 8 per cent. grades. In my next letter I will send you a photograph of a Heislet geared locomotive that we have in use on sharper curves, and on grades up to 12 per cent. Don't fail to straighten up my subscription, as I don't want to miss a number.

N. M. Chambless.

Eagle Gorge, Wash.

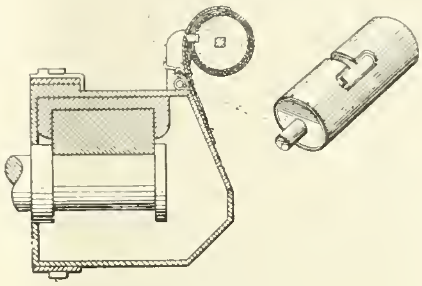
LOGGING TRAIN AT EAGLE GROVE, WASH.

Lock for Journal Box Lids.

Editor:

Please find inclosed print of a self-locking device for railway car journal boxes; it prevents others than railroad employes from removing packing and brasses from car journal boxes, and a brief description of it may be interesting. It is a patented device, No. 972,-749.

The lid has a plate fastened to the central portion of its outer surface, the free end of the plate being curved to conform to the contour of the locking cylinders and projects over them so that it will shield the slots. This plate has a latch fastened to it whose angular head is adapted to be passed through the lower slot of cylinder, and by rotating this cylinder the head engages behind the edges of the upper slot, thereby retaining lid closed.



JOURNAL BOX LID LOCK.

It will be understood from the foregoing that the outer cylinder is rotatable and the inside cylinder is stationary. But the engagement between shaft of the cylinder and the sleeve of cylinder being a threaded one, it will be clear that this cylinder can only be rotated by using a wrench or other similar turning tool.

To lock the lid the slot of one cylinder is aligned with this slot of the other. The head of latch is passed through said slots, and by means of a suitable turning tool, the cylinder is rotated to cause its slot to move out of alignment with the other slot, whereupon the latch will enter the lower slot and its head engage the outer cylinder on opposite sides, thereby locking the lid in a closed position. A reversal of this operation opens it. Martin Carle.

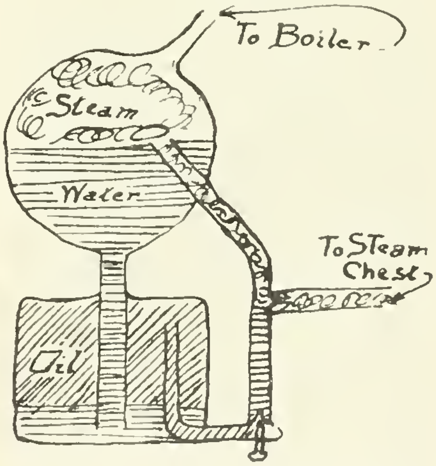
Clifton Forge, Va.

Lubricators and Their Defects.

Editor:

In dealing with lubricators a knowledge of their basic principles is necessary. There is no attachment on a locomotive which suffers from ignorance as does the lubricator. From the diagram here shown it will be seen that steam pressure in equal amounts are present at the top of the feed glass and at the top of the condensing chamber. The equalizing pipe protruding into the condensing chamber forms, as it were, a dam, holding back the condensed steam in the bottom of the condensing chamber. The weight of this volume of water is transmitted to the oil in the oil chamber by means of a water pipe. This weight of water is the real cause of a lubricator feeding. Any defect with a tendency to eliminate the equalizing of steam pressure at the two points before mentioned destroys the effectiveness of the lubricator.

The following tests for defects will aid the engineer or repairman to locate the defects without tearing the lubricator apart. On opening a feed valve, if no oil appears at cone, see if the steam and water valves are wide open. These valves



OUTLINE SKETCH OF LUBRICATOR.

being open and oil not appearing points to either a stopped-up cone or an equalizing feature destroyed.

Drain oil from lubricator by opening drain cock to oil chamber. If there is no strong flow of steam from this cock with water and steam valves open you will most likely find the port under the water valve seat closed. The end might also have come off one of the steam valves and be held over the steam passage.

After draining the oil chamber, if you get a good flow at the drain cock close the water valve. Then open and close each feed valve separately.

This move allows steam to flow down

through the feed cone and oil way into the oil chamber and out at the drain cock. The absence of steam at the drain cock with feed valve open points to an obstruction between steam valve and drain cock. Open the drain cock to the glass in question, and if steam blows out you may be sure the equalizing tube is open; if no steam appears it is closed.

The equalizing tube being open, the next move would be to remove the feed valve and ascertain if the cone is open. The cone being open, the only remaining point to contain an obstruction is the oil way.

A stopped-up choke plug in steam pipe to steam chest will also prevent the lubricator feeding by allowing condensation to fill equalizing tube to an equal height with that in the condensing chamber. Irregular-feeding lubricators are occasionally found which feed slowly when engine is working and rapidly when drifting. This defect points to enlarged choke plugs in steam chest or lubricator body. The openings in these plugs are of a size directly in proportion to the size of the steam pipe to condensing chamber. Any destruction of this ratio of sizes, either by restricted equalizing pipes or enlarged choke plugs, causes irregular feed.

Another defect tending to create irregular feed is worn feed-valve points. These points, by long usage, wear until their extremities enter well into the cone opening and prevent oil flowing through until the valve is opened wide.

It sometimes happens that apparently a lubricator runs dry in short time. A close look will show a gelatine-like deposit at tip of cone. This deposit prevents formation of drops but allows the oil to flow in thin streams down along the outside of the cone and up the side of the glass. A piece of gum joint pushed in may also form a bridge for oil to traverse without being seen. A loose-feed cone will allow oil to escape along the side of the glass also. On very rare occasions a cracked bridge between oil chamber and steam ports to steam chests has been found, allowing oil to escape without being seen. To find this, close feed valve and water valves and open steam valve and drain cock. A flow at drain cock may be attributed to a cracked bridge, leaking water valve or feed valve. A leaky feed valve will not show itself by the glass containing water to the height of the cone. An examination of the water valve and seat, showing these parts to be good, would place with certainty the cause of the flow as a cracked bridge.

In closing, a word as to handling of the lubricator might be dropped. On starting to use the lubricator open first the steam valve then the water valve. Allow a little time to elapse before opening feed valves, to insure proper condensation. When shutting off, reverse the operation. O. S. SPROUT.

Harrisburg, Pa.

Engine Pulling Lion's Cage.

Editor:

Reading how an engine tows a boat in your December number, page 492, reminds me of an experience I had while running engine 121 on the Wabash Railroad at Maryville, Mo. While loading Adam Forepaugh's Circus it was raining and the runways were very slippery. In pulling the lion cage up the runways, it slipped off the bolts in the bottom of the axles and stuck into the runways so that the horses couldn't pull it off. I said to young Forepaugh, "Hitch that rope to the rear end of this tank and I will pull the wagon off." "Yes," he said, "and then you will have us all hunting cellars to get out of the way of the lions." I said, "No, I won't, for I can stop within an inch if anything gives way, you couldn't do that with your horses." So he said, "I will try it." I pulled it off safely twice. C. J. MILLINGTON.

Fenton, Mo.

First Taunton.

Editor:

I am unable to remember if I answered your letter of the 14th regarding the first locomotive built by the Taunton Locomotive Works. I find that the picture I sent you was their first engine and was named the "Rough and Ready." The two first locomotive books of that company are lost, but the first engine of the Taunton Locomotive Works went to the Eastern railroad which is now part of the Boston & Maine Railroad. It is possible that the Providence & Worcester may have had her, as they had the Lonsdale, and she resembles her.

I am sorry I am unable to give you any details.

HERBERT FISHER.

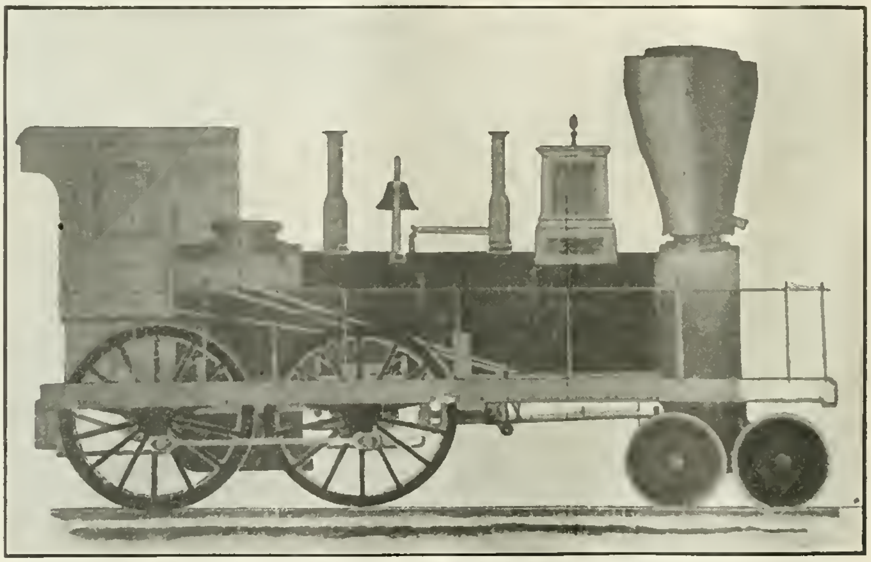
Taunton, Mass

Lubricator Troubles.

Editor:

In answering inquiry of Messrs. Mouckland and Eckert on "Lubricator Troubles," I will try and do so by explaining the same. The lubricators that are used in the general service must be understood to get the perfect service required. Some of the defects are small steam pipe, worn choke-plugs, feed valves and nozzle, leaky water valve and oil tube. The steam pipe should have not less than twice the area of the discharge pipes. Choke-plugs kept to standard size. Choke-chambers and glasses must be kept clean and free from any substance, as gaskets and glass. In the operation of the lubricator; when in service, shut off feed-valves, then water valve, open drain cock, let water out. Now be careful, as lubricator is hot, when taking out the filling-plug, "if you have let all the oil through the feed valves," as there is always a mixture of oil and water which is at a higher temperature, left in the tube and it will blow out through the filling-plug opening or through the drain-cock if same is open—water-valve may have a slight leak, and at the last of the draining will cause a puff of water, steam and oil to come out. After filling lubricator with oil, open water valve and wait for two or three minutes for oil to expand and settle, for when the water valve is opened, the water comes in at the bottom, and there is a space over oil and the expansion chamber to be filled. A little time must be given for oil to resume its normal condition as the first thing when oil and water are put together under a high temperature is to become a foamy mass. Steam enters choke chambers, through steam ports from tubes in condensing chamber, and condensing fills chamber with water until same are full up to opening of choke-plugs.

Now open feed-valves and if there is



OLD TAUNTON ENGINE WITH HOOK MOTION.

water in tubes it may take a little time for oil to start, as water in tubes and the choke chamber are at nearly the same specific gravity, but slightly in favor of the tubes. When the oil comes it raises to top of water by its specific gravity, where it is taken up by the current of steam and water passing through the choke-plug and enters the oil pipe in a fine watery spray. If feeds don't work shut them off. "If Nathan bull's eye lubricator," open the little drain cock to the choke chambers and open engine throttle and give them a good blowing out, this will clean choke-plugs and chambers. You can do this when engine is working if necessary. If the old style triple feed, you will have to shut off steam and take out safety valve. First shut off the water valve and steam valve; after blowing out see that choke chambers and glasses are clean, before connecting up.

Another defect that may affect one or more feeds, is obstruction in oil tube. Drain oil from lubricator, leave filling plug in, drain cock open, open steam valve, then open each feed valve separately and let water and steam blow through. This will clear tube of any obstruction. Another defect; after oil is fed about half out the feeds begin to drag and tiny water globules appear with oil. Open the feed valves until oil comes clear, then reset the feeds. When lubricator is empty you can tighten the oil through the opening for filling, as you will almost always find a leak in oil tube at the bottom. As oil comes in at the top and water leaks in the bottom it will overbalance the oil and hold it up. Another deceiving defect is leaks between condensing chamber and the oil reservoir and water tube at the valve. When choke-plugs are badly worn, oil will feed very fast on a small opening of feed valves. When plugs are of right size the pressure is the same in choke chamber and oil reservoir; when plugs are worn the top pressure is reduced or overbalanced as it were. The choke in steam chest plugs should not be less than 3/32 of an inch, nor over 1/8 of an inch in diameter, on account of holding up oil in delivery pipe, as steam leaves the lubricator through a small opening under high pressure and is overcome by steam from the chest at a lower pressure, but through a larger area.

In a Monitor lifting injector, if combining tube is loose and tank is full of water, injector will work a little while, but when water is low, water will flow out of overflow and injector will break. The same thing will happen if valve 19 of Simplex is leaking bad. Cut it out and work straight Monitor. Boiler check leaking, water and steam will keep running out of overflow. Steam valve or jet will show steam unless leak is very bad. To overcome the troubles rising from leaking steam valves and boiler checks, always shut off water valve when you shut off the injector; it will keep water from getting hot in feed pipe. Give injector a small amount of oil through oil plug at least once a week; it will help keep your injector in good clean working condition, free from scale and corrosion. Always use engine oil.

A. N. H.,
Loco. Engr. Div. 420.

Two Harbors, Minn.

Will Someone Tell Me Why?

Editor:

That a number of engines, all built by the same company, with the same size cylinders, boilers, wheels, heating surface, etc., in fact, all dimensions supposed to be exactly the same, and yet one will pull more tonnage over the same track than the others; some will steam fine, and the others very bad; some are always in the shop, and the others never need any repairs scarcely at all. Some will slip out of a sand house with the door shut, while others will climb the mountain with all ease and with the same tonnage; some will run the division with the amount of valve oil allowed them, while others require much more to be able to handle the bar at all; some will use two gallons of water to the others' one; some ride like an ox cart over the country road, while others ride like a baby carriage on the city street. I might go on with these differences and write quite a long list of questions, but will feel under many obligations to those who will answer these few. I have known just such conditions as I mention, and have wondered not a little why they are so. Tell me, someone, why it is.

O. P. Angelo.
Engr., Division 317.

Alexandria, Va.

[If any of our readers have found things as our correspondent describes them and can tell why they are so we shall be glad to hear from him.—Editor.]

Jacobs-Shupert Boiler Test.

Editor:

The description you published of overheated sheet experiments made with the Jacobs-Shupert boiler puzzles me considerably, not how the tests were made, but why they were made. When the officials of the Atchison, Topeka & Santa Fe Railroad went to the expense of providing boiler and appliances for carrying out the experiments with the Jacobs-Shupert boiler they must have been laboring under the delusion that injecting cold water upon overheated sheets is likely to cause an explosion. No well-informed engineer entertains such a belief. The scientific information concerning the safety of boilers compiled by the Manchester Boiler Insurance Company or by the Hartford Boiler Insurance Company all goes to discredit the popular delusion that an explosion will result from application of feed water to overheated sheets.

This does not mean that permitting the crown sheets of a furnace to become red hot is not dangerous. Overheating reduces the tensile strength of any metal and it is probable that boiler sheets when cold having a tensile strength of 60,000 lbs. to the square inch by overheating may be reduced to 20,000 lbs. tensile strength or under. There is where the danger of an explosion becomes imminent. The belief that throwing cold water upon the hot sheets may cause fracture is a delusion repeatedly proved to be unfounded. Such a belief is still prevalent, but it is in line with the mental conditions that enable fortune tellers to secure customers.

When the Atchison, Topeka & Santa Fe Company were enterprising enough to undertake the expense of demonstrating that cold water could be injected with impunity upon the hot sheets of a special form of firebox, they ought to have demonstrated what would have happened to a common firebox under similar treatment. Unless the sheets suffered from structural weakness due to deterioration they would have acted in the same way.

A. M. Leay,
Mechanical Engineer.

Great African Railway.

One of the greatest railway enterprises in the world is the construction of a railway to traverse the whole African continent from the Cape to Cairo, which will form a line about 5,000 miles long. From a recent Consular Report we learn that the section of this road from Khartum to Wad Madani, about 100 miles, was opened on Jan. 1, and the traffic during the first half year's working has surpassed all expectations.

The amount of produce secured from this new section has been a revelation to everyone. The freight returns for the first month's working were $50,000. From most parts of the Sudan hitherto served by the railway one or two train loads a week would be considered good. On this new section a train every day has hardly been sufficient to carry down all the stuff, chiefly dhurra (native corn), gum and cotton. The fourth-class native passenger traffic has produced almost enough to pay the working expenses of the section.

This is the first portion of the railway to leave the desert part of the Sudan and break into the edge of the land naturally fertile without artificial irrigation. If the success of this first 100 miles is any index to the possibilities of the rest of the country to the south, it would appear that the most sanguine forecasts of the country's commercial future were about to be realized.

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Walschaerts Valve Motion Model.

The increasing number of inquiries that have come to us from railroad men in regard to a model of the Walschaerts valve gear has induced us to give the matter serious attention, and after careful preparation we are now ready to furnish models of the gearing that in point of construction and material could not be surpassed. The entire model is of metal, iron and brass. The working parts are finely finished. The adjustability of the modeel is exactly similar to that of the valve gearing in use on the best passenger locomotives, and the construction and adjustment of the parts can be learned much more readily on the model than on a locomotive.

Those who have had the opportunity of examining or experimenting with our new model all agree that in point of design and durability in structure it is in every way equal to our model of the shifting link motion, generally known as the Stephenson valve gear. The great popular favor which our model of the latter gearing has met with is the best proof that we are well aware of the requirements of railway men, who have no use for toys, but are eager to secure something substantial. Large numbers of the intelligent, thoughtful railway men anxious to widen their field of knowledge may, in succession, use the same model for many years.

The particulars in regard to the form, size and price of the Walschaerts valve motion model will be noted on our advertising pages, but we may mention that the total length of the model is 19½ ins. and is 9 ins. high. The cylinder measures 1¾ x 2½ ins. and the driving wheel is 6 ins. in diameter. The throw of the return crank is 1 in. and the length of the link slot is 2 ins. We are now ready to receive orders.

Utility of Moderate Superheat.

As some disputes have arisen concerning the correctness of remarks we have made concerning the economy of superheating steam even when the degree of superheat is as low as 50 degs. F., we repeat part of our article which we published in 1909 under the caption "Steam Saving Problems," which gives some of the authorities whose work or ideas influenced our article.

A speaker who was discussing the subject of steam superheating at a railroad convention lately insisted that superheat of 100 degs. F. is useless, and that there is no advantage in trying to superheat the steam unless the temperature is almost doubled above that due to working pressure. That person did not understand the subject very well, and there are others familiarly discoursing on superheated steam who have much to learn concerning the phenomenon.

The steam used in locomotives is known as saturated or anhydrous steam. The term "saturated" confuses a great many people, who receive the impression that saturated in that connection means wet, which is not the case, for anhydrous steam is free from water. But as the steam passes out of the boiler it is constantly at the dew point, ready to revert into water on the least portion of the heat of evaporation being abstracted. As the steam chests and cylinders are colder than the boiler, they act to a great extent as condensers on the entering steam, depriving it of a portion of its energy, because the water resulting from condensation has no power to perform work.

For a long time after the steam engine was invented engineers believed that some mysterious influence neutralized the force due to the evaporation of steam in the boiler. Watt and others demonstrated that the "mysterious influence" was the comparatively cold metal of the steam chest and cylinders which robbed the steam of part of its power to do work. James Watt invented a steam jacket to keep the cylinders warm. It consisted of a steam-tight casing, into which steam was admitted from the boiler. This was vulgarly spoken of as a case of robbing Peter to pay Paul, yet it produced steam saving effects when the steam jackets were properly operated. Through ignorance in design and manipulation, the steam jackets acted as veritable condensers and wasted steam, instead of saving it.

Great hopes were entertained at one time of the advantage to be derived from steam jacketing, and for several years not a few locomotives were provided with steam jackets, the responsible officials holding that engines of that character were peculiarly liable to losses through cylinder condensation. About 1885 Mr. Alexander Borodin experimented extensively with the steam jacketing of locomotives in Russia, and he seemed to show a saving of from 15 to 20 per cent. in fuel. As the practice was abandoned in a few years we suspect that the saving needed the presence of the inventor to maintain it. Many steam engines in Euroope are still equipped with steam jackets, but the practice has never found much favor in the United States.

The practice of preventing cylinder condensation by means of steam jackets having been found unsatisfactory for locomotives, attempts to keep the cylinders hot were for a time abandoned, but the losses became more manifest as scientific investigators instituted elaborate tests to find out how much truth there was in the theory of cylinder condensation. Bryan Donkin, a celebrated English engineer, took a very prominent part in this line of investigation, inventing some valuable apparatus to aid in the work. He found that the theories of Watt, Kinnear Clark, Isherwood and others concerning the action of steam in cylinders was substantially correct. The theories in question are that the steam on entering the comparatively cool cylinder becomes partly condensed through the chilling action of the metal. This continues till the point of cut-off is reached, after which the expanding steam begins to absorb heat from the cylinder metal, thereby cooling it, and so preparing it to act as a condenser for the next period of steam admission.

In the course of his experiments Mr. Donkin found that 16 degs. F. of superheat was sufficient to prevent condensation of steam through the whole period of admission. The demonstration which Donkin and others made concerning the extent of the steam losses due to cylinder condensation moved a variety of inventors to begin devising some form of superheater that could be economically applied to locomotives. Some American inventors carried on exhaustive experiments with casing jackets through which the hot gases from the flues were passed, but that plan never worked properly. Among the inventions produced, the superheater patented by Mr. Schmidt, of the Prussian State Railways, took the lead and gave the proper cue to various American inventors.

Increased Efficiency.

A recent press dispatch from Chicago presents some very striking contrasts in the former and the present methods of operating a railway. Mr. W. L. Park, vice-president of the Illinois Central Railroad, who accorded the newspapermen an interview said that the railroad industry is the only one that has given any tangible evidence to the public of increased efficiency of the personal unit.

"The locomotive engineer is now hauling nearly 400 net tons per locomotive as against 200 net tons 10 years ago, an increase of 100 per cent. in efficiency. This has been brought about by the elimination of curves, rectification of grades, installation of interlocking and block signals, larger locomotives and cars, and up-to-date methods of accounting and checking.

"The people have received the benefit of this, for notwithstanding the increase in wages, amounting to from 25 to 50 per cent., increased cost of supplies and material, and the entire cost of the railroads' living, they have maintained the cost of transportation to the public at the lowest rates in the world, 7.5 mills per ton per mile."

To our way of thinking Mr. Park's reference to the increase of efficiency of the personal unit or the employee is most just and timely. There is no doubt that there has been a gradual though marked improvement in the discipline of most of our prominent roads. Individual railway workers are more careful than they were or more of them are careful, but either way the average of efficiency is raised. The chancetaker is less in evidence, and his exploits are not praised.

The larger locomotives and the heavier trains have put more exacting work on the employees, but the average performance, we believe, has shown that the men have kept themselves abreast of the times and have been prepared to take advantage of any improvements in locomotives, cars or roadway which the company have provided Railroad companies have maintained a higher standard of instruction for their men with correspondingly good results.

We believe that substantial progress has been made, and that a still greater measure of progress will be achieved in the future, and while we are still far from perfection it is our duty to go hopefully on, each man faithfully doing his duty with a full knowledge that safety in operation is the greatest step towards economy and efficiency.

The Equity of the Derail.

Since writing our editorial on the equity of the derail for the November issue of Railway and Locomotive Engineering we have been favored with the valuable opinion of a man not immediately connected with the mechanical department of railways, but a man who had practical experience in another of the "outdoor" departments of railroad life.

We consider our correspondent's point as to the original intention of the derail to be well taken. In fact, we have no quarrel at all with what he has written. His letter appears in the December, 1910, number of our paper. The original intention, however good, is nevertheless not the whole story.

The derail, intended originally to stop runaway cars, is able on occasions to work hardships and we have known of a passenger train thrown from the track by a derail at a level crossing with another railway. The locomotive engineer of the derailed train had disregarded the plain indication of the distant and the home signals before the derail brought his train to a very decided halt, fortunately without serious injury to passengers. It was, if one may so say, practically equivalent to the automomatic conviction of the chancetaker.

We do not deny what is good in the underlying intention of the derail, but we cannot help seeing that on occasion it may be made to work a severe hardship. We look forward, however, to the increasing respect for signals and signal observance to gradually eliminate the necessity of the derail and to substitute an equally efficient but less drastic action in case of runaway cars or in the now happily diminishing instances of reckless locomotive engineers. We are pleased to receive communications on the subject like that sent in by Mr. Clay and we desire to say our columns are still open for an intelligent discussion of the whole subject. You don't have to agree with us in every particular to get a hearing! What do you think of the derail?

The Selector in Train Dispatching.

In another part of this issue we give space to a carefully prepared description of that form of selective calling apparatus which has come into very general use on American railways. With 35,000 miles of line now operated under selective telephone calling, this system is of importance to every railway manager. The railroads in these days of enforced retrenchment are not taking up many new devices unless their use spells economy. The Federal law limiting the hours of labor of employes concerned in train movements would, under the telegraph dispatching system, have called for a very large number of additional operators. The telephone dispatching system broadened immediately the supply of efficient men available. It also opened the door to continued employment of men who had become incapacitated in service from accident or other cause, and from this class of men superior material for train dispatching service was available. Familiarity with the road, its rules and train movement had become second nature to them, and it was found easy to train such as telephone operators. For train dispatching service they are the equivalent of a Morse operator, plus the experienced railroad man. A dispatcher was talking to a yard man at a distant junction over the telephone line. The orders having been concluded, the yardman, with that freedom of speech which the personal touch conferred by the spoken word brings, wound up the conversation by saying:

"With this telephone line, it seems to me, I'm as good an operator as you dispatchers are!"

Physically considered, railroads find they can handle more business with telephone dispatching. Reversing the experience with the telegraph, the telephone works even better in bad weather than in good. The lower the static capacity of a telephone line the more satisfactory the service, and damp weather tends to reduce this capacity. If there is ever a time when good train dispatching service is needed it is when the weather is wet and foggy. The telegraph sounder call is intelligible only to a Morse operator; the bell signal tells every one within hearing that the operator is wanted. In Canada, recently, a station closed at the time, was called on a Sunday evening. The call was sent through the selector and bell. A townsman passing the station heard the call, and knew that the operator, being a pious man, was at church. So to church he went and found his man:

"Hey, Bill, you're wanted at the station. The call's ringing."

Beside affording protection at threatened points liable to failure or accidental obstruction, the telephone train dispatching system provides for prompt oral communication with train crews, the absolute command of emergency work by the dispatcher and the making of reverse movements on double-track roads with perfect safety. Selectors of the type described are working, we are told, in all parts of this continent, in wet climates, as well as dry, and on all ranges of current, without loss of efficiency or need of adjustment. Furthermore, station ringing, telephone conversation, and Morse telegraphing may be in progress simultaneously and without interference over any circuit.

An analysis of two consecutive days' dispatching on a Western road, by telegraph and telephone, showed that the telegraph handled 100 orders in an average time of 3 minutes 59 seconds per order, and the telephone sent 120 orders in an average time of 2 minutes 12 seconds per order. On a road about 400 miles long telephone train dispatching has resulted in an average saving of one and a half to two hours' time in freight train movement from one terminal to another. The personal element introduced into the service by the use of the human voice brings the dispatcher nearer his men, and "team work" is almost the inevitable result.

From its modest beginning on the New York Central in 1907 between Albany and Fonda, N. Y., telephone train dispatching has spread, until today over 60 railways are using it. The initial cost of full telephone train dispatching equipment is understood to be somewhat greater than that of telegraph equipment; its maintenance cost is about the same. There are, without question, cogent reasons for its widespread adoption. The claim is made that its capacity is considerably greater, and that its operation is as safe and accurate as the telegraph. During the period of this rapid extension of telephone train dispatching, it is stated by those who profess to know, there has been no accident of any kind that can in any way be attributed to the changed method of dispatching.

Cost of Railway Travel.

In the November issue of the *Official Guide* some interesting comparisons are made as to the cost of traveling in Europe and in America. The writer says: "The question as to whether traveling by railroad in Europe is or is not more comfortable than in North America, is one the decision of which depends largely upon the opinion of the individual as to what he considers are the most essential elements of comfort. The question as to the cost of traveling is, however, one of fact, not of opinion.

"The figures given below are taken from notes made by a not inexperienced traveler, of amounts actually paid during a recent tour of several thousand miles on the European continent, in passing through countries having a total population of about one hundred and thirty millions of people and traveling between sixteen cities with an aggregate population of about nine millions. In the journeyings in North America with which a comparison is made the country traversed has a population of about fifty millions and the routes are between sixteen cities having an aggregate population of a little less than ten millions. The territory covered in Europe was within an area of about six hundred miles by nine hundred miles, and is, therefore, about equal to that part of the United States north of the Ohio River and between the Atlantic coast and the Mississippi River.

"The statement covers cost of traveling first class for one person over a course of 2,154 miles in Europe, including eleven different journeys varying in length from 38 miles to 497 miles, with a trunk of the average weight of 168 pounds. It shows that the total fare paid was $76.55, and the transportation by rail of the baggage, $19.42, making a total of $95.97. This is nearly four and a half-cents a mile in all. The average speed of the trains was thirty and four-tenths miles per hour.

"To compare this expense with the cost of traveling in North America a table has been made up of eleven different journeys, varying in length from 40 miles to 411 miles, over well-known routes, the total distance being 2,211 miles. For this the total fares, including the cost of parlor car seats, figure up to $60.15, with a possible excess charge for baggage of $2.75, making a total of $62.90, or a trifle over two and eight-tenths cents per mile, the average speed being thirty-eight and six-tenths miles per hour. Under the above conditions, the cost of railway traveling in Europe is over 55 per cent. higher than in North America.

Steam Heat Losses in Motive Power.

A well known mechanical engineer read a paper some time ago on the "Economical Generation of Steam Power," in which the following statement was made:

"For the best non-condensing engines we would realize 6 per cent. of the energy of the coal consumed; for ordinary non-condensing engines, such as are found in the ordinary factories, about 3 per cent., and when the boiler is inefficient and the attendant careless, not more than 2 per cent. of the total heat units in the coal are utilized in actual work."

That is a striking statement and is apt to impress many people as an exaggerated description of the wasteful condition ordinary steam engines are working under; yet a few calculations that most persons can follow prove that the startling statement quoted is substantially correct. It seems to be deplorable that as little real work should be obtained from the immense energy held in fuel; but it is a fact that of the 2,000 pounds in a ton of coal the steam engine converts less than 150 pounds into useful work and in some cases not more than one-tenth of that. The worst of it is, too, that so long as the energy of fuel is converted into work through the process of boiling water and doing work by the expansive force of the steam produced there never will be a radical change from existing conditions.

When we investigate the locomotive to ascertain how far it compares with the ordinary steam engine in doing work out of fuel energy, we find very little cause for satisfaction, but nothing for lamentation, as the conditions under which fuel is transformed into work necessarily involve immense waste of heat. Let us take an actual case of locomotive performance, the particulars having been collected for this article: On a run recently made by engine 2516 of the Erie Railroad, pulling a train of nine cars, three of them Pullmans, having a total weight of 946,800 pounds, 4,000 pounds of coal were burned, an average of 90 pounds per mile. The division of 100 miles was passed over in three hours, an average running speed of 33.3 miles an hour. But there were delays and detentions that covered 17 minutes, so that the division was covered in 163 minutes or about 37 miles an hour, making no deduction for working with speed after delays. To balance that the average speed may be put down as 40 miles an hour.

The average resistance of this train would be about 13 pounds per ton, judging from the resistance of the Empire State Express, now under similar conditions, as noted by the writer during a series of carefully conducted tests. That resistance aggregates a constant force of 6,162 pounds, which being extended over one mile of 5,280 feet represents 32,535,360 foot pounds of work done in moving the train over each mile at 40 miles an hour, the locomotive developed an average of 650.68 horsepower.

The coal purchased by the Erie Railroad Company for locomotives is of average quality and under favorable conditions of firing will develop 12,000 heat units, each unit being the amount of heat required to raise the temperature of one pound of water one degree Fahr. When converted into work each heat unit is equivalent to 778.3 foot-pounds, that is, it will be capable of raising 778.3 pounds one foot high, which is known as the mechanical equivalent of heat. At this rate each pound of coal represents $12{,}000 \times 778.3 = 9{,}339{,}600$ foot pounds of work were it possible to utilize the whole potential energy reposing in the coal. These figures multiplied by the 90 pounds of coal burned per mile give, at 40 miles an hour, a total of 16,810.86 horsepower where 650.68 horsepower was employed. At this rate a little more than 3.87 per cent. of the fuel was converted into the work of moving the train. This, although small, is a high percentage of the fuel energy converted into work by a locomotive pulling a heavy train at high speed. We have never found more than 3 per cent. of the fuel energy utilized by locomotives working under similar conditions.

People who have failed to study the action of steam as motive power are mystified as to how the losses of heat occur, how out of the immense potential power of a pound of coal such a small proportion is converted into actual work. The explanation is that nearly all the heat energy developed by converting water into steam passes into the atmosphere through the exhaust pipes. The proportion borne by the heat actually converted into motive power to the entire heat expended is the measure of the efficiency of the operation.

In following the heat losses as they occur in the cycle of operations, we first direct attention to the firebox. With a properly designed boiler and skilful firing, 50 per cent. of the fuel energy may be utilized in the generation of steam. When the working pressure of the steam has been reached and work begins, the throttle valve usually located in the steam dome is opened and the steam passes through the dry pipe into the steam chest, the reservoir where the distribution of steam to the cylinders takes place. The front steam port being opened, steam passes into the cylinder and pushes the piston nearly to the end of the stroke, when the valve cuts off the supply and almost immediately opens the exhaust port. During the return stroke steam pushes the other side of the piston and the front part of the cylinder is filled with steam a little higher in pressure than the atmosphere until the valve closes, when that steam is compressed by the returning piston. These operations are repeated on the other stroke of the piston. The exhaust steam escapes to the exhaust pipe through the cavity under the valve or between the valve heads when piston valves are employed.

Heat losses in the steam begin as soon as the heating of the water begins. A pound of true steam contains an invariable quantity of heat energy corresponding to the pressure and temperature. But the heat expended upon the production of steam is greater than that contained in the steam by an amount equivalent to the work performed, that is the work of converting the water into the required pressure of steam. And conversely, however steam is used, provided no heat is lost by radiation or condensation, the total heat expended minus the heat left in the steam after performing work is the thermal value of the work accomplished. The proportion of the heat converted into motive power to the quantity of heat expended is the measure of the efficiency of the engine.

It is impracticable to estimate how much work a locomotive does with the steam used without having indicator diagrams taken at about every mile of the run, owing to the varying character of the work performed. At one time the engine may be using the steam full stroke, when the exhaust carries away all the heat used in generating the steam. That kind of working is so common that it is very evident why the heat economy of a locomotive is so low. Half of the fuel had gone up the smokestack and that portion of the heat converted into steam passes into the atmosphere through the exhaust. It is the waste through the exhaust that engineers and inventors find the greatest difficulty in restraining or reducing.

When an engine can be worked so that the steam is cut off at quarter stroke, a portion of the heat is converted into work and the quantity thus utilized represents the measure of heat economy. Suppose that one engine using steam of 130.3 pounds gauge pressure, which is 145 pounds absolute, cutting off at quarter stroke, the steam doing work falls from 145 to 36 pounds and as a consequence the temperature of the steam falls from 355.6° to 260.8° Fahr. According to Reganult's tables, one pound of steam at 145 pounds pressure absolute expanded against resistance down to 32° Fahr. without cylinder condensation converts 498 heat units into work. In our case the steam is exhausted at 36.25 pounds and according to the same authority still contains 387 heat units that would be converted into work by expansion to 32° Fahr. This indicated that 498—387=111 heat units of the steam have been converted into work by the act of expansion and therefore that quantity is utilized out of the total measure of heat employed.

Approximately there would be 1145 heat units expended in converting the pound of water at 32° F. into steam, so the economical efficiency of the work done is 111÷1145=.096, or about 10 per cent. That does not cover all the heat losses inevitable to a locomotive using steam at quarter stroke, but it represents the best possible performance, a measure of efficiency never realized in train hauling. Now, the people who marvel concerning the meagre economy of railway motive power may figure out for themselves where the heat energy of the coal dissipates itself.

Book Notices

THE "MECHANICAL WORLD" POCKET BOOK AND YEAR BOOK FOR 1911. Published by Emmott & Co., London. Price six pence.

This little book, which is issued each year for the *Mechanical World*, contains a collection of useful engineering notes, tables, rules and data. New sections have been added; one is on screw cutting, another deals with high-speed steel and its treatment. Yet another is on annealing, hardening and tempering and one other deals with details of gas engines. Several of the old sections have been extended, and the book has been brought up to date in every way. If you want a copy it can be had direct from the publishers, which we have given above.

EFFICIENCY. By Harrington Emerson. Published by the *Engineering Magazine*, New York. Price, $2.

This book is intended to set forth efficiency as a basis for operation and wages. It contains 171 pages, and is divided into twelve chapters. The publishers point out, in the introduction, that much preliminary work has been done in this field by Mr. H. F. L. Orcutt in his papers on machine-shop management, Mr. Carpenter's writings on profit-making management, Mr. F. W. Taylor's analysis of the times of operations, Mr. H. L. Gautt's development of the bonus system, and Mr. F. A. Halsey's advocacy of the premium plan. Mr. Emerson's book on Efficiency is another such extension, and is the latest development along this line of thought and work. The book is of convenient size and well printed.

BROOKE'S AUTOMOBILE HAND BOOK, by L. E. Brooke. Published by Frederick J. Drake & Co., Chicago, Ill. 706 pages, with numerous illustrations, flexible leather. Price, $2.

This book has become an established authority on all matters pertaining to the automobile, and the publishers have shown commendable business enterprise in having the book revised year by year, so that the work has all its original features with an added freshness at each successive reappearance. The author has had the assistance of several well-known experts in revising the edition of 1911. The methods described for dealing with road troubles are particularly valuable as embracing the condensed experiences of the best authorities.

Catechism of Railroad Operation

It is the purpose of the author in publishing this Catechism to make the work sufficiently comprehensive so that the information imparted will enable a candidate for promotion in train service to pass the examination required by any railway company in the United States or Canada, if the information given is learned properly. To pass an examination successfully, the candidate must study the questions in the manner they apply to his daily work and use their aid in making clear the why and wherefore of practices he is constantly required to follow.

If the Catechism is taken hold of in the proper spirit, its teachings will impart pleasure and draw the student into wide branches concerning the science of railway work. I should advise the student of these lessons to guard against the voice of ignorance so often heard abusing the practice of requiring people to pass examinations and praising the good old days when muscle was considered superior to knowledge. The examination has come to stay and the wise man makes the best of the situation. The sensible man finds that even unaccustomed mental labor when earnestly undertaken soon becomes a pleasure.

The principal part of this Catechism will be devoted to giving information concerning the handling, care and management of railway motive power and its attachments, but incidentally there will be some attention given to the principles of mechanics and to elementary chemistry, lines of useful knowledge which every intelligent man connected with railway operation is stronger for possessing. Let us not forget that knowledge is power.

The majority of the manuals of examination of engineers and firemen used by railway companies are based upon a catechism published by the Traveling Engineers' Association in 1896, but a great many changes and additions have been made since that time. In ordinary practice the form of questions is used merely to guide the examiner, who extends his questions to many practical and theoretical subjects introduced to test the general knowledge and intelligence of the candidate.

The plan of examination most commonly followed has been to examine a fireman once when he was wanted for promotion to the position of engineer. The practice is, however, becoming common of requiring firemen to pass what are known as progressive examinations. Concerning these, the manual of a prominent railway, which may be considered as a representative of growing railroad practice, says:

"When a man is employed as a fireman he shall be given the first series of questions and notified that at the end of the first year of service he will be required to pass a written and oral examination thereon under the direction of the divisional mechanical officer and air brake instructor.

After passing the first series of questions, he will be given the second series and notified that at the end of another year of service he will be required to pass a written and oral examination thereon, under the direction of the divisional mechanical officer and air brake instructor.

Failure to pass the first and second examinations will be sufficient cause for dropping the man from the service.

When he has passed the second series of questions he will be given the third series of questions and notified that before being promoted and within not less than one year he will be required to pass a written and oral examination before a general board of examiners.

At the third examination, if a man shall fail to pass 80 per cent. of the questions asked, two more trials, not less than two months apart, will be given him to pass the same examination. If he then fails to pass by a percentage of 80 per cent. he shall be dropped from the service.

CATECHISM, FIRST SERIES.

1. At what age and in what capacity did you enter the service of a railway company?

A. State the exact facts.

2. When did you enter the employ of this company and what work have you been doing?

A. State facts.

3. What engines have you been firing?

A. State facts.

4. What engineers have you fired for?

A. Give the names.

5. Has any influence been at work to prevent you from obtaining the information necessary for passing this examination?

A. State facts.

6. What are the fireman's first duties on arriving at the engine house previous to going out with a locomotive?

A. See that the water in the boiler is at the proper level. See that the fire is in condition to make up a proper fire for starting. Make sure that the ash pan is clean. Ascertain that the engine has got on all the necessary tools and supplies, that the engineer's oil cans are filled, have the cab dusted, the floor nicely swept and the coal on the tender watered.

7. Give particulars of the various rules relating to signals found in the company's Book of Rules.

A. Describe the various signals.

8. What else would you consider a danger signal?

A. Any light swung violently near the track, anything burning on the track or any article waved in a manner evidently intended to attract the notice of the engineer.

9. Have you got into the way of comparing your watch with that of the engineer?

A. I always do so regularly before starting out on a train.

10. Do you consider it your duty to read all orders given to the engineer concerning train movements?

A. I do.

11. What good arises from that practice?

A. It tends to prevent mistakes, two memories being more reliable than one.

12. What is the purpose of the steam gauge?

A. The steam gauge indicates the pressure above the atmosphere of the steam in the boiler.

13. What is atmospheric pressure?

A. The weight of the air pressing upon the earth; it averages 14.7 lbs. to the square inch at the ocean level.

14. What is absolute boiler pressure?

A. The pressure above vacuum. To find the absolute pressure on a boiler add 14.7 lbs. to the gauge pressure.

15. What is the purpose of gauge glass and of gauge cocks?

A. To indicate the level of water in the boiler.

16. What is important concerning the water level?

A. It must be kept high enough to cover the heating surfaces, no matter what grade may put the boiler off the level line.

17. What effects on the water level is the action of opening and closing the throttle?

A. With most locomotives the water level is raised when the throttle valve is opened and the water level subsides when steam is shut off.

18. What would indicate to you that the boiler connections of a gauge glass were becoming clogged?

A. The up and down movement of the water in the glass would become slow and inactive.

19. What is the source of power that operates a locomotive?

A. Heat through the medium of steam.

20. How is steam formed in a locomotive boiler?

A. By the fire evaporating water.

21. At what temperature does water begin to boil in a locomotive boiler?

A. At 212 degs. Fahr.

22. At what temperature does the water in the boiler boil when the gauge pressure is 200 lbs.?

A. At that pressure the boiling point will be 387.5 degs. Fahr.

23. What weight of water is usually evaporated in a locomotive boiler for each pound of coal burned.

A. That would depend upon how hard an engine is worked. When the work done is light the water evaporation per pound by coal may reach ten pounds, but it averages from 4 to 7 lbs. of water to the pound of coal.

Properties of Matter.

The world around us is composed of material substance. This is usually spoken of in a broad sense as matter, probably derived from the Latin mater, mother. So that the expression "mother earth" has a very definite significance. This material substance, or matter, as we call it, has a number of properties which are common to all forms of matter, though they are possessed by all substances in very widely different degrees.

MAGNITUDE AND FORM.

All bodies have magnitude or bulk and occupy some space. When we say bodies are possessed of magnitude, we refer to length, breadth and thickness. The form of a body is its external shape. It may be a regular shape, such as a ball or a cube or some other figure, or it may be as irregular in form as a fragment of stone broken off a rock, but it necessarily possesses form. Substances may have the same magnitude and yet be very different in form. A ball of lead and a circular sheet of boiler plate may have the same magnitude; that is, they may each contain the same number of cubic inches, while they are totally different in form. Many substances of widely different densities may have the same form, like a cake of soap and a smooth brook-pebble, and yet be quite different as to magnitude.

IMPENETRABILITY.

This property always seems to be a sort of declaration of independence of matter, for it briefly states that no two bodies can occupy the same space at the same time. You can't pack two books into a box which will just hold one; that is plain enough, but when sugar or salt are poured into a glass of water and both disappear without causing the water to overflow the tumbler, the case is not so clear. As a matter of fact, the property called impenetrability is not interfered with, because the particles of sugar and of salt penetrate into the interstices of minute empty spaces between the molecules and atoms of the water. This must be so, because the sugar and the salt cannot occupy space that is already occupied by water and neither of them change their substances, for both salt and sugar can be recovered by boiling the water away.

POROSITY.

The property called porosity is simply the degree of separation between the particles of a body. The spaces are called pores, hence the name of the property. All bodies are more or less porous. When the pores are exceedingly small, the body is spoken of as being dense. Gold, which is considered to be a very dense metal, was proved to be porous by a Florentine philosopher, who performed a very ingenious experiment. A hollow sphere of gold was filled with water and tightly closed. The sphere was then subjected to enormous pressure, and the water was actually forced through the minute pores of the metal and appeared on the outside surface of the sphere in the form of a thin film of dew.

DIVISIBILITY.

Divisibility is the property by virtue of which a body can be divided and subdivided an almost infinite number of times. When mechanical subdivision fails chemical means may be employed. The practically exhaustless emanations from radium have, of late years, given the most convincing proof of the extreme divisibility of that form of matter. It is said that a grain of carmine imparts a sensible color to a gallon of water. The electrolytic deposition of metals, as in silver plating, copper plating, etc., afford examples of the extreme divisibility of these metals.

COMPRESSIBILITY AND DILATIBILITY.

These two properties may be considered together, for they are in a rough way each the compliment of the other. Compressibility is the quality of being reduced in volume by pressure from without. All bodies have this quality in some degree. Gases are highly compressible, while liquids are only slightly compressible. Water is for all practical purposes incompressible as it yields only .00046 of its volume under one atmosphere. Sponge, India rubber, cork are easily compressible solids. Metals are slightly compressible, as is evidenced by the way they can be stamped into coins and medals.

Dilatibility is the opposite of compressibility, but it is not produced simply by the release of external pressure. The application of heat is one of the commonest ways of producing dilatibility in a substance. Many railroad shop operations, such as the shrinking on of a tire, would be an impossibility if the property of dilatibility was absent in the tire. The hot air balloons which are often a feature of a great fireworks display, exhibit the dilatibility of air in a very marked degree.

ELASTICITY.

This is the property of matter by which a body after having been extended or compressed, returns approximately to the same size and shape as it had originally. The cooling of the steel tire to which we referred in the preceding paragraph is a case in point. Perhaps some of the least elastic bodies known are putty or clay, but all possess the property to some extent. A very interesting experiment may be made to show that ivory billiard balls are elastic, and that may be accomplished by taking a smooth, flat slab of marble and coating it with oil. Drop the ivory ball from various heights. The greater the fall the more extended the displacement of the oil film will be found to be, showing that the ball actually undergoes very considerable distortion, but by reason of its elasticity it is able to quickly and surely regain its spherical shape. Numerous instances of elasticity could be given; the bouncing of balls on hard substances, the shock-absorbing qualities of springs, air, etc., the elasticity of steel wire, catgut strings, etc., all permit of these substances being used very considerably in the commercial arts.

INERTIA.

Inertia is the name given to the property of matter by which, when a body is at rest it tends to stay at rest, and when in motion it tends to keep moving in a straight line at a uniform rate. This is practically a statement of Newton's first law of motion. A body has no power of its own to change its state of rest or of motion. This can only be done by the application of some outside force to the body. All railroad men know of the power required to start a railroad train, and they also know of the expenditure of power required to bring the train to rest again by the application of the brakes. There have been some inventors who have endeavored to argue that a brake might be devised which would stop a fast moving train in a few feet. Suppose such a thing could be done, the inertia of the people inside the car and the inertia of the internal fixtures, such as seats, parcel-racks, etc., would cause them all to be so violently thrown forward that they would cause injuries almost as bad, if not worse, than a serious collision at the present time does. It is the inertia of the hammer head which causes it to overcome the resistance of a nail being driven into wood. No amount of steady pressure that a workman could exert between hammer and nail would force the nail home like the power of the blow.

Locomotive Running Repairs

XI. PISTON RINGS AND CYLINDERS.

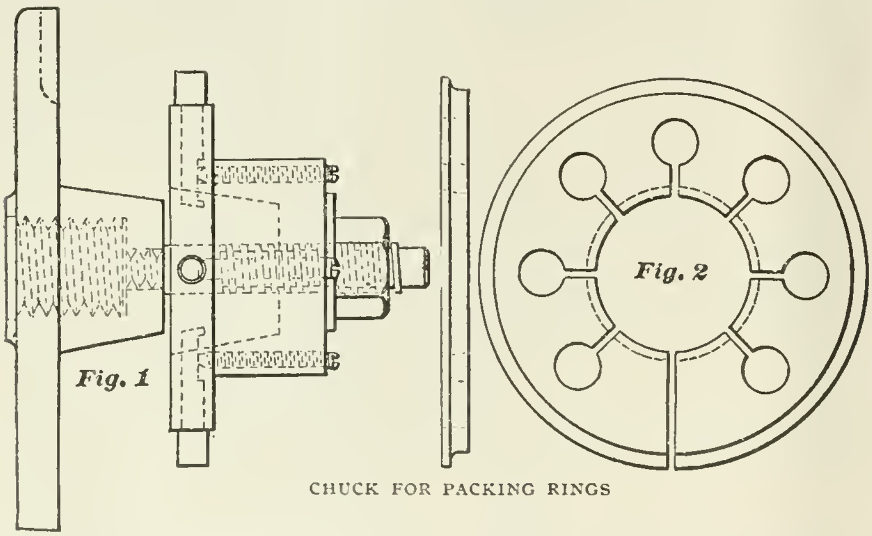
Economy in machine shop practice is a good thing, but it has its limitations. Many roundhouse troubles begin in the machine shop. The desire to beat the record, to get the engine out ahead of some specified time is sure to bring about occasions in active operation when the locomotive will be coming in behind time. Locomotive machinists are, as a rule, high-class workmen if they are let alone, but like crows if they are disturbed while their building operations are going on, they take umbrage very readily, and are apt to let the job go as it is.

This is particularly true of what may be called the finishing touches on the locomotive. The pistons are literally thrown into the cylinders. The connecting rods, and even the valve gearing, are not infrequently assembled with almost criminal haste. As for the piston rings, they are, generally speaking, allowed to fit themselves.

The trouble with them begins with the ill-fitting ring, and if time was taken to compare the form which the split piston ring has assumed with the true circle of the cylinder into which it is supposed to fit, it would be seen at a glance that the piston ring had assumed in a greater or less degree the outlines of an oblate spheroid, a marked abnormal extension being almost invariably apparent toward the points of the split ring, as if the insensate metal was endeavoring to straighten itself out. In the finer kinds of piston rings used on automobiles, the rings after being cut are again subjected to another outer cutting in the lathe when the distortion referred to is removed, and in many cases the piston rings are afterwards ground in the cylinder, thereby perfecting the fit.

In the case of locomotive piston rings there is rarely or never such pains taken. The prevailing idea that the admission of steam to the inner face of the ring will equalize any irregularity is false in general and false in detail. The ring will never be a good fit until both ring and cylinder have removed a considerable portion of the metal from the contacting surfaces, thereby hastening the call for new rings and a reboring of the cylinder.

This is not the only one of the defects in piston ring construction. The advisability of holding the piston rings in separate positions so that their joints will not come in line in the cylinder is so obvious to all who have ever removed pistons from cylinders we believe that the use of some simple contrivance adapted to that purpose might be looked upon as a necessity. Such, however, is far from being the case. The practice in many shops of placing the pistons in the cylinders is to "break the joints," as it is called, that is to place one joint at some point in the cylinder and the other ring joint at another, with perhaps the half circumference between them. In the case of pistons where no means are used to hold the rings in position, the piston is no sooner at work than the two joints begin moving towards each other, and complete their movement by settling together at the upper part of the cylinder. This is easily understood when we bear in mind that at the joint of the ring, no matter how slight the opening may be, that position or section of the ring must necessarily be something lighter than the part of the ring opposite to the joint, and consequently the law of gravitation soon brings the heaviest part to the bottom.



CHUCK FOR PACKING RINGS

It need hardly be stated that through these two open joints moving along in the same path in the cylinder, a considerable blast of steam finds an easy passage, and thus the quickly constructed, ill-fitted, loose-jointed piston ring not only wastes steam, but hastens its own decay and multiplies labor in the reboring and bushing of the cylinders.

Going back to the construction of the piston ring, the most approved method is to make the rings at least one-quarter of an inch larger than the diameter of the cylinder, and after splitting the ring and fitting the joint carefully, the ring should be re-chucked in the lathe, the joint being closed and the ring then cut down to the size required. A dowel pin should be put in the bull ring, or in the piston head as may be most convenient, and a notch cut in the piston ring, fitting the size of the pin as carefully as possible. These operations take time, but, like the fitting of every other part of the locomotive, the work should be done in the best possible manner.

Apart from the loss of steam incident to the joints of the rings coming together at the upper part of the cylinder there is an added reason in keeping the joints on opposite centers of the cylinders. With the joints of the rings on the top there is a danger of the joints projecting over the opening of the steam port, in which case there is a risk that more or less cutting of the cylinder and rings will occur with a tendency to deepen into grooves that add to the disasters to which we have already alluded.

There are several clever designs of piston rings devised to obviate the disadvantages of the solid rings, some being sawed into a number of separate pieces and set out against the cylinder with a flat spring, others have tongue-shaped springs attached to each part of the separated ring. These contrivances are claimed to have done good service in cases where the cylinders are much worn, but the reboring and, if necessary, the rebushing of the cylinder is better practice than any flexible kind of rings that may be used for the purpose of making up for any irregularity in the surface of the cylinders.

There are a number of clever devices in use in facing parallel the bull rings and also the spring rings of locomotive pistons. The illustrations, Figs. 1 and 2, are samples of these contrivances. Fig. 1 shows a mandrel on which the bull rings may be made perfectly true, the work being bored on an ordinary chuck and while the range of work is limited to one size, there may be as many sets for different sizes of cylinders as may be required.

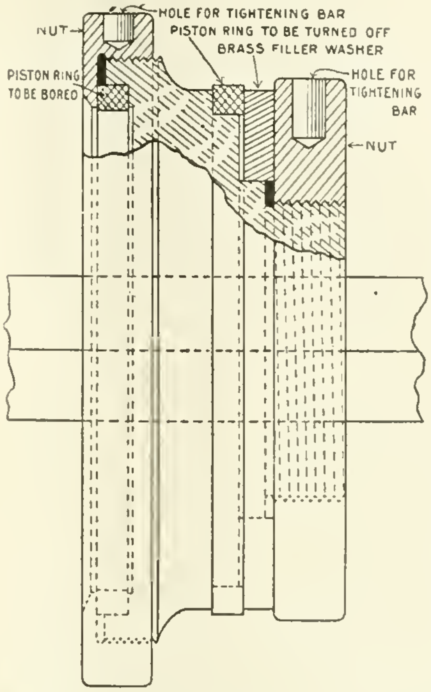
Fig. 2 shows a method of facing the spring rings, the rings being bored to fit the mandrel near the face of the plate and are brought up square by the follower and are held in place by the nut. One-eighth of an inch may be allowed for expansion.

It may be remarked that while a common chuck is theoretically true, machinists are well aware that in the running of packing-lathes, the tendency is to spring the work out at the jaws, and flexible rings readily lend themselves to this distortion. On the mandrels illustrated, the strain in tightening is towards the plate in all cases, and any outward springing of the ring is a physical impossibility..

It will be noted in the illustration that the V-thread on the central stud is flattened. This is for the purpose of preventing a loose fit on the follower, which should be as good a fit as possible to insure a central attachment of the parts. A slot should be made in the face plate to admit of calipers or template for the exact gauging of the rings.

Fig. 3 shows another form of mandrel with attachments for holding piston rings, while being bored out and also while being trued up on the outer face. As already stated, the rings should be left with extra metal on the inner and outer diameter. When the joint in the ring has been fitted the ring may be readily compressed by a thin flexible band and held in position until the washer and nut are tightened, when the flexible band may be removed. The stress or strain on the ring will remain equal after being finished in this way if the rings are allowed to rest horizontally. Suspension by hanging on pins, even for a short period of time, tends to distort the rings again. Rings that are laid away for future use should have a coating of oil, as even irregularities in the quality of the metal affect the shape of the rings if left exposed to the atmosphere. It should also be borne in mind that the method of hammering the inner faces of rings in order to close them or correct irregularities has a tendency to increase the brittleness of the metal and lead to fractures

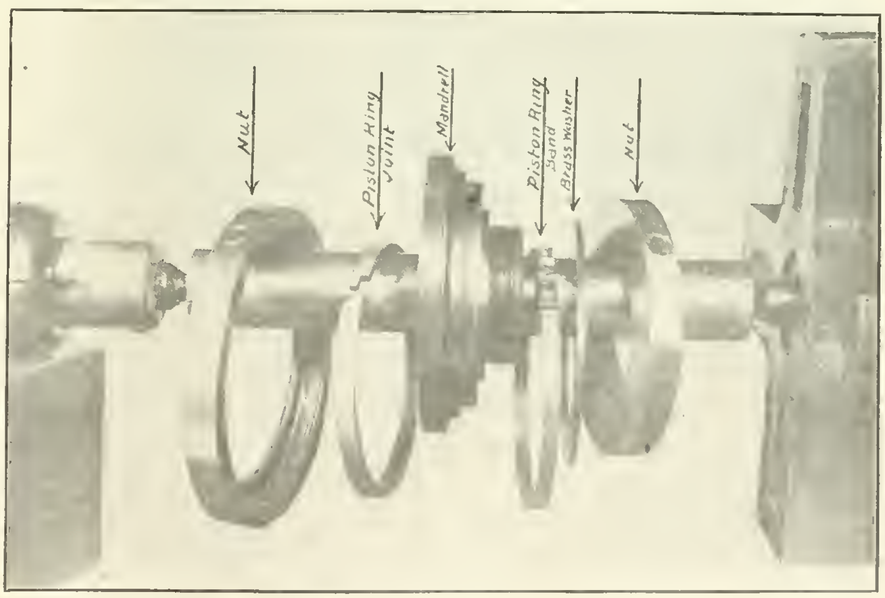
A word may be added in regard to the bushing of cylinders, as this operation occasionally comes under the head of locomotive running repairs. As is



MANDREL HOLDING RING READY FOR TURNING.

well known, different railroad shops have various methods of fitting and applying cylinder bushings, as well as piston valve cages, and, as a rule, the operation is successful and satisfactory. A successful method is to have the bushing turned the same size as the cylinder. In some shops the cylinder is heated by the application of a compressed air and oil torch, but where this is not available the cylinder may be expanded by building a fire around the cylinder. It is claimed by many that there is less danger of damaging the cylinder when a wood fire is used. With wood the heating is more gradual. In using an oil or gas blower the risk is greater.

A gauge made of ¼-in. round iron and pointed at both ends can readily be made the exact size of the cylinder. If this gauge does not go in the cylinder easily the bushing should not be inserted in the cylinder. The bushing heats rapidly, and if it should get stuck in the cylinder, the cylinder may be heated again from the outside and the bushing cooled by a blast of compressed air being applied to the inside when the bushing may after a little delay be pushed into the cylinder. Building a fire inside of the cylinder produces an equal expansion. It should be remembered that the thickest part of the cylinder is on the top and pains should be taken to apply the heat in whatever form it may be to that part. Steam will not heat the cylinder sufficiently. A cylinder may be readily expanded one-sixteenth of an inch, but care should be taken that the bushing is not made much larger than the cylinder. The size should be carefully proved before the operation is begun. If the bushing be larger than the cylinder it will be found that when both are cooled the bushing has lost its perfectly circular form, and is not held in place with any greater degree of security than when both sizes exactly correspond.



MANDREL WITH ALL THE PARTS DISPLAYED.

Questions Answered

WARNING PORT CLOSED.

1. K. N., Wheeling, W. Va., asks: Can the warning port of a brake be opened without taking the valve apart? The person who said it could be done will not say how.—A. If the warning port in the G 6 brake valve is not stopped up with any hard substance, or if there is

merely some scale or rust deposited on top of the port, the brake valve handle can be placed in release position and the pump shut down, after which the valve handle can be removed and a monkey wrench used to move the key and valve back past release position until there is a heavy blow of air from the emergency exhaust port. This will be main reservoir pressure escaping through the large port through the rotary valve, and at this time the large end of the warning port will be directly over the brake pipe port L and as main reservoir pressure on top of the valve reduces, brake pipe pressure will flow through the warning port in the opposite direction and dislodge and blow out any little obstruction in the port.

TRACTIVE EFFORT OF A MALLET.

2. C. A. O., Altoona, writes, I am a reader and subscriber to your excellent paper and I am looking for an explanation of the calculation of tractive effort of a Mallet compound when the size of the cylinders, the diameter of the driving wheels and the steam pressure are known. Will you please give it? A.—The formula employed by the Baldwin Locomotive Works is as follows:

$$T = \frac{d^2 \times s \times 1.2 \times P}{D}$$

Where T is the tractive effort in pounds
d is the diameter of the high pressure cylinders, in inches
s is the stroke in inches
P is the boiler pressure in pounds
1.2 is a constant, found by the Baldwin people to be applicable to this class of engine.
D is the diameter of driving wheels in inches.

KEEPING WATER FROM FREEZING.

3. McR., Kingston, Pa., asks: We have water tanks around our car shops and sheds here to be used in case of fire. Is there any way of preventing the water from being frozen?—A. It is good practice in cases of this kind to place a considerable quantity of rock salt in the water. There are cheap, coarse grades of salt that may give service equal to the more refined kinds.

RIGHT OR LEFT LEADING ENGINES.

4. I. R. C., Moncton, writes: Will you please fully explain how to tell a right lead from a left lead engine. In answer to a similar question some time ago RAILWAY AND LOCOMOTIVE ENGINEERING said that with the right hand crank on forward centre and the left crank on top quarter, that would be a right lead engine. With the right crank in same position and left crank on lower quarter, would it be a left lead engine? If this is correct, will you please explain how it is determined. A.—Yes, the first case you give is a right lead engine and the second is a left lead engine. A locomotive is really two steam engines placed side by side, and the right or left lead is determined simply by which engine is set ahead of the other. In the right lead engine, beginning with piston at front end of cylinder, let two strokes be made; this is one revolution of the wheel, and the right engine has completed two strokes. While the left began on top quarter, with piston approximately in the centre of the cylinder, and in one revolution the left piston got back to the same position at or near the centre of the cylinder. Of course the engine is supposed to be running forward in each case. In running along the track the right lead engine completes its double stroke ahead of the left hand engine, and if the left hand engine lead, the left one would complete its cycle ahead of the right. Putting it another way, suppose the right hand engine made a double stroke (equivalent to one driving wheel revolution), in 4 seconds. The right hand piston would, in any minute, be at the front of the cylinder on the 4th, 8th, 12th, 16th, 20th and 24th, etc., second, and if the left hand engine was one second later it would arrive at the front of its cylinder in any minute on the 5th, 9th, 13th, 17th and 21st, etc., second. These are later periods in the second and show that the right engine leads. If the left engine leads the completion of any cycle would be ahead of that of the right side.

COMPENSATED CURVES.

5. L. H. E., Ithaca, N. Y. asks, will you please explain to me the meaning of the terms compensated and non-compensated as applied to railway curves? For instance, in your November number you say that the C. & O. Mallet compound is to work on a portion of the road having uncompensated curves. What do the terms mean? A.—There is a certain resistance to train haulage caused by a curve. It depends on the degree of curvature on the level, but, if it is desired to continue this curve on an up-grade, the degree of curvature is reduced so that the total resistance of the curve and the up-grade combined will about equal that of the original curve. The fact that allowance is made for the resistance of this grade by easing the curve is what is called compensated curve.

QUANTITY OF OIL.

6. , C. M. J., Central City, Ky., writes: I would like to ask how much oil a tank 6 ft. 9½ ins. by 4 ft. 11 ins. by 4 ft. 4½ ins. can contain? and also how much oil will it hold per inch?. A.—This tank contains about 146.09 cubic feet or 252,446.25 cubic inches. You do not say what oil you are using. Find out in Kent's or in some such engineering pocket book how many cubic inches go to a gallon of your oil and divide the total cubic inches by their number and you have the total number of gallons the tank will hold. In order to find out how many gallons to the inch multiply the length of the sides of the base in inches and divide by the number of inches to the gallon. You ought to get hold of some simple book like Machine Shop Arithmetic in order to teach you how to calculate the contents of a tank with retangular or circular base.

To Educate.

Education must educe, being from "educare," which is but another form of "educere" and that is "to draw out" what is in the child, the immortal spirit which is there; this is the end of education; and so much the word declares. The putting in is indeed most needful, that is, the child must be instructed as well as educated, and the word "instruction" just means furnishing. He must first have powers awakened in him, measures of spiritual value given him.

Steel Cars Save Passengers.

Indications are that the general introduction of steel passenger cars will effect much saving of life when accidents happen. A striking test of the resisting power of steel cars was involuntarily made on one of our leading railways last month. Owing to a mistake in signals made by the engineer, a limited express ran into the rear of a freight train at high speed, but being composed of all steel cars, the shock of collision was withstood so firmly that no passenger sustained injury.

The severe weather with which this winter has opened has put extraordinary stress upon the railroads obeying the law requiring them to use self-cleaning ash pans. Where steam or water has been used to force the ashes out of the ash pans, annoying delays have occurred through freezing. A master mechanic of one of the important Western roads talking about this source of trouble and delay asserted that the ash pan made by Talmage, of Cleveland, O., was the only one that met the law and gives no annoyance.

The Houghton Line is the name of a monthly magazine published by E. F. Houghton & Co., Philadelphia. It is a particularly racy publication, full to overflowing with smart, funny things. It is sent free to any railway man or woman who writes to the manager of the company saying that he or she is a friend of RAILWAY AND LOCOMOTIVE ENGINEERING.

Air Brake Department

Conducted by G. W. Kiehm

No. 6 Distributing Valve Test Rack.

Of the two photographic views that are reproduced, one represents a distributing valve test rack, the other, an air pump and feed valve test rack working in combination, that is, the air pump being tested, or the shop compressor, furnishes the compressed air for both racks; one brake cylinder and one equalizing reservoir are used for either rack.

The use of one brake cylinder is made possible by employing a double check valve of the schedules S. W. A. and S. W. B., and there is a stop cock in each equalizing reservoir pipe, so that the one reservoir can be used with either the G 6 or the H 6 brake valve. On the opposite side of the wall there is a main reservoir, a brake pipe volume reservoir and an auxiliary reservoir to store the air for operating the triple valve.

If necessary, pump governors can also be tested as well as brake valves, but triple valves are of course tested on the standard triple valve test racks.

This description is intended to deal entirely with the distributing valve test rack which is not a Westinghouse device, but rather one designed because of a necessity for the use of a test rack in connection with the cleaning and repairing of distributing valves.

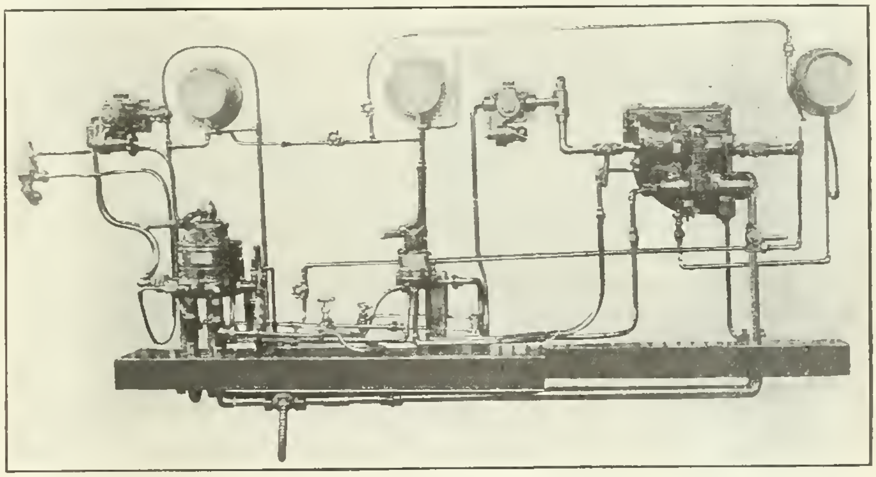
By referring to the photographic view it will be observed that the greater portion of the distributing valve reservoir is on the opposite side of the wall, likewise the reservoir pipe, brake pipe, brake cylinder pipe and equalizing reservoir pipe.

The first air gauge, above the automatic brake valve, registers main reservoir and equalizing reservoir pressures; the second gauge, just above the independent brake valve, registers brake pipe and brake cylinder pressures, and the third gauge, near the distributing valve, registers pressure chamber and application chamber pressures.

There is a stop cock in the brake pipe near the distributing valve, and a bleeder cock in the gauge connection to the pressure chamber and the brake cylinder pipe and the distributing valve supply pipes have the usual stop cocks.

When a distributing valve is removed from the test rack the three cocks mentioned are first closed and the bleeder cock is opened to drain the pressure chamber, and after a distributing valve has been cleaned or repaired, lubricated and assembled, it is bolted to the reservoir and the three cocks are opened and the bleeder cock is closed, and after the pressure chamber is charged and the valve is operated a few times in the service, emergency and independently, and after it is ascertained that there is no leakage from the gaskets, cap nuts, exhaust port, or from the exhaust port of the automatic brake valve, the safety valve should be adjusted.

The adjustment can be made with the automatic brake valve in emergency position or by increasing the tension on the adjusting spring of the reducing valve, but there should be no attempt made to adjust the safety valve or apply the independent brake until the pressure chamber has become partially charged on account of the liability of unseating the equalizing or graduating valves and depositing dirt or foreign matter on their seats.



DISTRIBUTING VALVE TEST RACK.

While the distributing valve is being operated it should be noted that proper brake cylinder pressure is obtained and maintained upon various reductions of brake pipe pressure and that there is no increase or decrease of brake cylinder pressure while the brake valve handles are on lap position.

If the action of the distributing valve up to this time is apparently satisfactory it will become evident to the air brake man that the following tests should be conducted in order to determine positively the condition of the operative parts of the valve.

In view of the manner in which the No. 6 E. T. brake has been dealt with in these columns during the past two years, methods of locating the source of blows from the exhaust ports can be ignored at this time, and in connection with the tests there should be used a ¾-in. pipe plug and a circular piece of wood, the outside diameter being the same as the equalizing valve piston and 9/32 of an inch thick, with a suitable opening through the center for the shoulder on the equalizing valve piston and the equalizing valve to pass through. This piece of wood will then be used between the equalizing valve piston and the equalizing slide valve bushing during the test to determine equalizing valve packing ring leakage. The equalizing valve could be blocked in lap position by using a lower cap nut with an extension, but experiments prove that this results in either bending or breaking the equalizing piston, due to the off-set in which the graduating valve is fastened.

The tests that should be conducted after the foregoing has been faithfully observed are:

1st. Feed groove capacity, or charging test.

2nd. Equalizing piston packing ring leakage.

3rd. Application piston leather leakage.

4th. Application piston ring leakage.

5th. Frictional resistance to application piston's movement.

6th. Frictional resistance to equalizing piston's movement.

7th. Emergency check valve leakage.

8th. Graduating valve leakage.

The tests should be conducted as follows:

1st test.—Close the stop cock in the

brake pipe and bleed the pressure chamber; close pressure chamber and open the brake pipe stop cock and note the time required to charge the pressure chamber to 70 lbs. From 55 to 90 seconds time will be satisfactory.

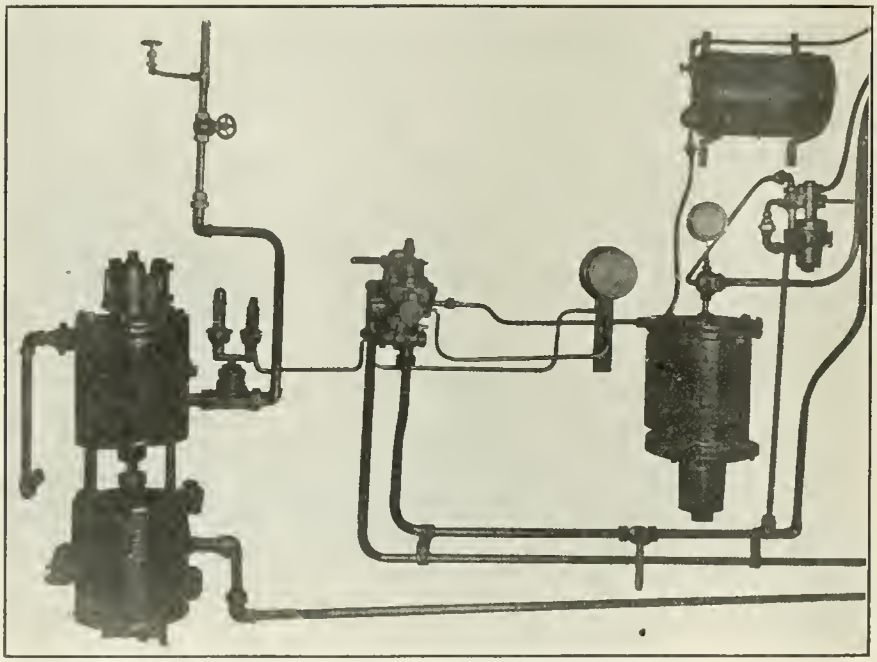
2nd test.—Close the stop cock in the brake pipe, bleed the pressure chamber, remove the equalizing valve cylinder cap and insert the wooden washer to block the equalizing valve in lap position. Replace cover and open stop cock in brake pipe. Piston ring leakage will be shown by gauge hand attached to the pressure chamber; it should not exceed 35 or 40 lbs. per minute. On repaired work it should be kept down to 25 or 30 lbs. per minute.

3rd test.—After the wooden washer has been removed and the pressure chamber recharged, close the stop cock in the distributing valve supply pipe, place the independent brake valve handle in application position and close the stop cock in the brake cylinder brake pipe. The brake cylinder gauge hand rising will show leakage past the application piston packing leather and ring.

4th test.—There being no leakage past the leather, open the stop cock in the brake cylinder pipe, then slowly open the stop cock in the supply pipe, which will fill the brake cylinder; then screw the ¾-in. pipe plug in the exhaust port of the distributing valve and place the independent brake valve in running position. A blow at the emergency exhaust port of the automatic brake valve, accompanied by a fall in brake cylinder pressure after application cylinder pressure has escaped, indicates leakage past the application piston ring, which is a leak of brake cylinder pressure into the application cylinder.

Test 5.—After test No. 4, remove the plug from the distributing valve exhaust port and use the brake, making light, independent applications. The hands on the gauges showing application chamber pressure and brake cylinder pressure should rise together and show the same pressures simultaneously. In the event of a failure to do so the differences in pressure show the amount of frictional resistance encountered in moving the application piston and its attached valves.

Test 6.—Release with the independent valve and operate the distributing valve with light reductions from the automatic brake valve. The hands on the gauges showing brake pipe pressure and pressure chamber pressure should fall together, remaining at the same figure until the point of equalization is reached. Failure to do so indicates undue resistance to movement in the equalizing portion of the distributing valve. The distance the brake pipe gauge hand falls before the pressure chamber hand starts shows approximately the amount of frictional resistance.



AIR PUMP AND BRAKE VALVE TEST RACK.

Test 7.—Place the automatic brake valve in service position until equalizing reservoir pressure has entirely escaped. There should then be no further escape of air from the brake pipe exhaust port. If there is a continuous blow of air from the exhaust port after equalizing reservoir pressure has escaped, it indicates leakage from the brake cylinder into the brake pipe past the check valve or the guide in the quick action cylinder cap. Very slight leakage at this time accompanied by a falling of pressure chamber air as indicated by the gauge attached would point to leakage of pressure chamber air past the equalizing valve packing ring and cylinder cap gasket into the brake pipe.

Test 8.—Place the automatic brake valve in release position until brake pipe and pressure chamber have charged to main reservoir pressure, then make a light reduction in brake pipe pressure and return the handle to running position. The brake should remain applied. If the brake releases under the conditions cited, application cylinder pressure escaping at the exhaust port of the automatic brake valve, it indicates a leaky graduating valve. Graduating valve leakage, if any, might possibly be observed while the distributing valve is being operated with light reductions from the automatic brake valve, but test No. 8 will show positively whether the equalizing valve is being forced to release position due to graduating valve leakage.

Testing the application piston packing leather consists of maintaining 45 lbs in the application cylinder which is shown by the gauge connected to the application chamber, and the closed stop cock in the supply pipe prevents main reservoir pressure from entering, and any leakage past the leather and ring will quickly build up a pressure in the small space between the application piston and the closed cock in the brake cylinder pipe, and the cylinder gauge connection being between the closed cock and the distributing valve will permit the gauge to register this leakage, if there is any.

One brake pipe is used for both racks, and by placing the cut-out-cock handles in the proper positions the distributing valve can be operated with the G 6 brake valve, or, by cutting out accordingly, the triple valve can be operated with the H 6 brake valve. This is of no particular advantage except to reduce the amount of piping required, but it will be observed that if the graduating valve of a distributing valve is leaking so badly that the equalizing valve is forced to release position after an application and return to lap position, the distributing valve will release when being operated with the G 6 brake valve when that valve handle is placed on lap position after an ordinary brake pipe reduction.

The time required to bolt the distributing valve to the reservoir and conduct the tests prescribed, and remove it is about 13 minutes, provided nothing is found wrong during the test, and inasmuch as the valve cannot be properly cleaned in less than 35 or 40 minutes it follows that a 13-minute test is of a comparatively short duration. The globe valves shown in the gauge pipes have no connection with the distributing valve test, they are for the purpose of "by-passing" air from one gauge pipe to another to show the effects of some of the disorders that neglect will produce.

It will simplify matters to state that, with this arrangement, either main reservoir pressure or brake pipe pressure can be admitted to the equalizing reservoir pipe, to the application cylinder pipe or to the brake cylinder pipe by opening the globe valves. They will show the effects of a leaky rotary valve in the independent brake valve, a leaky equalizing slide valve, a leaky application valve, or a leaky emergency valve in the quick action cap, and by admitting main reservoir pressure into the equalizing reservoir the effect of a leaky body gasket in the automatic brake valve is shown. Admitting brake pipe pressure to the equalizing reservoir will have the effect of a leaking equalizing discharge valve packing ring, and admitting both main reservoir and brake pipe pressures into the equalizing reservoir will have the effect of a leaky rotary valve in the automatic brake valve.

The rack could have been arranged to show a number of other effects, but it was not desired to complicate the piping arrangement, and as the rack is installed the effect of broken pipes can be shown, also causes of "brakes sticking," "brakes creeping on," "failing to apply," and "brakes releasing."

The causes and effects of a number of other disorders can be illustrated without any lengthy verbal explanations. As this is intended as a description of a distributing valve test rack, we do not at this time dwell upon the necessity of cleaning and testing distributing valves.

Origin of the Air Brake.

Mr. George Westinghouse, the retiring president of the American Society of Mechanical Engineers, in his farewell address, threw some interesting side lights on the origin of the air brake. He said:

"My first idea of braking apparatus to be applied to all of the cars of a train came to me in this way: a train upon which I was a passenger between Schenectady and Troy in 1866 was delayed a couple of hours due to a collision between two freight trains. The loss of time and the inconvenience arising from it suggested that if the engineers of those trains had had some means of applying brakes to all of the wheel of their trains, the accident in question might have been avoided and the time of my fellow-passengers and myself might have been saved."

The first step was the attempt to devise a brake connected by levers to the draw gear. This was found not to be a workable scheme and was abandoned. Later an inventor named Ambler already had perfected a chain brake which was operated by the revolving of a windlass in the engine, the chain thus being taken up and the brake levers of each car thus operated. To Mr. Westinghouse came the idea of exchanging the windlass for a cylinder beneath the locomotive, the piston of which should be of extraordinary length and connected with Mr. Ambler's chain so that the drawing in of the piston by the application of steam from the locomotive would give a more accurate control of the brakes than was possible with the windlass device. But experiments showed quickly that the piston could not be made long enough to operate the chain on more than four or five cars, and Mr. Westinghouse overcame this difficulty by placing a cylinder beneath each car with the flexible pipe connecting each one to the locomotive for its supply of steam. This effort failed because, even in warm weather, it was found impossible to transmit the steam.

"My next thought," said Mr. Westinghouse, "was the placing of a steam cylinder under each car with a pipe connection extending from the locomotive beneath its tender and under each car, with flexible connections of some sort, not then thought out, so that steam could be transmitted from the locomotive through the train pipe to all of the cylinders; but, as in the case of the attempt to improve the chain brake, it required but little time with some experimentation to disclose the fact that it would be impossible, even in warm weather, to successfully work the brakes upon a number of cars by means of steam transmitted from the locomotive boiler through pipes to brake cylinders.

"Shortly after I had reached this conclusion, I was induced by a couple of young women who came into my father's works, to subscribe for a monthly paper, and in a very early number, probably the first one I received, there was an account of the tunneling of Mount Cenis by machinery driven by compressed air conveyed through 3,000 ft. of pipes, the then depth of that tunnel. This account of the use of compressed air instantly indicated that brake apparatus of the kind contemplated for operation by steam could be operated by means of compressed air upon any length of train, and I thereupon began actively to develop drawings of apparatus suitable for the purpose, and in 1867 promptly filed a caveat in the United States Patent Office to protect the invention. In the meantime, I had removed from Schenectady to Pittsburgh, where I met Mr. Ralph Baggaley, who undertook to defray the cost of constructing the apparatus needed to make a demonstration.

"At that time no compressed air apparatus of importance had within my knowledge been put in operation. The apparatus needed for a demonstration was, however, laboriously constructed in a machine shop in Pittsburgh, being finally completed in the summer or early autumn of 1868. This apparatus consisted of an air pump, a main reservoir into which air was to be compressed for the locomotive equipment, and four or five cylinders such as were to be put under the cars, with the necessary piping, all so arranged that their operation as upon a train could be observed. Railway officials of the Pennsylvania and Panhandle railroads were then invited to inspect the apparatus and witness its operation. As a result, the superintendent of what was then known as the Panhandle Railroad, Mr. W. W. Card, offered to put the Steubenville accommodation train at my disposal to enable me to make a practical demonstration. The apparatus exhibited was removed from the shop and applied to this train, which consisted of a locomotive and four cars. Upon its first run after the apparatus was attached to the train, the engineer, Daniel Tate, on emerging from the tunnel near the Union Station in Pittsburgh, saw a horse and wagon standing upon the track. The instantaneous application of the air brakes prevented what might have been a serious accident, and the value of this invention was thus quickly proved and the air brake started upon a most useful and successful career.

"In 1885 the Master Car Builders appointed a committee to report upon the feasibility of the application of brakes to freight trains, and this committee inaugurated what are now known as the Burlington (Ia.) brake trials made in 1886 and 1887. There were presented two trains fitted with air brakes, one fitted with a vacuum brake and one with the brake operated by means of attachments to the drawbars similar to the conception first referred to. Each of these trains had fifty cars. These tests proved the inadequacy of the type of automatic air brake then presented by the Westinghouse Air Brake Company, as well as the inadequacy of all the other brakes then tested. It became apparent that the lack of success at Burlington was due to the comparatively slow application of the brakes upon the rear portion of the train, the effect of which was to cause most serious shocks almost like collisions. A new development was imperatively needed in order to insure the successful handling of freight trains of fifty cars.

"As a part of the automatic air brake passenger equipment, I had developed in the '70s a system of train signaling involving the use of a second train pipe, which is now in general use upon all of the railways. This signaling apparatus had a sensitive valve device connected to a small reservoir upon the locomotive and these were so arranged that when compressed air was admitted through a small opening into the signaling pipe, both the pipe and reservoir were charged to a low pressure (at the present time to 45 lbs.). By opening a valve at any point in the train to permit a small quantity of air to escape from the signal pipe, the delicate valve referred to was caused to move so as to admit air from its auxiliary reservoir to blow a whistle located in the cab of the locomotive. It was found upon experimentation that when the valve in any car remote from the engine was quickly opened and closed as many as five times, the whistle would be blown an equal number of times.

"No sooner had the quick action automatic brake been developed to operate successfully on trains of fifty cars than new conditions were presented. Steel freight cars carrying enormous loads had in the meantime been developed and freight locomotives had been increased in capacity, so that trains were often composed of seventy to eighty cars and more recently some trains have had as high as one hundred cars. This possibility had, however, been foreseen and experiments were constantly being carried on to so improve the apparatus, that it could be used to control trains of any practical length, and these experiments also had in view the more nearly instantaneous action of the brakes for ordinary service purposes than was possible with the automatic brake or with the quick action brake. The result was a most important development. The present improved triple valve has the emergency feature, but it also has what is known as the quick-service application feature, that is, for ordinary purposes the air is admitted to all of the brake cylinders so quickly that the longest freight train can be handled with almost the precision obtainable in the control of passenger trains of from six to twelve cars.

"I have spoken of four chief developments. It has been necessary, in order to avoid disastrous consequences, that each development should be of such a kind that cars fitted with newer apparatus could operate with little inconvenience with cars fitted with earlier apparatus. As it stands today, scarcely any of the old type of brakes and the first type of automatic brake are in use, but should a car fitted with the first form of automatic brake be found and put into a train with the more modern apparatus, such older apparatus would be found to operate fairly well with the more perfect form. The prevailing idea in the development and introduction of the brake has, therefore, been an adherence to such uniformity of apparatus that the interchange of traffic over various roads could go on uninterruptedly. In my estimation, there could be no better illustration of the valve of the maintenance of standards than has been given by the manufacture and introduction of air brakes upon railways.

"My story would be incomplete without a reference to the splendid assistance which the railways of this and many other countries have rendered. They have been lavish in providing those facilities for making the thousands of tests which were necessary to progress in the developments I have recited; to the Pennsylvania Railroad especially, upon which the more important experiments were first made, the other railways of the country, as well as the traveling public, owe a debt of gratitude. When a railway (as did the Southern Pacific two years ago) provides a new train of one hundred steel cars to be fitted with the newer form of automatic brake, in order to carry on, with a staff of skilled men under the direction of the chief officers of the company, a series of experiments upon its heaviest gradients, requiring several weeks, for the purpose of securing greater safety and an increased carrying capacity per train, with the consequent lessening of the cost of transportation, it is just that the managers of such a corporation should receive credit for their far-sighted policy. To name the railways and to merely state chronologically the tests of brakes which have been made during forty years would require several volumes."

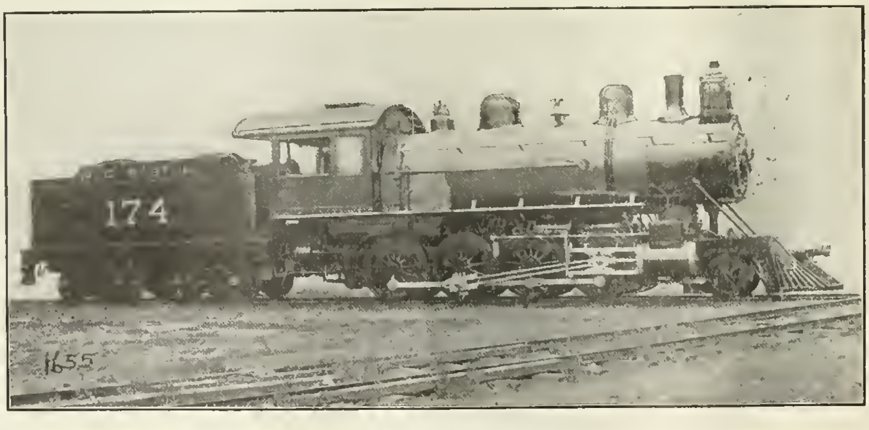
2-8-0 For the N. C. & St. L.

Some time ago we received a letter from a correspondent in High Point, Texas, Mr. C. Howard, asking us if we would reproduce a consolidation engine which had been built for the Nashville, Chattanooga & St. Louis some time after he left that road. We have at length located the engines and herewith reproduce a photograph of No. 174, which is one of them. The engines were built at the Baldwin Locomotive Works.

There is nothing particularly remarkable about the construction of these 2-8-0 machines, but they are substantial and well proportioned. The cylinders are 21 x 28 ins., the driving wheels are 55⅝ ins. The second driver is without flanges and it and the leading driver and pony truck are equalized together. The two rear drivers are also equalized together. With a boiler pressure of 200 lbs. to the square inch the tractive effort of these engines would be, according to the Master Mechanics' formula, about 37,820 lbs.

The boiler of this engine is straight-topped and the first course measures 68 ins. in diameter. The back sheet and the throat sheet slope forward. The tubes are 247 in number, 2¼ ins. in diameter and 14 ft. 6 ins. in length. These give a heating surface of 2097 sq. ft., and this, added to the firebox heating surface, which is 168 sq. ft., make a total of 2,265 sq. ft. The firebox itself is 101⅞ ins. long and 65⅝ ins. wide.

The driving-wheel base is 15 ft. 4 ins., the total of the engine is 23 ft. 8 ins. The weight on the driver is 140,730 lbs., and the total weight of the engine is 140,730 lbs. The tank has a capacity of 5,000 gallons.



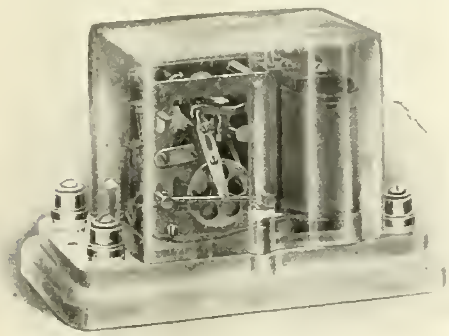
2-8-0 FOR THE NASHVILLE, CHATTANOOGA & ST. LOUIS.

Air Brake Car.

The Lehigh Valley have an air brake instruction car on the road. It goes over the road, stopping at every point where it is convenient for the employes to gather. The moving school keeps the men always fresh on this important subject of railroad operation. It is a matter of importance to passengers, to shippers and to the company that the air brake equipment shall be operated skillfully. If the employes have the brakes in good order before a train starts, and know how to test and keep them in good order on the road, the motion of trains is smooth and their progress rapid. The instruction car is fitted out with all the latest air brake equipment, both for cars and locomotives. A general bulletin conveys to the employes information as to the time of the car's arrival at points along the line. If this does not result in an attendance sufficiently large, special notifications are sent out.

Railroad Train Dispatching by Telephone.

Possibly it may have occurred to some persons who listened to Mr. George Westinghouse's description before the American Society of Mechanical Engineers of his discovery and perfecting of the air brake, that its most remarkable feature was the prompt use of suggestions brought about by familiarity with other lines of mechanical effort and the manner in which the needs of the rail-



THE GILL SELECTOR.

roads were anticipated and met by the development of improved apparatus. A similar development in a parallel line of railroad service has been in progress for something more than twenty years, and, although the prime investigator and inventor is making no public addresses, a representative of Railway and Locomotive Engineering has been able to acquire information regarding the application of selective calling to railway service, and in particular the use of the selector telephone system in train dispatching, with the intention of presenting to its readers a comprehensive statement of the present status of the art and an indication of the high development of the apparatus now available for this service.

The very evident need of an efficient selective calling device was early apparent and engaged the attention of many inventors. As in the early days of the telegraph it was a pretty poor operator who had not designed a repeater or other telegraphic device, so numerous apparatus aimed to accomplish selective calling was brought out. Few of these earlier devices survived, owing to the fact that they were either too complex or fundamentally wrong in construction or method of working, and therefore increased the cost of operation and maintenance and affected adversely the service in general. During the early eighties Mr. Edwin R. Gill started the development of a selective calling system with particular reference to the telegraph and the telephone. The growth of the telephone industry was for a time concentrated in cities, and its development aimed at the reduction of length of lines and the number of stations per line to a minimum, so that there was a lessened demand for selective calling in telephone service. Before 1890, however, several hundred of Mr. Gill's selectors were installed on the telegraph lines of various railroads where, in many cases, they are still giving service. It was not, however, until the application of the telephone to train dispatching was taken up in earnest by the railroads that selective calling came into its fullest use.

There are a number of patterns of selectors on the market, but it is intended to describe the mechanism which has been adopted as standard equipment by such roads as the Lackawanna, a line one hundred per cent. equipped for train dispatching, the Lehigh Valley, the Virginian, the New York Central, the Erie, the Chicago and Northwestern, the Great Northern, the Norfolk and Western, the Southern Pacific and many others. This is the apparatus invented and developed by Mr. Gill and made by the United States Electric Company of New York.

The essentials of a successful selector are that it must be reliable and constant in operation, free from disturbance by dust or moisture, have but one contact, must operate without the use of intermediate relays, be economical in current consumption, have a wide range of operation both as to current and speed, and must give an answer-back signal, showing that the bell or signal at the station called is being operated.

The general manager, the telegraph superintendent, the signal engineer and the user of the selector have passed in the last five years from incredulity and indifference to a willingness to study the details which make for simplicity, reliability and economy in operation. Developed, as previously stated, as an adjunct of the telegraph, the selector did not come into its enlarged field until it was combined with the telephone. Singularly also this was not due to the telephone interests, as owing to the neglect of rural telephone extension, selective signaling was regarded as of constantly diminishing importance by the telephone companies. Telephone train dispatching, which is the equivalent of rural telephone service on a greatly enlarged scale, brought selective calling to its present importance, and it is worthy of note that this demand from the railway companies came so suddenly that when a reliable selector system was required to meet their emergencies, even the largest manufacturers of telephone equipment were unable to supply their demands.

A Gill selector is an instrument about the size of a telegraph relay. It is operated by sending over the line a pre-determined combination of impulses of current, properly spaced between each group of impulses. Its essential features are a combination wheel and a time wheel suitably governed by a magnet, levers, and detents. In the illustration the time wheel is shown at the top of its inclined track. The combination wheel is on the further side of the instrument next the frame, and is not shown in this view. The operation of the selector is analogous to that of a combination lock. By ingenious governing of the relations of a pawl and the teeth on the combination wheel, innumerable variants may be made, and as a combination lock can be opened only with its own key, so the Gill selector can be operated only by impulses of the prearranged number and sequence. All combination wheels in other selectors on the line fail to reach the contact position, for the reason that lacking the correct sequence of impulses and intervals, the combination wheel has been returned to its original position. Thus, though the calling current energizes every selector in the circuit, it actuates to an operative contact only the instrument at the station desired to be called. In construction the selector has been reduced to the fewest possible number of parts. Working parts which would be affected adversely by the electric current are made of non-magnetic materials. The selector is mounted on a porcelain

AUTOMATIC CALLING KEY.

base, to which its glass cover is hermetically sealed. The makers are so confident that it will render satisfactory service that they will replace at any time instruments out of order, if the seal is not broken. The selector needs no adjustment; it may be installed by the ordinary lineman and needs only to be let alone to do its work properly.

As originally designed for telegraph

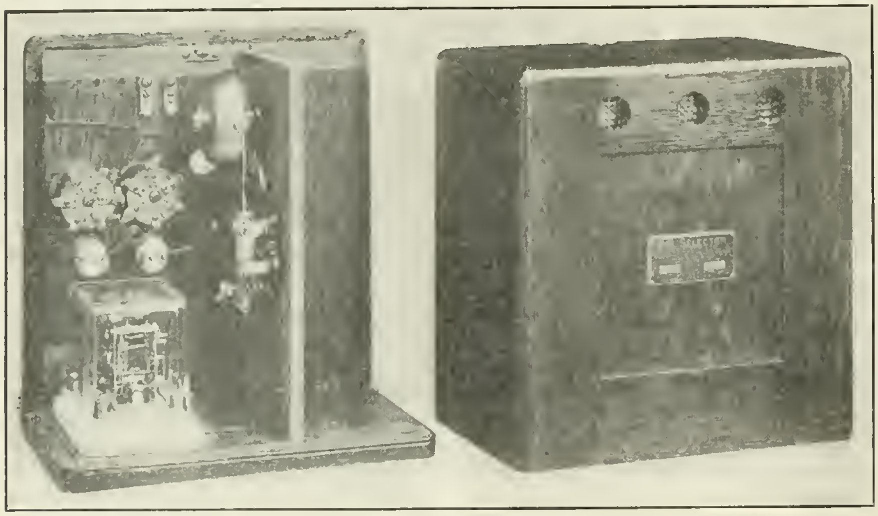
service, stations were called through the selector by number with the Morse key. This method may be used where it is desired to use the line for both telephone and telegraph service. In fact selective calling on a telegraph line presents to a designer a problem more formidable than the corresponding service on a telephone line.

With the telephone, the selecting current is usually of a different character from the voice current and is sent over the line with an apparatus different from that used to transmit speech.

The physical differences in the two systems are the use of two copper wires for the telephone system in place of one iron wire and selective calling apparatus in place of the telegraph key. The operating differences are that orders are transmitted by speech instead of by Morse code, and stations are called selectively and distinctly in lieu of the telegraph signal. The orders are issued by the dispatchers, orally, word by word, in some cases words and figures being spelled letter by letter to insure accuracy. The dispatcher writes the order in his book as he dictates it to the operators, thus regulating his speed to such a rate as to enable the order to be readily copied by the receiving operators. The same form of order is used as heretofore and operators receiving the orders repeat them back to the dispatcher for checking as heretofore, save that this is done by telephone.

The sending of the proper calling combination from the dispatcher's office is accomplished by an individual calling key consisting of a simple train of gears somewhat similar in operation to the familiar district messages call box. One such calling key is provided at the dispatcher's office for every station on the line. The key cabinet shown in the illustration has forty keys. Each station's number is shown on the disk back of the key, and the station's name is inserted in the designation strip just above the keys. By giving a quarter turn to the small handle corresponding to the station desired, the bell or signal at that station may be operated in a few seconds without any of the others being affected. Furthermore, this may be done while a telephone conversation is being carried on without interfering with the telephone service.

An essential feature of the system under description is that each station as called by the selector gives an automatic answer-back, and this is arranged to operate whether the service is by telegraph or telephone. This gives the official making the call positive assurance that the call has been received at the desired station, the distinctive combination of that station being repeated to the dispatcher. The moral effect of this check upon the dilatory answer of calls needs no argument. Where block signals are arranged to be controlled by selectors, the answer-back is received only when the signal has reached the desired position and the code answer-back then is individual to the particular signal which has been set.



MAIN LINE BATTERY BELL, SELECTOR, ETC., STATION OUTFIT.

The selector bell call may be operated in two ways; by a local battery of dry cells or by the main line signaling battery. Some roads prefer the local battery at the station, claiming that a louder and more insistent signal is given. Probably the larger number of users, however, favor the main line battery for ringing the bell. By its use the possibility of the local battery giving out under the load is eliminated, and as the battery is at the dispatcher's office, it is easy to supervise it and keep it up to normal. The bell may be rung with less current than is required to step around the selector to the contact position. Our illustration shows a station equipment arranged for ringing the bell with the main line battery. The selector is here shown in end view, the time wheel being on the right. The numbered coils are resistance coils, arranged for variations of from 0 to 30,000 ohms. The resistance connections are so proportioned that the difference in potential across the line is such that the flow of current in each selector magnet will be approximately the same. Telephone train dispatching equipments of this kind are working satisfactorily on lines of 257 miles in length, with 51 stations connected.

A Fish that Shoots Flies.

We are reminded by tales sent to us by a Queensland correspondent of a Scotch sailor's yarns to his mother. He had returned from a long voyage, and had many wonderful yarns for his old mother's ears. Among other things he told her that when they were pulling up their anchor in the Red Sea it brought with it a wheel of Pharaoh's chariot. He also told about the flying fishes he had seen in the tropics. Then she remarked:

"Yer tellin' me lees noo, Jamie. I can well believe that yer anchor pulled up a wheel of Pharaoh's chariot, for we read aboot the chariots in the Bible, but when you tell aboot flying fishes ye maun be leein' tae yer auld mither. Flyin' fishes wad be agan nature." Our correspondent writes:

"In Queensland some of the most interesting forms of animal life are to be found. The duckbilled platypus (with the web feet of a duck, which lays eggs and suckles young), the lung fish, the walking perch and many other queer creatures might be mentioned in confirmation of this. A remarkable little fish is the rifle fish, which lives in the far northern rivers of Queensland. A full-grown specimen (writes a correspondent) measures about ten inches in length and averages one and one-half pounds in weight. The rifle fish derives its name from the fact that it shoots its food. It swims leisurely about the stream, a few inches below the surface, and is always on the lookout for flies and other insects that settle on the floating leaves and twigs or on the surface of water plants. On getting close enough to its victim it discharges a tiny jet or ball of water, which, if shot straight, knocks the fly into the stream, where it is instantly gathered in by the shooter."

Erie Station Renamed.

An official circular announces that the Erie Railroad station known as Susquehanna Connecting Railroad Junction, Pa., will soon be changed to Suscon, Pa. This name is made up of the initial syllables of Susquehanna and of connecting.

The British museum contains books written on oyster shells, bricks, tiles bones, ivory, lead, iron, sheepskin and palm leaves.

4-4-0 Engine for the Western Railroad of Havana

The American Locomotive Company some time ago completed two eight-wheel passenger locomotives for the Western Railway of Havana, one of which is shown in our illustration. The chief feature of interest in connection with these engines lies in the fact that they are equipped with the builders' latest design of fire tube superheater, with side headers and are the first superheater engines to be built for this road. The superheater is of the same type as that applied to a consolidation locomotive built for the Wabash-Pittsburgh Terminal Railway by the same company and is arranged to give a moderate degree of superheat. This engine was described and illustrated in our June 1909 issue, page 244.

Briefly, this design of superheater consists of two steam headers placed one on either side of the smokebox and secured to a box casting bolted to the side of the smokebox. A curved pipe connects the saturated steam compartment of the header with the tee-head, while the superheated steam compartment is connected directly to the steam passages in the cylinders by a pipe cast integral with the header, thus reducing the number of joints. There are twelve large boiler header. A gland connects the ends of the two pipes in each superheater unit and they are secured to their seats by means of a single bolt which passes through the header and box casting with the unit on the back end. These bolts are thus protected from corrosion by the hot flue gases; and covered openings are provided in the side of the smokebox to give access to them from the outside. There is a damper for controlling the passage of the gases through the 5¼-in. tubes and around the superheating pipes. This damper is automatically operated by a steam cylinder which has a pipe connection to the steam chest. When the throttle is open the pressure in the steam chest opens the damper which is closed again by a counterweight as soon as the throttle is closed. On account of the use of superheated steam the engine carries a low boiler pressure of 165 lbs.

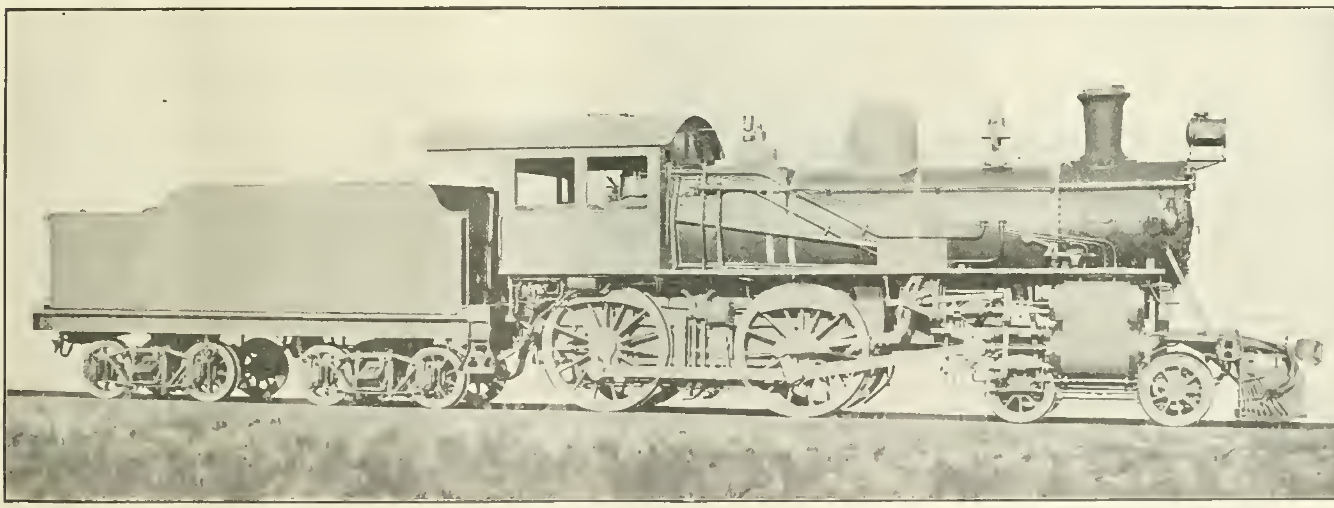
The cylinders are 18½ x 24 ins. and the superheated steam is distributed to the cylinders by means of piston valves having inside admission and operated by a simple arrangement of Walschaerts valve gear. Reversing is effected by means of a screw and hand crank. The boiler is of the straight-top type with Bel- placed between the frames, it is 75½ ins. long and 34 ins. wide and provides a grate area of 17.8 sq. ft. The inside firebox is of copper, with the exception of the firebox tube sheet which is of steel. All the staybolts in the side and back are of bronze, while those in the throat are of wrought iron as are also the crown stays.

A departure from American locomotive practice will be noticed in the design and location of the sand box. This is placed just ahead of the front driving wheels, underneath the boiler and is supported on the frames.

The tender is provided with a tank having a water capacity of 4,000 gallons and space for 6½ tons of coal. The tender frame is of steel, the center and side sills being constructed of 10-in. channels. The trucks are of the 4-wheel arch-bar type.

Some of the principal dimensions, weights and ratios of the design are as follows:

Weight on drivers ÷ tractive effort, or factor of adhesion	4.06
Tractive effort × diam. drivers ÷ heating surface	1,079.00
Total heating surface ÷ grate area	60.1
Firebox heating surface ÷ total heating surface, per cent	12.32
Weight on drivers ÷ total heating surface	64.4
Volume both cylinders, cu. ft.	7.46
Tractive power, 17,000 lbs.	



W. J. Griggs, Locomotive Superintendent. 4-4-0 FOR THE WESTERN RAILWAY OF HAVANA. American Locomotive Co., Builders.

tubes 5¼ ins. in diameter outside, each of which contains four seamless steel superheating tubes 1½ ins. in diameter. The superheater tubes are arranged in pairs, the two tubes in each pair being connected at the back ends by cast steel return bends. The ends of the superheater tubes are bent around horizontally to meet the steam headers. This arrangement allows complete freedom for the expansion and contraction of the superheater tubes due to variations in temperature and thus serves to prevent the leaking of the joints. The ends of the superheater pipes are upset and machined to form a ball which is ground into its seat in the paire firebox, and the barrel measures 55 ins. in diameter inside at the first course. It contains 135 tubes 2 ins. in diameter and 10 ft. 10½ ins. long, and, as before stated, 12 tubes 5¼ ins. in diameter and the same length which contain the superheater tubes. The total heating surface of the boiler is 1,071 sq. ft., of which the tubes contribute 939 sq. ft., and the remainder, or 12.3 per cent. of the total is provided by the firebox. The superheater has a heating surface of 158 sq. ft., which is 16.8 per cent. of the tube heating surface. The superheater tubes extend to within about 32 ins. of the firebox tube sheet. The firebox is narrow and is

Wheel Base—Driving, 8 ft. 6 ins., total 23 ft.; total, engine and tender, 47 ft. 10 ins.

Weight—In working order, 114,500 lbs.; on drivers, 69,000 lbs.; in working order, engine and tender, 208,100 lbs.

Grate area, 17.8 sq. ft.

Axles—Driving journals, 7½ x 8½; engine truck journals, diameter, 5½ ins.; length, 12 ins.

Boiler—Type, straight top; O. D. first ring, 56 ins; working pressure, 165 lbs.; fuel.

Firebox—Length, 75½ ins.; width, 34 ins.; thickness of crown, ½ in.; tube, ½ in.; sides, ½ in.; back, ½ in.; water space, front, 4; sides, 3; back, 3; crown staying, radial.

Engine Truck—Four-wheel swing suspension; piston rod, diameter, 3 ins.; smokestack, diameter, 14 ins.; top above rail, 13 ft. 7 ins.

Tender—Frame, 10-in. steel channels; tank, style, square-sloping, with well bottom.

Valves—Type, piston; travel, 5½ ins.; steam lap, ⅞ ins.; ex-clearance, ⅛ in.; setting, 3/16 ins.; lead constant.

Wheels—Driving, diameter, outside tire, 68 ins.

Carnegie Entertains Train Men.

One day last month our Chief was invited by Mr. Andrew Carnegie to help at a reception, which was very correctly described by a reporter of the New York *Times* thusly:

"A score of men who were fellow-workers with Andrew Carnegie when he was in the employ of the Pennsylvania Railroad met at the Carnegie mansion on Fifth avenue, New York, and were entertained by the Laird of Skibo and Mrs. Carnegie. They were old employees of the Pennsylvania Railroad who had come to the city at the company's invitation to inspect the new Pennsylvania station. Among them were the oldest living railroad conductor and engineer. All of them worked with Andrew Carnegie when he was getting his start in life, and were young men when, at the age of 22, he was made superintendent of the Pittsburgh Division of the Pennsylvania at a salary of $125 a month. When he heard they were to be in the city he invited them to visit him at his home.

"When the men arrived at the Carnegie home, shortly after 5 o'clock, Mr. Carnegie received them as they filed in at the door. Conductor William R. Whery, still on the active list with forty-eight years' service to his credit, was the first, and assisted in recalling the names of the white-haired men to the retired steel king. But Mr. Carnegie would not hear a name until he had searched his memory for a clue to the identity of each of his callers. Most of them he knew at sight.

"There was much handshaking, many delighted exclamations as a familiar face came to sight. Flashes of reminiscence from the men, no sooner begun than interrupted by others from different directions, were received by Mr. Carnegie with eager attention, and it was plain that he was enjoying himself. Some of them he did not recognize immediately.

"'Don't tell me the name,' he would say. 'Wait a minute.'

"Somebody, after a pause, would start to tell him, but the others would not have it. And generally by the time he had finished shaking hands he had recalled the person together with some incident of past service.

"'These are my boys,' he explained to two other guests, R. A. Franks and Angus Sinclair, who had been there before the men arrived. 'They used to work for me about fifty years ago.'

"'Now here's Bill Hawkins,' he went on. 'Bill, you must be the oldest passenger conductor living, arent you?'

"'I guess I am,' answered Mr. Hawkins.

"'But not in service,' said Conductor Whery. 'I've been going forty-eight years, and I've got a year and nine months to run yet.'

"'They ought to give you a double pension when you retire,' said Mr. Carnegie.

"'Now let's see, who's this?' he asked, as another man appeared. They told him it was Bob Gordon.

"'What?' he exclaimed. 'Why, there's something wrong about your looks. I know. You've shaved your whiskers off.'

"'Yes,' said the old man, with a grin. 'I used to wear 'em down to here'—indicating a point pretty near the waist line.

"'And here's Fred Fleck. Why, they told me you had died. Now here's a man I want you to know,' he said, turning to his other guests. 'He's the oldest railroad engineer living.'

"Then the reminiscences began. Then Mr. Blain McCormick, a former yardmaster, showed Mr. Carnegie an old railroad pass to New York dated in 1863 and signed 'A. Carnegie, Division Superintendent.' The steel king smiled and then told them of getting only a few weeks ago some old pay sheets, on one of which he was down as a clerk for a salary of $35 a month, and on the other as division superintendent at $125.

"'They gave me that job when I was entirely too young,' he said. 'No man can run a division at the age of 22. Why, I used to think that I had to do all the work myself. It taught me a lesson when an old foreman came to me after a week of bad wrecks and said, "Mr. Carnegie, that crew can't do any more work. You've tired them all out." After that I began to let other people do most of the work.'

"Mr. Carnegie was a little puzzled when the two men, who were plainly not of the age the rest were, appeared to shake hands.

"'Where have I seen you before?' he asked.

"'We are Conductors Emery and Tarner,' one of them answered, 'and we visited you two years ago at Skibo Castle.'

"Mr. Carnegie let out what almost amounted to a whoop of joy as he shook hands.

"'Gentlemen,' he said, 'I was delighted with these men. They came to my place, and I think we had three or four dukes or barons there. They made a fine showing, for these, I told the Englishmen, were ordinary American railway men. They were astonished, for they said if they had brought English train men amid the same surroundings they would have been very much out of place and ill at ease.'

"William McKelvey, the present roundhouse foreman at Altoona, showed Mr. Carnegie an old train order that he had given him, signed with the familiar initials. Then he recalled how he had been in charge of an engine which had been wrecked and had torn up considerable track while Mr. Carnegie was on a fishing trip at a near-by trout stream.

"That recalled to the host an adventure of his own when he had been near death. He told it to the men, and said it was not generally known.

"'In the winter of '56,' he began, 'when I was assistant to Thomas Scott, then division superintendent, we had a great deal of trouble getting trains over the mountain divisions. The Van Amberg Circus had a train which we wanted to get across, and Scott and I climbed into the cab of the first engine of a double-header to see it through. We went through a blinding snowstorm, and finally could not see a thing on account of the driving snow into which we were heading. We had been going along this way when suddenly we looked back and saw by the flare from the fire under the boiler that our engine had come uncoupled from the other. Here we were ploughing through snow on the track with difficulty, while behind us a whole train was coming along on a track which we had cleared. Of course there was nothing to do but jump. And we did. Scott landed in the snow, which came up to his shoulders. But I disappeared from view completely. Fortunately, they had heard our whistle from behind and they stopped the train. We looked for our fireman, who had also jumped, but we couldn't find him. Finally Scott said we couldn't wait, and the poor fellow was left in the snow all night.'

"The party was made up of R. B. Hawkins, retired passenger conductor; Robert Gordon, retired freight conductor; Thomas E. Watt, retired district passenger agent; Blain McCormick, retired yardmaster; H. L. Delo, retired chief clerk, motive power department; William Burbank, retired engineer; William Brady, retired engineer; Frederick Fleck, retired engineer; Christ Horner, retired engineer; Wilson Ringle, retired engineer; Bernard Nearney, retired freight conductor; Frank Adams, retired engineer; William McKelvey, roundhouse foreman at East Altoona; Frederick Ehrenfeld, supervisor at Greensburg; Nathan Henry, passenger engineer; William R. Whery, passenger conductor; S. R. Tarner, passenger conductor, and George A. Emery, passenger conductor."

Union Station for Memphis.

Before the end of the present year Memphis expects to see the completion of a union passenger terminal to be built by five of the roads centering there. It is to cost $600,000. Whether the Rock Island and Frisco will participate has not been decided.

A man is born for action. Work, at every step, awakens a sleeping force and roots out error. Who does nothing, knows nothing.—*Aloysius.*

Items of Personal Interest

Mr. M. B. Dube has been appointed locomotive foreman of the Grand Trunk Pacific Railway, with office at Graham, Ont.

Mr. J. R. Morton has been appointed acting locomotive foreman of the Grand Trunk Pacific Railway, with office at Redditt, Ont.

Mr. H. A. Southworth, division foreman at Waterville, on the Maine Central, has been appointed master mechanic, with office at Portland, Me.

Mr. R. L. Morton has been appointed general foreman at the Coxton Yards of the Lehigh Valley Railroad, vice Mr. P. N. Forbes, resigned.

Mr. W. North has been appointed foreman blacksmith of the Canadian Pacific Railway at Revelstoke shops, vice Mr. J. Ryecroft, transferred.

Mr. R. H. Aishton, general manager of the Chicago & North Western, has been elected vice-president of that road, vice Mr. W. A. Gardner, promoted.

Mr. George S. Hunter has been appointed assistant master mechanic of the Missouri Pacific Iron Mountain system, with office at Jefferson City, Mo.

Mr. E. J. Snell has been appointed master mechanic on the Pennsylvania division of the New York Central & Hudson River, with office at Corning, N. Y.

Mr. Rudolph Ellzey has been appointed master mechanic of the Kentwood & Eastern, with office at Kentwood, La., vice Mr. John May, retired.

Mr. W. A. Gardner, vice-president of the Chicago & North Western, has been elected president of that road, vice Mr. Marvin Hewitt, elected chairman of the board.

Mr. F. T. Slayton has been appointed superintendent of motive power of the Virginian Railway, with office at Princeton, W. Va., vice Mr. L. B. Rhodes, resigned.

Mr. Ernest Becker has been appointed master mechanic on the Chicago & North-Western, with office at Green Bay, Wis., vice Mr. F. W. Peterson, promoted.

Mr. H. C. Oviatt, master mechanic of the Western division of the New York, New Haven & Hartford at Waterbury, Conn., succeeds Mr. Richards as general inspector.

Mr. J. Ness has been appointed car foreman of the Grand Trunk Pacific Railway, with office at Portage la Prairie, Man., vice Mr. A. Possnett, transferred.

Mr. Alfred E. Calkins has been appointed assistant to the superintendent of rolling stock of the New York Central & Hudson River, with office at New York.

Mr. A. Possnett, heretofore car foreman at Portage la Prairie, Man., on the Grand Trunk Pacific Railway, has been appointed car foreman at Springfield, Winnipeg, Man.

Mr. A. R. Manderson, master mechanic of the Maine Central at Portland, Me., has been appointed assistant superintendent of motive power, with offices at Portland, Me.

Mr. H. F. Lowther, formerly chief clerk to the purchasing agent of the D., L. & W. Railway, was recently appointed assistant purchasing agent of that road. Mr. Lowther is a young man and this promotion is a well deserved recognition of the faithful and intelligent service which he has rendered to the railroad company with which he is connected.

H. F. LOWTHER.

Mr. Marvin Hewitt, president of the Chicago & North Western Railway since 1889, recently resigned the presidency to accept the position of chairman of the board of directors.

Mr. D. D. Robertson, master mechanic at Wilkes-Barre, Pa., on the Lehigh Valley, has been transferred to Buffalo, N. Y., in the same capacity, vice Mr. Willard Kells, promoted.

Mr. C. R. Dobson has been appointed general foreman of the car department of the Rock Island Lines, with office at Cedar Rapids, Iowa, vice Mr. C. Setzekorn, resigned.

Mr. George F. Wilder has been appointed purchasing agent of the Chicago, Milwaukee & Puget Sound, with office at Seattle, Wash., succeeding Mr. D. F. Buckingham.

Mr. John A. Dent, recently with the oil pipe line service of the New York Transit Company, has been appointed Instructor in Mechanical Engineering at the University of Illinois.

Mr. W. G. Burroughs, master mechanic on the Lehigh Valley at Weatherly, Pa., has been transferred to Wilkes-Barre in the same capacity, vice Mr. D. D. Robertson, transferred.

Mr. Silas Zwight, master mechanic of the St. Paul division of the Northern Pacific at Minneapolis, Minn., has been appointed master mechanic of the Idaho division, vice Mr. Cutler, transferred.

Mr. J. G. Bower is appointed assistant manager of sales, Western District, Pressed Steel Car Company and Western Steel Car & Foundry Company, with office at Old Colony Building, Chicago, Ill.

Mr. E. B. Gilbert, formerly mechanical engineer of the Louisville & Nashville, has been appointed special agent of motive power of the same road with headquarters at Greenville, Pa.

Mr. S. R. Richards, general inspector of the New York, New Haven & Hartford, at New Haven, Conn., has been appointed superintendent of shops at New Haven, vice Mr. George Donahue, resigned.

Mr. G. H. Watkins has been appointed assistant master mechanic on the Pennsylvania Railroad at Meadows, N. J., on the New Jersey division, vice Mr. Edwin Schenck, Jr., promoted.

Mr. John Leisenring, signal engineer of the Hudson & Manhattan at New York, has been appointed to the new position of signal engineer of the Illinois Traction System, with office at Peoria, Ill.

Mr. G. H. Watkins has been appointed assistant matser mechanic on the Pennsylvania Railroad (New Jersey Division), with headquarters at Meadows, N. J., vice Mr. E. Schenck, Jr., promoted.

Mr. F. W. Peterson, formerly master mechanic of the Chicago & North-Western at Green Bay, Wis., has been appointed master mechanic of the Wisconsin division of that road, with office at Chicago, Ill.

Mr. George H. Eck has been appointed master mechanic of the Hudson River division of the New York Central & Hudson River, with office at

New Durham, N. J., vice Mr. C. E. Keenan resigned.

Mr. G. M. Gray, mechanical engineer of the Bessemer & Lake Erie at Greenville, Pa., has been appointed superintendent of motive power, with office at Greenville, vice Mr. E. B. Gilbert, promoted.

Mr. H. B. Dirks, formerly Instructor in Mechanical Engineering at the University of Illinois, has resigned to accept a position as assistant to the general manager of the National Machinery Company, Chicago, Ill.

Mr. A. Bell, heretofore locomotive foreman of the Grand Trunk Pacific Railway, at Edmonton, Alta., has been appointed locomotive foreman at Wainwright, Alta., vice Mr. W. W. Yeager, transferred.

Mr. J. D. Muir, heretofore acting locomotive foreman of the Canadian Pacific Railway, at Red Deer, Alta., has been appointed locomotive foreman there, vice Mr. J. G. Norguay, assigned to other duties.

Mr. Willard Kells, heretofore master mechanic at Buffalo on the Lehigh Valley Railroad, has been appointed assistant superintendent of motive power on the Atlantic Coast Line Railway, with headquarters at Wilmington, Del.

Mr. A. R. Fugina, formerly assistant signal engineer of the Chicago & North-Western, has been appointed signal engineer of the Louisville & Nashville, with office at Louisville, Ky., vice Mr. C. J. Cannon, resigned.

Mr. T. J. Cutler, master mechanic on the Rocky Mountain division of the Northern Pacific at Missoula, Mont., has been appointed master mechanic on the Idaho division, with office at Spokane, Wash., vice Mr. F. B. Childs, deceased.

Mr. E. S. Elden, formerly engine house foreman on the Central New England Railway at Maybrook, Conn., has been appointed master mechanic of the same road with headquarters at Hartford, Conn., vice Mr. C. J. Stewart, resigned.

Mr. John Pickley, formerly general road foreman of engineers on the Lehigh Valley Railroad, has been appointed train master on the same road, with headquarters at Sayre, Pa. The position of general road foreman of engineers has been abolished.

Mr. M. P. Cheney, road foreman of the engines on the Atchison, Topeka & Santa Fe Coast Lines. at San Francisco, Cal., has been appointed master mechanic of the Arizona division, with office at Needles, Cal., vice Mr. L. A. Mattimore, transferred.

Mr. J. F. Farrell, purchasing agent of the Michigan Central, the Detroit & Clarlevoix and the Toledo Terminal, at Detroit, Mich, has been appointed general tie agent of the Michigan Central and other New York Central Lines west of Buffalo, with office at Detroit, vice Mr. W. F. Goltra, resigned.

Mr. H. McCormick, heretofore general foreman of the Grand Trunk Pacific Railway, at Fort William, Ont., has been appointed roadmaster between Fort William and Pelican, including Fort William and Graham Terminals, with office at West Fort William, Ont., Canada.

Mr. H. C. May, master mechanic of the Louisville & Nashville at South Louisville., has been appointed superintendent of motive power of the Chicago, Indianapolis & Louisville, with office at Lafayette, Ind., vice Mr. O. S. Jackson, promoted.

Mr. C. J. Stewart, formerly master mechanic on the Central New England Railway, has been appointed master mechanic on the New York, New Haven & Hartford, with headquarters at Waterbury, Conn. Our previous notice of Mr. Stewart's appointment read N. Y. C. instead of the New Haven road.

Mr. J. T. McGrath, master mechanic in the locomotive shops of the Grand Trunk Railway at Battle Creek, Mich., has been appointed superintendent of rolling stock, in charge of the Bloomington locomotive and car shops and terminals, of the Chicago & Alton, with office at Bloomington, Ill., vice Mr. Peter Maher, superintendent of motive power and equipment, resigned.

Mr. A. Dinan, who was recently appointed mechanical superintendent of the Southern district of the Atchison, Topeka & Santa Fe, with office at Amarillo, Texas, has also been appointed mechanical superintendent of the Southern Kansas Railway of Texas, the Pecos & Northern Texas and the Eastern Railway of New Mexico.

Mr. Thomas F. Meek has been appointed by the Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, as their representative for southern Michigan, with office at 415 Moffat Building, Detroit. Mr. Meek was secretary and manager of sales for the Detroit Steel Casting Co. for twenty years. He has a wide circle of friends and his genial disposition and excellent reputation should make him exceedingly popular and successful in his new line of work.

At the recent annual meeting of the American Society of Mechanical Engineers Mr. George Westinghouse, in a farewell address as president, told the members how he came to invent the air brake. Extracts from this interesting address are printed on another page of this issue. Engineers of prominence gathered from every part of the United States to hear Mr. Westinghouse. As retiring president of the society, a vote of thanks was extended him by the members. Col. E. D. Meier, of New York, was chosen head of the organization for the ensuing year.

Obituary.

It is with great regret that we have to announce the death of Thos. F. Downing, the secretary and treasurer of the Chicago Car Heating Company since its organization in 1903. Mr. Downing died suddenly of hemorrhage of the brain, brought on as a result of injuries received in a street car accident last June. He was only thirty years of age, and had been associated with the president of the company in a business capacity since leaving high school at the age of fifteen years.

H. C. Short, General Traveling Auditor of the Santa Fe Railroad, connected with this line for over thirty years, passed away late in November, at his home in Topeka, Kan., after an illness of two months. Mr. Short was in railroad work fifty years, during which time he held many positions of trust and responsibility. He was most highly esteemed by a very wide circle of friends, who learn of his death with the keenest regret.

Frederick G. Ely died at the Hotel Marie Antoinette, New York, last month. He was born in Watertown, N. Y., August 2, 1838, and has been identified with the railway supply business for many years, more recently with the Schoen Pressed Steel Car Company, and upon its absorption by the Pressed Steel Car Company he became a director and has been one from that time until his death. Mr. Ely was a brother of Mr. T. N. Ely, Chief of Motive Power, Pennsylvania Railroad.

New Commerce Court.

The personnel of the newly created commerce court is as follows: Mr. Martin A. Knapp, of New York, the present chairman of the Interstate Commerce Commission, to be chief justice and to serve for five years; United States District Judge Robert W. Archbald, of the middle district of Pennsylvania, to serve four years; Judge William E. Hunt, of Montana, now associate justice of the customs court, to serve for three years; United States District Judge Arthur C. Denison, of Michigan, to serve for two years, and Mr. Julian W. Mack, of Chicago, to serve for one year.

This court has been constituted for the principal purpose of hearing and deciding appeals from the Interstate Commerce Commission's rulings or from its orders. The Commission will elect its own chairman to succeed Mr. Knapp. Professor W. H. Meyer, of Wisconsin, now a member of the Wisconsin railroad commission, will probably be appointed. Mr. G. S. McCord, a lawyer of Louisville, Ky., will be appointed to take the place of Mr. F. M. Cockrill, whose term has just expired.

General Foremen's Department

To All Members of the International Railway General Foremen's Association.

I want to take this opportunity to wish every member of the International Railway General Foremen's Association a Happy and Prosperous Year. We have many things to be thankful for in the history of our association, and present indications for our future success cannot be too highly estimated.

Now that holidays are over and we all feel at our very best, I think it is a good time to ask every member of the International Railway General Foremen's Association to commence immediately and pull towards our convention, which will take place on July 25, 26 and 27, 1911, at the Hotel Sherman, Chicago, Ill.

When you take hold to pull, see that you have at least a new member in each hand to bring along. I know you are all built of the best material, and for that reason I know you can be depended on to carry out my request. If you want any information, or application blanks, our secretary, Mr. L. H. Bryan, of Two Harbors, Minn., will be glad to receive your communication and assist you in every possible manner.

Did you ever stop to think how much you have done for this association? If you haven't, now is your opportunity. Have you gained in technical knowledge required by railway general foremen since you have been a member of this organization? If you haven't, I can tell you why! You have not taken an active part in the association's work. Now, if you find you have not been as active as you might have been, start right now and make up for lost time and show us you mean business. We need your co-operation and activity. Will you let us have it? Of course, you will. I venture to say there is not one member of this association who would decline when called upon to step to the front with the royal banner of the International Railway General Foremen's Association.

I am going to keep in close touch with our secretary to see how many applications you will have sent in by March 1, 1911.

I wish you all a very prosperous and happy new year.

Sincerely and fraternally yours,

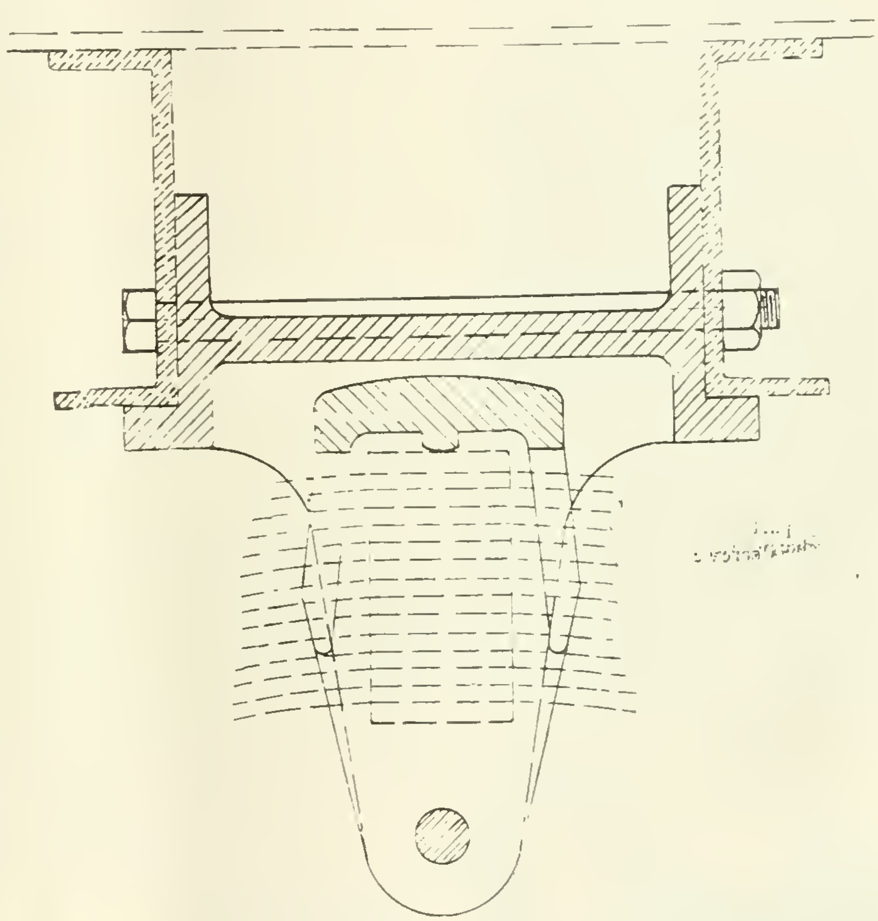
C. H. Voges,

Bellefontaine, Ohio.

Pres. I. R. G. F. A.

Swinging Tender Spring Buckles.

Some of the tenders of the Canadian Pacific Railway are equipped with swinging spring buckles on the rear trucks. The spring buckle proper is the same as on other springs, but there is a casting attached to the channel members of the tender frame. This casting projects downward about 12 ins., and at its lower extremity a bolt 1½ ins. in diameter passes through it. On the inside of this casting is a rocking piece which swings about the 1½ in. bolt or pivot pin just referred to. Within the swinging piece the spring buckle is placed. It is held in place by a pap on the swing piece pressing on the top of the spring buckle.



SWINGING TENDER SPRING BUCKLE.

This whole arrangement is such that in running along the track the up and down motion of the wheels, slightly tilting the truck frame which carries the springs, is taken up by the rocking motion which the spring can assume. It has a tendency to make the tender ride more easily and it eliminates wear from the end of the springs. The arrangement of parts is simple and durable, and any ordinary type of tender spring can be applied and it will have the flexibility which the device is intended to impart.

Early Searchers for Knowledge.

Natural philosophy, or physics, which relates to the material world with the phenomena presented to mankind was the first line of investigation pursued by searchers after knowledge. Ever since man came into being, he must naturally have been struck by the spectacle of the heavens and the continually changing aspect of terrestrial phenomena. But isolated and vague observations, and the barren admiration of phenomena which excite attention or provoke curiosity, do not constitute science; this can only exist where there is a mass of accurate knowledge in which the facts are related to each other and studied in connection with the causes which produce them.

The collection of facts sufficient to establish scientific laws must have been a very slow process in ancient times, and truths were no doubt demonstrated on the wreck of many blunders. The Greek philosopher Aristotle (383 B. C.) was one of the first investigators to use experiments in searching for accurate knowledge. To investigate the weight of air he tried one experiment which consisted in weighing an empty bladder, then inflating it and weighing it again. When he found there was no difference in the weights, he concluded wrongly that air had no weight.

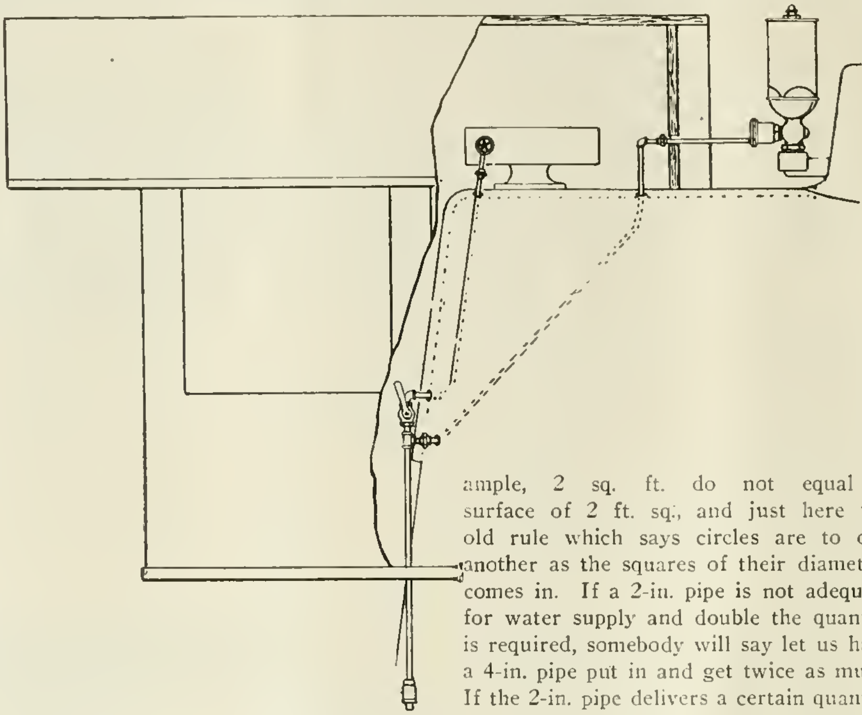
Aristotle discovered a few other things that were not so, but his system of experimenting led to highly important discoveries by other searchers after knowledge.

Steam Whistle Valve Opener.

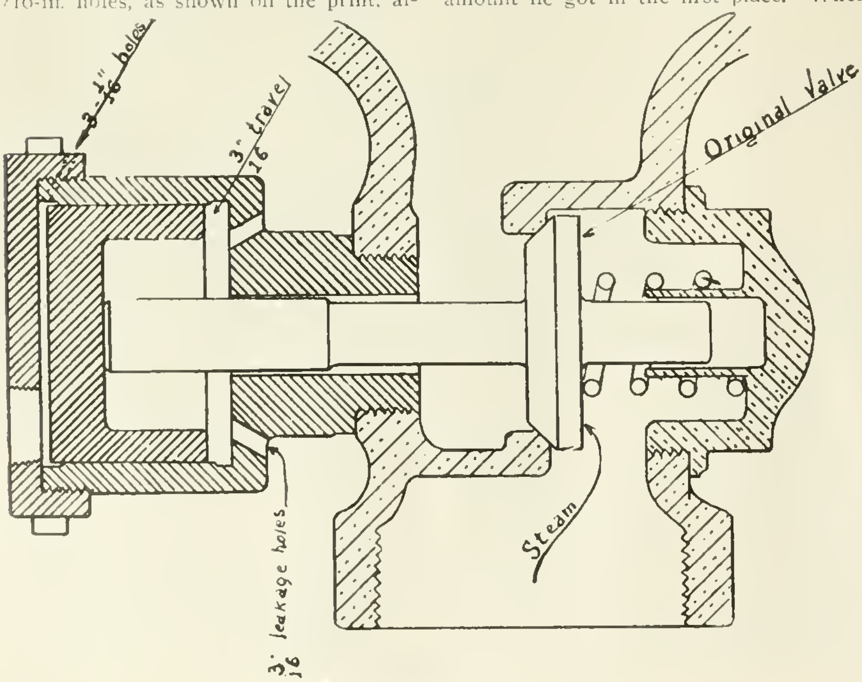
Editor:

I send you a blue print showing locomotive steam whistle operated by simply opening a ½-in. globe valve, in place of the unhandy and expensive whistle rig which is now used on modern locomotives. This arrangement, as shown by print, was successfully tried, and any whistle that could be produced by the lever rig could also be produced by the operation of the ½-in. globe valve, but as it would take time to educate the enginemen to its use, it was thought best not to adopt it. To use this device all that is required is a cast iron cylinder and piston 1/16-in. larger than area of original whistle valve, which is screwed into body part of whistle. Into the cylinder head is screwed a ⅜-in. steam pipe, and when ½-in. globe valve is opened steam is admitted to the piston, which opens the main whistle valve, and when ½-in. globe valve is closed the steam is exhausted from cylinder through three 1/16-in. holes, as shown on the print, allowing the main whistle valve to close. As the blue print gives full details, no further explanation is required. I believe, however, that it will interest readers of Railway and Locomotive Engineering.

Chas. Markel,
Shop Foreman, C. & N. W. Ry.
Clinton, Ia.



ARRANGEMENT OF WHISTLE VALVE.



STEAM WHISTLE VALVE OPENER.

Circles and Squares.

If a man goes into a large department store and buys a yard of ribbon he gets a certain amount, and the only dimension he and the salesman speak of during the transaction is the one we call length. If the man buys 2 yds. he gets twice the amount he got in the first place. Where length only is considered it is what is called one dimension space.

If one deals in surfaces, the case is entirely different. Twice the area is not twice the principal dimension. For example, 2 sq. ft. do not equal a surface of 2 ft. sq., and just here the old rule which says circles are to one another as the squares of their diameters comes in. If a 2-in. pipe is not adequate for water supply and double the quantity is required, somebody will say let us have a 4-in. pipe put in and get twice as much. If the 2-in. pipe delivers a certain quantity of water in a given time, a 4-in. pipe will deliver not simply double the amount, but four times the amount in the same period.

When one follows out the first part of the rule for the squaring of the circle, that is to multiply the diameter by itself, an area results. Mathematicians speak of multiplying a number by itself as squaring it, because multiplication of two quantities involves the idea of area, or two dimension space. Having squared the diameter we really have a square with the diameter of the circle as a side, and the circle which we wish to obtain the area of, is the inscribed circle. This expression means the circle with diameter equal to the side of a square and lying wholely within the square, but of such size that the circle touches each side of the square exactly in the centre of each side.

From this it is easy to see that the square with a circle's diameter for a side must be greater in area than the circle. So it is, and to complete the operation for finding the area of the circle we multiply this square containing the circle by some constant which will lop off the corners of the square and give the area of the circle alone. This constant is the decimal fraction .7854, which is exactly one-quarter of the ratio existing between the circumference and the diameter of any circle. For example, multiplying 2 ft., the diameter, by itself gives an area of 4 sq. ft., and further, multiplying this area by the constant, .7854 lops off the queerly shaped areas between the angles of a square and the curved line of the circle, and gives the exact area of the circles.

If one takes a circle of 2 ft. diameter and finds the area according to this rule he will be in possession of the fact that the 2-ft. circle contains 3.1416 sq. ft., and if a 4-ft. circle is next worked out the area ought to be four times that of the 2-ft. circle. If a 2-in. pipe be compared to a 3-in. pipe it will be found that their areas are to one another as 4 is to 9, or in other words, if the larger pipe will deliver 500 gallons in a given time the 3-in. pipe will deliver 2¼ times that amount in the same time, or it will deliver the same amount 2¼ times as fast.

In comparing the capacity of pipes it is not necessary to work out the area of the pipe in each case. It is only necessary to square the diameter of each and compare the two products. Such a comparison simply gives the relative capacity of the pipes, but does not give any information as to the area of either. The reason for this is not far to seek. One of the rules in mathematics is that the ratio existing between any two numbers is not altered if both of them are multiplied or divided by the same quantity. For example, 5 is the 1-5 part of 25. If 5 and 25 be multiplied by the same number, say 3, the resulting products, 15 and 75, have exactly the same ratio to one another as 5 and 25 had. That is, 15 is the 1-5 part of 75, or 75 is 5 times larger than 15. In the case of the two circles, after we square the diameter of each, we multiply the diameters by the same constant, viz., .7854, and thus the ratio between them is not disturbed, as this decimal fraction merely lops off what architects would call the spandrels between the curve of the circles and the angles of the square.

Successful Shop Supervision.

By L. H. Burrhus.

Shop efficiency is obtained by successful supervision of foremen, and the successful foreman of today must have a trait, unknown in the past, but recognized to-day as "business ability."

All terms describing success culminate in the simple definition "business ability." And the secret of this success can be worked out by any man, whether he be a common laborer or shop superintendent. Of course, it means study and hard work, but the results are so vast that it is well worth any man's time to try to develop along these lines.

So in any large shop, factory or mill that is run along successful lines and you will admit they have a great "system." That system wouldn't have been installed if some person or persons with good business ability, hadn't been able to determine the great results and thus bring about its success.

In any large shop or factory, no doubt but there is some small article that does not receive proper attention, perhaps the foreman is too busy or too "big headed" to notice it, yet if some employe with business ability can perfect a system of saving on that one article alone, he is successful. This is only a step for if any employe can show his superior officers that he has ability to handle small things successfully, then promotion is sure to follow.

As we often hear an unsuccessful man say "in the good old days" when an employe was promoted, he was generally the oldest man in the service and we all know how some of these promotions resulted. It is unnecessary for me to give any examples as I may safely say every shop has made these mistakes. No thought was given to a man's business ability and the man himself would probably think he had the necessary ability on account of his long term of service.

Of late years competition has been so keen that every business has to be run under a perfect system, and to install and maintain a perfect system requires "business ability." Some may say it requires energy, yet we have all seen cases of men, who were "hustlers" and hard workers in the shop, get promoted and be dismal failures in a supervising position.

Also in the past, when a firm wanted to promote a man to the position of foreman, they endeavored to get the best mechanic, but today it is a well established fact that the best mechanic doesn't always make the best foreman, and that the perfect foreman is not always a good mechanic, also some men are good mechanics when working under some other man, but when working for themselves they are no good. This is easily explained by saying they haven't any ideas of how to "go ahead" or in plain language they haven't any "business ability."

It is unnecessary for me to give a list of successful men and I only ask the reader to pick out a man near his own home and follow this man's career. You will find that his success was just what he made it and that as he advanced he used better business ability, which plainly shows he had to study for each advancement.

You might say some certain man was sure of his promotion on account of his "pull," but what happens when a man looses his pull? If he doesn't show good business ability he looses his position. On the other hand, if he tries to improve his business ability, his efforts will soon be noticed and he will retain his position.

I have often heard that a business man and a railroad man worked along entirely different lines, but is it not recognized today that a successful railroad must be run on business principles? If this is true then each man on a railroad ought to try and do his work in a business way. The man working by the day should not go to work with the idea of simply staying in the shop 10 hours in order to draw a day's pay, but he should endeavor to give in return for a day's pay a day's work. He should constantly be on the watch for some way to help his employer increase his output or as a business man would say "help to sell more goods."

In any factory or shop there is always a chance for business ability to be developed. In order for any firm to be successful they must show an increased output at a decreased cost and how is this to be brought about? Possibly the factory is so large that it is impossible for any one man to organize the entire plant under a perfect system, so the only course to follow is for each foreman to carefully study his own department with the view of increasing the output at a decreased cost. This should be done in a business way so that actual tests would prove the success of his efforts.

In the United States today there is a man working for the government whose entire time is spent in going from shop to shop and factory to factory to study different methods of doing work, with the express purpose of finding out why some firms are not working successfully. He studies the system used in each shop or factory and checks over the weak points. He proves by actual tests that there is some reason for running behind and in order to find this reason "business ability" is the method he uses. Perhaps the machines are not running at the proper speed or the work is not delivered promptly from one department to another. All these points can be easily remedied by each shop staff, if they will only get to work along business lines.

All that any man need do, who is desirous for advancement and for increased salary is to study his present position with the intention of finding some weak point to be strengthened. If the fault lies in himself, he ought to get after it the more quickly or else someone will take his position from him. Remember it is possible for any man to study and advance along business lines and that all firms are constantly in need of men with business ability who can stop losses and bring about success.

The Pacific Electric Railway Company of Los Angeles, Cal., has just made a contract with the Westinghouse Electric & Manufacturing Company of Pittsburgh for one 100-KW., and two 600-KW. motor generator sets, and three 475-KVA. and six 300-KVA. Oil insulated self cooled

Atlantic and Pacific Type Engines for the Santa Fe

Atlantic and Pacific for the Santa Fe.

The Baldwin Locomotive Works have recently built 35 passenger locomotives for the Atchison, Topeka & Santa Fe Railway. Twenty-three of these engines are of the Atlantic type, with balanced compound cylinders and reheaters, while the remaining twelve are of the Pacific type, with single expansion cylinders and superheaters. Both classes are fitted with the Jacobs-Shupert design of firebox, and the heaters are of the Buck-Jacobs type. The total number of balanced compound Atlantic type locomotives now operating on the Atchison, Topeka & Santa Fe Railway is 171, and the new engines thus represent the latest development of a class of power which has proved remarkably successful in express passenger service.

ATLANTIC TYPE.

These are the 4-4-2 engines shown in our illustration. The extensive experience acquired by the officers of this road in operating locomotives equipped with compound cylinders and superheaters has been used to advantage in designing the new engines. The Atlantic type locomotives, built in 1909, were fitted with both superheaters and reheaters. In the engines now under notice a reheater only is used, and it is built into the shell as an integral part of the boiler. As in the previous locomotives, the steam pressure is 220 lbs. and with driving wheels 73 ins. in diameter, the tractive force exerted is 23,800 lbs.

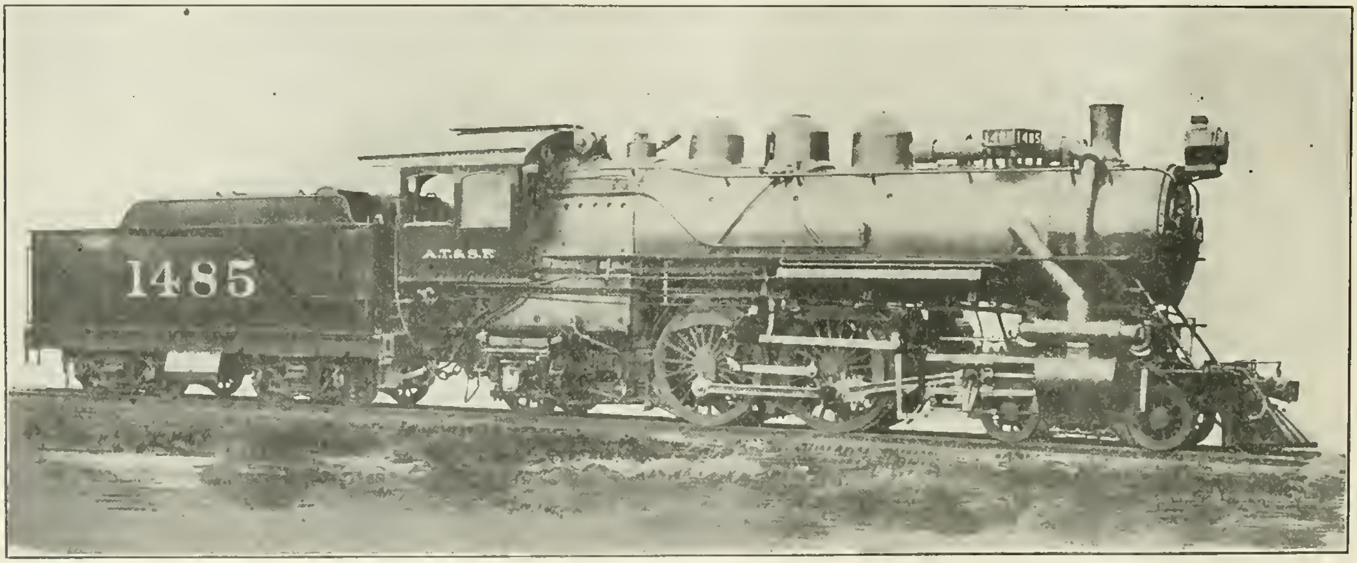
The inside and outside firebox shells are each composed of eleven channel sections and are braced by stay plates, arranged as in previous examples of this type of furnace. This type of firebox was fully illustrated and described in Railway and Locomotive Engineering on page 357 of the August, 1909, issue. In order to provide ample steam room, the barrel ring, immediately in front of the firebox, has a slope on top, the flattened sides of this ring being stayed by T-irons. Two steam domes are provided, one being placed near the front tube sheet and the other on the gusset. The latter dome is of cast steel, in one piece.

The reheater in this locomotive is built into the boiler shell as an integral part of the same, and is placed adjacent to the smokebox. The heater is 48 ins. in length and is traversed by 417 tubes which are distributed over the entire cross section. Between it and the evaporating section of the boiler is a combustion chamber 30 ins. in length. This arrangement reduces the length of the tubes to 14 ft. 6 ins., but experience on this road indicates that no reduction in efficiency should result on that account.

The arrangement of the reheater makes it possible to place all the steam piping on the outside of the boiler. The live steam supply is drawn from the rear dome, and is conveyed to the forward dome through two pipes, each 5 ins. in diameter. The throttle valve is placed in the forward dome, and it communicates with an external dry pipe which is placed on the top center line of the boiler. This pipe terminates in a T-head, from which external steam pipes run to the steam chests.

The steam distribution is controlled by one piston valve on each side. The steam chest heads are provided with internal extensions, which form steam-tight sliding joints with the interior surface of the piston valve. These joints are packed with snap rings. The front steam chest head is closed, but the back head communicates with a pipe connection leading to the reheater. The high pressure steam exhausts into the interior of the valve, and is then conveyed to the reheater by the pipe connection. Internal baffle plates here compel the steam to follow a circuitous course among the tubes. The steam leaves the reheater through right and left-hand pipe connections and enters the steam chests through annular-shaped openings formed in the heads. The valves are arranged for outside admission to the low-pressure cylinders, hence the low-pressure ports are placed in the ends of the steam chests adjacent to the heads. The steam escapes under the outside sections of the valve, and thence into the exhaust passages.

As in previous locomotives of the Atlantic type built for this road, all four main rods are connected to the first pair of driving wheels. The valve gear is of the Walschaerts type and the links are placed back of the main drivers in order to gain the required room. The valves are driven by means of rockers, whose bearings are bolted to the guide yoke. The frames have single front rails and separate rear sections. The trailing truck is of the Rushton type, with outside journals. As the front truck has a swing bolster, the rigid wheel base is the distance between the drivers, that is, 6 ft. 10 ins.



PASSENGER 4-6-2 FOR THE ATCHISON TOPEKA & SANTA FE RAILWAY.
W. F. Buck, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

PACIFIC TYPE.

The Pacific type locomotives have 25 x 28-in. cylinders and with driving wheels 73 ins. in diameter, and a steam pressure of 175 lbs.; the tractive force exerted is 35,700 lbs. The general design is based on that of previous locomotives of the same type built for this road. We have not been able to secure a photograph of these engines.

The boilers of these engines are closely similar to those of the Atlantic type locomotives, the principal difference being in the length of the tubes, which in the present case is 17 ft. The firebox dimensions are identical with those of the Atlantic type engines, as is also the arrangement of the steam domes and throttle. The dry pipe terminates at the top of the superheater, and the steam leaves the latter at the bottom, and is conveyed by short pipe connections to the live steam passages in the cylinder saddle. The distribution is controlled by inside admission piston valves, 13 ins. diameter, which are set with a travel of 6¼ ins. and a lead of ¼ in. The steam chests are set out sufficienty to enable all parts of the motion to be placed in one vertical plane, thus simplifying the arrangement of the gear.

The tenders of both classes are similar in construction, those of the Atlantic type engines having a somewhat greater capacity than the others. All have steel channel frames, water bottom tanks and arch-bar trucks equipped with cast steel bolsters and "standard" steel-tired wheels. The Atlantic type locomotives are arranged for the use of oil fuel, while of the Pacific type engines five, burn oil and seven, coal.

In designing these two types of locomotives, special care has been taken to make the details interchangeable where possible. This is particularly true in the case of the boiler work, where, because of the style of firebox used, a large number of flanged shapes are required. One set of dies, however, served for all the boilers.

The principal dimensions of both classes of locomotives are given in the accompanying tables:

ATLANTIC OR 4-4-2 TYPE.

Cylinders, 15 and 25 x 26 ins.
Boiler—Type, wagon top; diameter, 72 ins.; thickness of sheets, 11/16 in.; working pressure, 220 lbs.; fuel, oil.
Firebox—Length, 109⅝ ins.; width, 63¾ ins.; depth, 74⅛ ins.; thickness of sheets, sides, 5/16 in.; back, ⅜ in.; crown, 5/16 in.; tube, 9/16 in.
Water Space—Front and back, 5 ins.; sides, 5½ ins.
Tubes—Material, iron; thickness, No. 11 W. G.; number, 273; diameter, 2¼ ins.; length, 14 ft. 6 ins.
Heating Surface—Firebox, 190 sq. ft.; tubes, 2,318 sq. ft.; total, 2,508 sq. ft.; grate area, 48 sq. ft.
Driving Wheels—Diameter, outside, 73 ins.; journals, main, 10 x 10½ ins.; others, 9 x 12 ins.
Engine Truck Wheels—Diameter, front, 34¼ ins.; journals, 6 x 10 ins.; diameter, back, 47 ins.; journals, 8 x 14 ins.
Wheel Base—Driving, 6 ft. 10 ins.; total engine, 32 ft. 8 ins.; total engine and tender, 61 ft. 1 in.
Weight—On driving wheels, 112,125 lbs.; on truck, front, 62,225 lbs.; back, 57,325 lbs.; total engine, 231,675 lbs.; total engine and tender, about 405,000 lbs.
Tender—Wheels, diameter, 34¼ ins.; tank capacity, water, 9,000 gals.; oil, 3,300 gals.; service, passenger.

PACIFIC OR 4-6-2 TYPE.

Cylinder, 25 x 28 ins.
Boiler—Type, wagon top; diameter, 72 ins.; thickness of sheets, 11/16 in.; working pressure, 175 lbs.; fuel, coal or oil.
Firebox—Length, 109⅝ ins.; width, 63⅜ ins.; depth, 74⅛ ins.; thickness of sheets, sides, 5/16 in.; back, ⅜ in.; crown, 5/16 in.; tube, 9/16 in.
Water Space—Front and back, 5 ins.; sides, 5½ ins.
Tubes—Material, iron; wire gauge, No. 11; number, 273; diameter, 2¼ ins.; length, 17 ft.
Heating Surface—Firebox, 190 sq. ft.; tubes, 2,720 sq. ft.; total, 2,910 sq. ft.; superheating surface, 1,147 sq. ft.; grate area, 48 sq. ft.
Driving Wheels—Diameter, outside, 73 ins.; journals, main, 10 x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels—Diameter, front, 34¼ ins.; journals, 6 x 10 ins.; diameter, back, 47 ft.; journals, 8 x 14 ins.
Wheel Base—Driving, 12 ft. 8 ins.; total engine, 35 ft. 2 ins.; total engine and tender, 67 ft.
Weight—On driving wheels, 150,500 lbs.; on truck, front, 43,450 lbs.; back, 46,600 lbs.; total engine, 240,550 lbs.; total engine and tender, about 400,000 lbs.
Tender—Wheels, diameter, 34¼ ins.; journals, 5½ x 10 ins.; tank capacity, 8,500 gals.; fuel capacity, 3,300 gals. oil or 12 tons coal; service, passenger.

Steam Gauges.

Midwinter is a good time to keep a sharp eye on the steam gauge. The freezing of the condensed steam in the gauge or pipe leading to the gauge is not uncommon, and while the safety valves may be very reliable in the matter of blowing off at, or nearly at, the right pressure, a freezing of the steam gauge or its connections has a pernicious effect in the delicate mechanism of the gauge. Even under the best conditions and with incessant watchfulness the steam gauge is a delicate instrument and subject to erratic changes. Their errors, when they exist, are nearly always on the side of safety. They usually indicate a higher pressure than that which is in the boiler. The particular form of construction, as well as the location of the gauge, has much to do with its baffling eccentricities. If the internal mechanism or motive power of the gauge is of the horseshoe or bent-pipe variety, commonly called the Bourdon tube, the expansion of which, when under pressure, moves the pointer on the dial, errors should not be unexpected on their records.

The common practice of testing gauges by cold water pressure is being improved upon. It is well known that a metal subjected to any unusual degree of heat is not as rigid as it was when under normal temperature. It may therefore be understood that if a bent pipe will straighten out to some extent when a pressure of cold water is applied, it will certainly straighten out still further when the water is at a boiling heat, and a high pressure of steam, of course, having a correspondingly greater degree of heat, the metal becomes more elastic, the greater the heat. The variation is slight by actual measurement, but the variation has a tendency to increase, and hence the necessity for repeatedly testing the gauge. In some well-managed roundhouses the steam gauge is tested at each period of boiler washing.

It should also be noted that the variations will likely increase in the case of steam gauges that are set in close proximity to the heated boiler. Pieces of wood set under the gauge-stand give a double advantage in lessening the degree of heat reaching the gauge, as well as deadening the incidental vibration unavoidable to locomotive running.

It will also be observed that it is not good practice to make repeated changes in the adjustment of the safety valves to suit the more flexible, and hence more erratic, steam gauge. The safety valve springs are substantially constructed and are much less likely to be in error than the steam gauge. The opening of the safety valves at a slight variation from the point originally adjusted to suit the gauge is a matter of little consequence. If the safety valves are occasionally readjusted to suit the steam gauge the chances are very great that the locomotive will lose in power and efficiency, and a repeated testing of the gauge by some fixed standard is better than a constant meddling with the safety valves themselves.

The length of the connecting pipe between the boiler and the steam gauge is an important factor in the equable working of the gauge. A long, bent pipe soon becomes filled with water which, being exposed to the open air, will be much cooler than if a short pipe is used, and therefore less likely to add to the vagaries of the indications. The connecting pipe should also be connected directly to the boiler. When connected to turret heads or fountains where the injector valves or other attachments are also supplied the current of steam may be, to some extent, temporarily diverted from the steam gauge, and superinduce the errors to which the gauge is liable.

Considerable improvement has been made in recent years in the construction of steam gauges, some manufacturers cleverly brazing steel and brass together in such form as to act as a kind of thermostat, the one metal acting upon the other in such a way that they nullify undue expansion up to a certain point. These improved gauges, of which there are several kinds, when set sufficiently far away from the boiler remain nearly correct for a long time, and probably approach as near perfection as can be expected from so delicate an instrument, which must necessarily continue to be subjected to incessant variable degrees of temperature.

Always Had Company.

The case concerned a will, and an Irishman was a witness. "Was the deceased," asked the lawyer, "in the habit of talking to himself when alone?"

"I don't know," was the reply.

"Come, come, you don't know, and yet you pretend that you were intimately acquainted with him?"

"Oh," said Pat dryly, "I never happened to be with him when he was alone."

Electrical Department

What Is a Commutator?

By George S. Hodgins.

The discovery by Michael Faraday that electric currents could be generated in a closed coil of wire by moving a magnet in its vicinity, and also that moving the

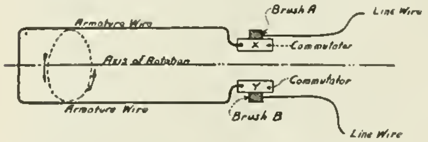


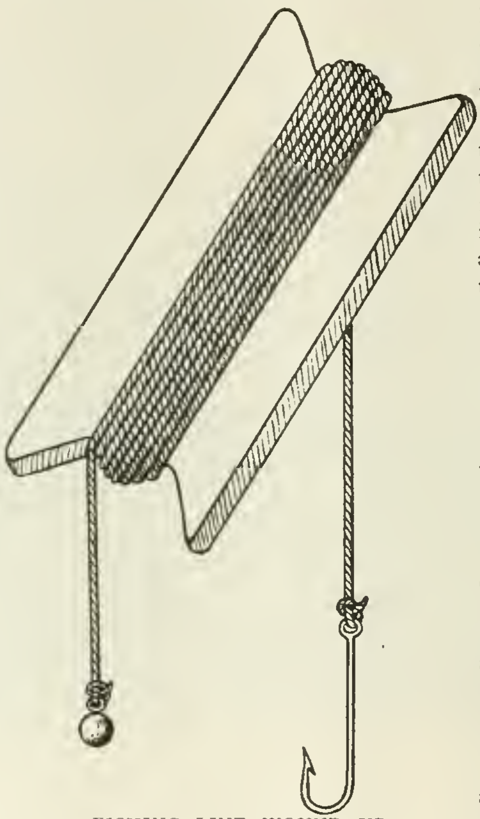
DIAGRAM OF WIRES, BRUSHES, ETC.

closed coil in the vicinity of the magnet would also produce a flow of current in the wire, led to many experiments. It was found that on causing the closed coil of wire to approach a permanent magnet, a flow of current took place in one direction in the wire, and that when the coil was past the poles of a permanent magnet a reverse flow of current was manifested in the coil.

Among the many steps toward the production of the efficient modern dynamo was the making of the magneto machine. In this machine a permanent magnet was used, and the closed coils of wire were wound on a frame carried on a revolving shaft. The motion of the shaft carried the coils of wire past each pole alternately, and as at each approach and recession a flow in one direction was followed by a flow in the opposite direction, an alternating current was delivered to the live wires.

One step in advance of the magneto machine was the dynamo proper. It is a simple machine, and is usually spoken of as a separately-excited dynamo, because instead of the permanent magnet used in the magneto, the field coils became electro-magnets by reason of a current of electricity being sent over a coil of wire wound upon soft iron cores, which took the place of the U-shaped arms of the permanent magnet, while the armature revolved between the poles of this dynamo, as in the more primitive machine. This separately-excited dynamo would, however, deliver alternating current, as the magneto had done, but for the fact that the armature was built with what has been called a commutator for the purpose of producing a direct current from the alternating current generated, that is, current in which the flow is always in one and the same direction. In fact, it may be said generally, that all dynamos deliver alternating current, but the intervention of the commutator causes the alternations to become a steady flow in one direction.

This brings us to the consideration of what is a commutator. It is, roughly speaking, a device for converting an alternating current into a continuous one. As a sort of convenient way of presenting to the mind the winding of an armature of the Siemens type, let us look at the way a fisherman might be expected to wind up a long line on a piece of wooden shingle taken from the roof of a house, and notched out into a rough V at each end. Say he began with the rod-end of his line and wound it back and forward over the notched shingle. When it was



FISHING LINE WOUND UP.

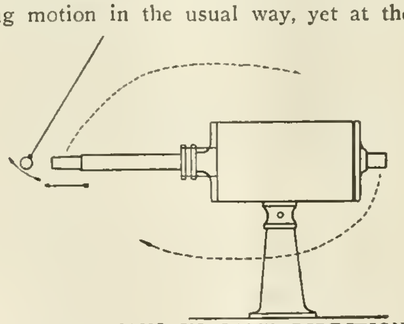
all wound up the line at the rod-end might be covered by all the other turns of the line, and the hook-end would come off on top and hang free. Now, suppose that it was possible to send some kind of molecular impulse along this fishline, it would begin, say, at the free end, and go in along the hook and finally come out at the rod-end after having traversed all the intermediate coils. A similar impulse entering the line at the rod-end would rapidly traverse all the coils of fishline and come out, off the hook-end. That would practically be equivalent to an alternating current, and here the commutator steps in and produces a continuous current from these two which have flowed through the line in different directions.

A glance at the outline sketch will show a pair of commutator bars as two oblong strips of metal attached to the armature wires. These single wires represent coils of many windings, so that the distance from one commutator to the other by way of the armature coils is a very considerable distance. As the upper and lower armature wires sweep past the poles of the electro-magnet a flow of current is produced, as if it entered, let us say, through brush A along commutator bar X, along the armature wire, and leaving at brush B, fills the line wire with current flowing, as indicated.

The rotation of the armature quickly brings the commutator bar Y, which in the sketch is in contact with brush B, up to brush A at the top. Then the commutator bar X, first in touch with A, finds itself now in contact with B. The flow in this newly assumed position has been, as it were, in through brush B and out through commutator bar Y at the top.

A reverse flow would manifestly be in through commutator bar Y and out of X. This is exactly what takes place, and the current in traversing the armature coils has alternated with the direction of the first flow. It has gone in over Y and out by X in the new position, but Y in contact with brush A preserves the continuous flow in through A and out by B.

The line current is rendered continuous or direct while the reversal of the armature current, which the machine does for itself, has been met by the mechanical alteration of the position of the armature coils by rotation on their longitudinal axis. One may say that if a locomotive cylinder with piston and tail-rod complete, detached from an engine, was actuated by steam so as to have a reciprocating motion in the usual way, yet at the



BLOW ALWAYS IN SAME DIRECTION.

same time if the cylinder was spun round on the swiveling head of a screw-jack supporting the cylinder at its center, the alternate action of piston-rod and tail-rod could be made to deliver a series of blows in one and the same direction.

The back stroke of the piston would cause the crosshead-end of the piston-rod to deliver the first blow directed toward the rear of the engine, and the cylinder then being quickly turned round end for end, the forward stroke of the piston would drive the tail-rod out and cause it to deliver a similar blow in the same direction while the piston maintained a distinctly reciprocating motion.

The armature windings are not, however, confined to the upper and lower coils represented in our sketch, but (thinking of a clock face) one may say that the XII-VI coil lies closely beside the I-VII, and it in turn against the II-VIII, and that one next to the III-IX coil, and so on all the way round. The spinning armature with its vast number of coils thus pours out on the line wire a steady, continuous current, caught, and, if one may so say, rectified by the neatly packed circle of insulated commutator bars.

Motor Trains on Long Island Road.

By W. B. Kouwenhoven.

(*Continued from page* 468, *Nov.* 1910.)

The wires belonging to the train line that lead to the master controller are connected by means of junction boxes to the train line proper which runs the length of the car and which is also connected to the electro-magnet valves of the unit switches. The junction boxes are simply boxes which are fitted with a number of connection studs, by means of which the wires are connected together. The train line ends in two jumper sockets at each end of the car, one being on each side. The socket is a cast iron shell provided with a swinging cover. Inside of the shell are seven split pins to which are connected the seven wires of the train line, one to each pin. The jumper connectors fit into these sockets only one way, so that there is no danger of making a mistake when connecting two cars together. The bus line jumper sockets differ from the train line sockets in having only four pins, and in that all of those four pins are connected to the one wire which forms the bus line.

The current for the master controller and train line is as mentioned before supplied by two storage batteries of seven cells each. One of these batteries is always charging while the other is in use. The charging current is taken from the air compressor motor circuit through a relay mounted on the switch board which automatically takes charge of the current once it has been turned on. On the switch board are also mounted the light, heat and compressor switches with their fuses, the main switch, the battery switches, the limit switch and the line relay.

It has already been explained that if the storage battery current or the air pressure should fail the unit switch will open and cut off the power and no damage or danger will result. It sometimes happens on an electric road that the electric power in the third rail will fall to a very low value or will fail altogether due to trouble in the power house or substation. When this is the case the power does not usually come back gradually, but with a rush. If the current should be off long enough to allow the speed of the train to slacken, and if the unit switches were in when it comes back, then the rush of current would very likely do serious damage to the motor equipment of the train before either the overload trips or the fuses could act. Between the line switch and the switch group, the line relay is placed. The relay depends for its action upon the rise and fall of the voltage or power in the third rail, it is connected across the circuit, and its purpose is to open the battery circuit if the voltage falls below a certain value, and thus cause the unit switches to open. It will hold the battery circuit open until the voltage comes back to its proper value, when it will reclose the battery circuit again and if the master controller handle is still in a running position, then the unit switch will begin at the start and go through the process of notching up again under the control of the limit switch, and supply current to the motors. The line relay is a magnet switch opened by gravity. Its magnet is made up of a large number of turns of very fine wire, one terminal of which is connected to the main motor supply circuit and the other to the ground, that is, the track return circuit. When the line switch is closed and there is current on the third rail and on the mains of the car the magnet attracts its plunger, which carries a copper disk and closes the battery circuit for the switch group as explained. The action of the line relay takes place on each car individually so that if the current supply should fail on any car in the train, then the switch group on that car will open independently of any other car in the train.

In case of the failure of one of the motors, there is a control cut-out switch underneath one of the cross seats in the car. This switch consists of a wooden drum upon which are mounted copper contacts against which fingers press. The switch has four positions: No. 1, motor out; No. 2, motor out, both out and both in. The motorman has access to the switch by lifting the cross seat.

Before starting the train the motorman should go through each car and close the air compressor pump switch, the storage battery switches, and the main switch on each switch board, and at the same time see that all the small switches in each motorman's cab are open, that the train and bus line jumpers are in place, and that there is no other controller handle on the train except his own. When he has completed this inspection he returns to his cab at the head of the train, places his controller handle in position, closes the line switch cut-out switch and proceeds to test the air brakes as by this time the compressed air reservoirs have become fully charged. Then the pushes the controller handle to the off position on the right of the central or brake position, and closes the brake cut-out switch. This turns on the storage battery current for the electro-magnet valves of the switches of the switch groups through the train. When he receives the conductor's signal to go ahead, he pushes the controller handle up against the stop on the right and holds it there unless slow or half speed is desired, in which case he only brings the handle to the second or third notch. With the handle against the post the unit switches on each motor car in the train automatically notch up the control one step at a time, being interrupted at each step by their limit switch as already explained, until the electric power is full on and the train running ahead at full speed. If backward motion is desired the controller handle is thrown to the left of the central position.

Single-Phase Traction in France.

The electrification of existing steam railways is being pursued with activity in France. One of the latest electrifications is that which the Midi Railway of France will make in connection with the Montrejeau-Pau portion of the Toulouse-Bayonne Line. The portion to be electrified has a length of some seventy miles; the country is very hilly and the line has a number of steep gradients, one of 3½ per cent. being about seven miles in length. This is the largest scale upon which electrification of existing lines has been attempted in France, and the results will be watched throughout Europe with no little interest. Later the electrification is to be extended to the entire Toulouse-Bayonne Line, a distance of 200 miles.

The Midi Railway Company has ordered from the French Westinghouse Company, whose works are at Havre, the equipments for thirty double bogie electric motor coaches for the passenger service, and one complete electric locomotive for the freight service of this line. The locomotive and motor car equipments will be built by the Italian Westinghouse Company at the Havre works, while the mechanical parts of the locomotive will be built by the Italian Westinghouse works. The design and construction are based on the results obtained in connection with the very successful electrification by the Italian Westinghouse Company of the Giovi tunnel section of the Italian State Railways on the dense traffic line between Genoa and Milan.

The thirty motor coaches, each seating about fifty passengers, will be equipped with four 125-h. p. Westinghouse single-phase motors, 16⅔ cycles, 285 volts, and with Westinghouse multiple control. These motor coaches will be able to haul trains weighing 100 metric tons, including the motor itself, at a speed of forty-five miles an hour on level track. The weight of a motor coach in running order will be about fifty-six metric tons.

The Midi locomotives will be provided with five axles, three of which will be driven by the motors through jack shafts and connecting rods. The locomotive will be equipped with two 600-h. p. single-phase motors. The locomotive will weigh 80 metric tons, and will be able to haul trains weighing 400 metric tons. inclusive of the locomotive. With a haulage load of 280 metric tons the speed will be twenty-five miles an hour, and with 100 metric tons about thirty-eight miles an hour. The current will be supplied to the motors by means of a 12,000-volt overhead catenary line. The pantagraph type of trolley will be used.

The Thunder Bolt.

Not long ago a householder in England wrote to the London *Spectator* to inquire if it was worth while to provide his building with lightning conductors. The *Spectator* replied by referring their correspondent to a little book called "Lightning and the Churches," by Mr. Alfred Hands. From the data collected it appears that lightning strikes much oftener than the ordinary citizen has any idea of. The decade between 1897 and 1908 was selected for investigation and it appears that during that time 211 churches were struck, 3,190 other buildings, 226 hay ricks, 1,251 trees, 398 other objects. During the period under investigation 194 persons were killed and 1,016 injured, 1,307 animals killed. The monetary loss has been estimated at between £50,000 and £100,000 per annum. Translated into our figures the loss of property aggregated between $243,000 and $486,000 each year. The article goes on in part as follows:

"What, then, is the tremendous force which does all this mischief? We can examine some of the effects which are produced by the ether in motion or under stress or strain. From the latter we get static electricity, and the ether in continuous motion produces current electricity. The explanation of what happens when an object is "struck" by lightning may be given in Mr. Hand's own words. He says: "When a thunder storm occurs a stress is thrown on the air, either between two clouds or between a cloud and the earth, and when this stress has reached a pressure of about half a gram weight to the square inch, smash goes the air—it is literally cracked. The line of the fracture is illuminated by the intense heat caused, rendering the air particles incandescent, and we see this and call it lightning. This is all lightning is; there is no "bolt," and no transference of matter from one place to another. To speak or write of an object as being "struck" by lightning is calculated to produce a wrong impression, because it conveys the idea of a ponderable object giving a blow. It is literally an incorrect term. The incorrectness of the word can be better understood when we realize that when there is a flash of lightning the air is just as much "struck" as the other objects through which the flash passes—a church steeple, for instance, or a tree or a human being. What happens in each case is the same; the lightning is finding its way by the path of least resistance. It runs through the weakest substance near, just as paper is torn at its weakest points, or as a river winds its way to the sea. The strongest substances withstand it, and the weaker substances give way. When the air is cracked, then the lightning makes its path by the weakest component parts of it—those parts, for instance, which contain moisture; that is why the flash is seen to take a sinuous course.

Just here we would like to remark that the zig-zag line, ordinarily used to represent a lightning flash is entirely incorrect. Lightning does not double back on its course or make acute angles. It rather resembles the line made by a piece of coarse string which has been curled up and let hang freely from one end without weight at the lower end to bring it taut.

"But air, as a fact, is relatively very strong as regards lightning, while other substances, which we think of as strong, are to lightning very weak. Metal is weakest of all; a human being is stronger than metal, and masonry or wood is stronger than a human being. So that a lightning flash occurring in the neighborhood of a wall or a tree and a man would choose the man rather than the wall or tree, and would leave either of these for a path of metal."

"That, then, is the principle of the lightning conductor, and we do not regard the conductor rightly if we think of it as "attracting" lightning. A conductor no more "attracts" lightning than a bank of sand attracts a stream which must either pass through the sand bank or a wall of rock. And, as Mr. Hand points out, we should none of us be so foolish as deliberately to attach to any building an instrument designed to attract lightning. As a matter of fact, the point of a conductor actually dissipates electricity, and to a certain extent can be said to prevent an electric discharge. On dark nights during thunder storms you can see the point of a conductor glowing with the pale light known as "St. Elmo's fire," and sailors are familiar with the lights which play on mastheads, yardarms and other pointed parts of vessels."

A flash of lightning is believed to be really an alternating current of such intense frequency that it has so far been impossible to measure it and man has not been able to reproduce it by any commerical apparatus.

"To sum up the question of the value of conductors generally, could anything be better than the argument, not of the house but of the battleship? In the old days of masts and sails the wooden ships were constantly being struck. Now, with ships of steel, the crew live in a vast floating conductor, and steam through a storm more safely than if they were walking on dry land."

Strange as it may appear, the very treatment which would be given to restore one of the crew if apparently drowned is the proper course to pursue to resuscitate a man "struck" by lightning or injured by any form of dynamic electricity.

Awful Liar.

In Sir Archibald Geekie's "Scotch Reminiscences" he tells this story against himself, which was connected with his work of searching for geological specimens:

"I was quite sure you had been in our neighborhood," a friend said to Sir Archibald. "I met the old farmer of Garvock who had a strange tale to tell me. 'Dod, Mr. Caithcart,' he began, 'I ran across the queerest body the ither day. As I was comin' by the head of the cleugh I thocht I heard a wheen tinkers quarrelin', but when I lookit doon there was ae wee stoot man. Whiles he was chappin' the rock wi' a hammer, whiles he was writin' in a book, whiles fechtin' wi' the thorns and misca'in them for a' that was bad. When he cam' up free the burn, him and me had a large confab. Dod! he tell't me a' aboot the stanes, and hoo they showed that Scotland was ance like Greenland, smoored in ice. A very entertainin' body, Mr. Caithcart, but—an awfu', awfu' leear."

J. M. Pickens, editor of the bureau of animal industry, recently gave out a list of 154 different spellings of the word bureau which he had noted in letters received from farmers.

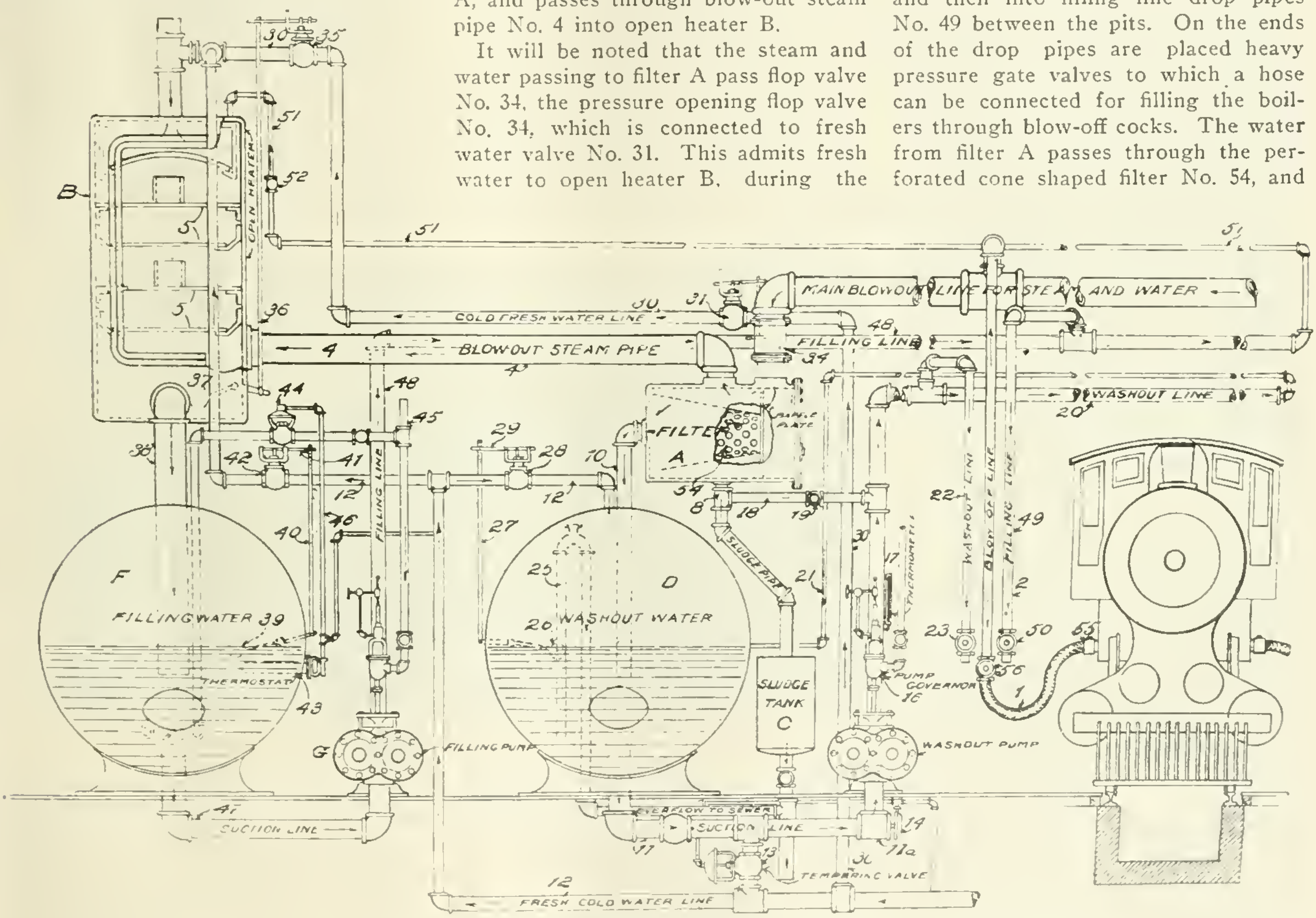
Some college graduate with a taste for mathematics and not much work to do has figured it out that the wheels in the average watch travel 3568 miles in a year.

Improved Boiler Washing Apparatus.

It is a remarkable fact that the prolonged neglect in a thorough method of washing boilers, and especially in locomotive boilers, has been the cause of much of the engine failures that were so common in railroad service. Much improvement has been made in recent years and there is still room for more improvement, both in method and in manner, but it is gratifying to observe that the new roundhouses are being fitted up with appliances calculated not only to keep the boilers clean, but what is also of much importance to do the work in much shorter time and at less expense than formerly.

Among the most successful manufacturers of improved boiler washing apparatus at the present time is the National Boiler Washing Company, of Chicago. We recently had an excellent opportuunity of observing their appliances in action at the new roundhouse of the New York Central Railroad at Corning, N. Y. Mr. John Howard, the superintendent of motive power, pointed out the interesting details to us.

If one compares the original outlay and the cost of manipulation with the amount of saving it becomes apparent that there is a genuineness about the improvement which cannot be said of every mechanical contrivance. Our illustration will be of interest to all railway men as showing in as brief space as possible a general outline of the appliance, and the description which is appended will well repay those who are desirous of keeping abreast of the times.



NATIONAL BOILER WASHING EQUIPMENT.

Beginning with the locomotive in the right lower corner of the illustration it may be stated that the steam and water are blown out of the locomotive through the blow-off line between the pits and through the main blow-out line, which extends around the entire roundhouse and then into the filter A. The steam and water then strike a baffle plate, and the steam is separated from the water. The steam then rises from filter A, and passes through blow-out steam pipe No. 4 into open heater B.

It will be noted that the steam and water passing to filter A pass flop valve No. 34, the pressure opening flop valve No. 34, which is connected to fresh water valve No. 31. This admits fresh water to open heater B, during the time that the engine is being blown off. The steam entering the open heater B heats the cold water automatically, just as an injector heats water from a tank, and the water is admitted in sufficient quantity to refill the same boiler from which the steam and hot water are being blown. The heated water flows from open heater B, through a pipe, No. 38, to storage tank F, for filling water.

A thermostat, No. 43, is placed in storage tank F and controls live steam valve No. 44. This valve is open when the temperature in the tank is below any desired temperature, preferably 170 degrees F. At this point the thermostat operates and closes the live steam valve, thus automatically maintaining water at 170 degrees F.

This valve is seldom opened, as the steam blown off from the boilers will maintain the proper temperature.

Flat No. 39 and valve No. 42 are for the purpose of controlling the admission of fresh water to the filling water tank when the level of the water falls below a certain point. In this manner there is always a minimum amount of water for filling purposes.

The hot water from the filling tank F is pumped by filling pump G, and is discharged from filling line No. 48, which extends around the engine house and then into filling line drop pipes No. 49 between the pits. On the ends of the drop pipes are placed heavy pressure gate valves to which a hose can be connected for filling the boilers through blow-off cocks. The water from filter A passes through the perforated cone shaped filter No. 54, and through filtering material into pipe No. 10 and flows into washout water reservoir D. By this means of purification and storage much waste heat blown out of locomotives is saved.

The temperature of the water direct from the washout tank is about 185 degrees F. As this is too hot to be safely handled the temperature is reduced and controlled by a cold water pipe line, No. 12, which is connected to a hot water pipe line, No. 11. A tempering valve, No. 13, is placed in cold water line. This valve is actuated by a thermostat, No. 14, inserted in tee No. 11A in section line No. 11. A positive temperature of the washout water is maintained. The water is discharged from the washout pump through washout line No. 20, which also extends completely around the engine house and through drop pipes No. 22 at the side of the pits.

Leading from filter A is a sludge pipe which is connected with sludge tank C, and all sludge and scale blown into filter A drops into the tank C, from which it can be readily washed into the sewer. Circulating pipes extend from the ends of the washout and filling pipes back to the reservoirs. Through these pipes, Nos. 51 and 21, a constant circulation of washout and filling water is maintained.

For blowing out the boiler, connection is made, as we have already stated, from the blow-off cock No. 55 to blow-off drop pipes No. 56. The blowing out of the boiler occupies about 30 minutes. The capacity of the filling water reservoir is about 10,000 gallons. The washout reservoir is nearly as large. The pumps are brass-fitted duplex, equipped with governors and lubricators. The washout pump has sufficient capacity to wash three boilers at once and maintain a pressure approaching 100 pounds.

It is not necessary to describe the method used in washing out the boilers. As is well known the condition of the boilers varies according to the kind of impurities that may be in the water and also the period of time between washings. The advantages of the system are particularly in the saving and purifying of the heated water, the constant supply of heated water for washing out and also for refilling. The results that came under our own observation bear out the reports that have come to us from other places, the average gain as compared with the older methods of blowing out into the sewer the heated water and washing and filling the boiler with cold being about 40 per cent.

To be more exact, the reports agree that in the item of washing out the boiler under the old system 3½ hours were consumed, while the average time under the improved system that we have briefly described is two hours. The amount of water used under the old system was 2,000 gallons, the new method only requiring 1,000 gallons. In the item of firing up a certain class of engines 2,200 pounds of coal was used as against 1,500 pounds under the new system.

It may be added that the maintenance of the temperature of the boiler at a degree of heat calculated to avoid the distorting strains incident to rapid heating and cooling is an item which, while it cannot be exactly estimated, is one that will readily enter into the minds of the railway men of experience as one of much importance in the repairing and renewing of certain parts of locomotive boilers.

Advantage of the Compartment.

A press dispatch to the *New York Times* says: "A good story about an English cabinet minister is going the rounds. It must be stated that the name fitted to the story varies as it is told in different quarters .

The hero of the story had been staying in the country, and on the morning of his departure he arrived at the railway station a quarter of an hour before the train was due out. The sun shone brightly, and the minister, attracted by its warmth, walked to the end of the platform and took a seat on the grass of the embankment. Here he remained until the arrival of his train. When he was comfortably seated in his reserved first-class compartment he discovered, to his horror, that he was swarming with ants from a nest on which he had all unconsciously been sitting.

Taking off his coat, he shook it out of the window, only to find that his lower garments were also alive with ants. He was by himself, with no risk of any one intruding, so he took off his trousers and shook them also out of the window. At this moment an express rushed by, the trousers were caught, and before he knew what had happened, they were torn from his grasp. London was only an hour's journey distant, and he was trouserless.

The train stopped at a station. With the blinds of his compartment closely pulled, the minister put his head out of the window and signaled the station master, to whom he appealed for a pair of trousers. There was no garment of the kind at hand, but the station master telegraphed to the London terminus, where a porter, when the train arrived, presented the blushing minister with a pair of stout corduroys, and in these garments he made his way home.

The Operating Ratio.

A short time ago the members of the New England Railroad Club had the pleasure of listening to an address by Mr. D. C. Buell, chief of the educational bureau of the Union Pacific Railroad.

One of the greatest problems that the railroad executive officer has had to solve within the past few years, Mr. Buell remarked, has been the maintaining of a satisfactory operating ratio. In only three of four directions is it now possible to make appreciably large economies. The man in charge must endeavor to reduce operating expenses by fuel economies, tonnage economies, reduction of accidents and claims, increasing the efficiency of officials and employees. The effect of fuel economy and the reduction of accidents argues the greater efficiency of the men. In fact aside from the opportunities for realizing more efficient and economical railroad operation depend today largely on the railroad manager's ability to increase the efficiency of his officials and employees.

With a realization of these truths, Mr. Buell said that the Union Pacific set itself the task of accomplishing results along the line of increasing the efficiency of its officials and employees, and the result was the establishment of the educational bureau.

Several fundamental business principles were kept constantly in mind of the officials. These are examples: loyalty and efficiency go hand in hand; to create loyalty employees must know and be made to feel that the company is interested in their welfare and success; to make them know this, promotion of those in the service must be made, seniority and ability both being considered; outsiders must not be put over the heads of loyal and able employees. Means must be devised and provided whereby ambitious and loyal employees may have opportunity to become better informed concerning their work and the work of the position ahead of them for which they are ambitious to qualify, for promotion.

The Union Pacific recognizes these fundamental principles and does not go outside of its own ranks to fill vacancies if any competent employee can be found for promotion. It offers aid to the ambitious, so that they can fit themselves to grasp the hand of opportunity when it is offered to them; and tries to give a "square deal" to every man in the service.

The objects of the bureau are: To assist employees to assume greater responsibilities; to increase their knowledge and efficiency, and to prepare prospective employees to enter the service.

Although the bureau maintains the closest relations with all departments of the road, it has no authority in departmental matters.

In organizing the bureau it was decided that, if employees were to be assisted to assume greater responsibilities, such assistance must be extended to every man in the service that desired it, no matter what his position or occupation might be, but the acceptance of the company's offer is not obligatory on the employee. The only way to reach all employees with equal effectiveness and to insure to every man the opportunity to take advantage of this offer was, we believed, to give the instruction according to methods of successful correspondence schools.

Complete courses are being prepared on such subjects as there is the greatest demand for. Other subjects or special lines of work, on which information is desired by only a few of the employees, are being covered by special instructions, or, possibly, by transferring the employee to a department or position where he can gain the information desired through practical work with the co-operation of the bureau.

No attempt has been made to get students, yet more than 1,600 have voluntarily sought the advantages offered, and 80 per cent. of these have made good.

New Erie Furniture Car.

A special form of furniture car has recently been put in service on the Erie Railroad. It has a steel underframe and wooden superstructure. The capacity of the car is 80,000 lbs., and 100 of them have been built by the Pressed Steel Car Company of Pittsburgh, Pa. Among them 25 are equipped with end doors.

The length of the car over end sills is 50 ft. 7¼ ins., and the width over side sills is 9 ft. 1¾ ins. The distance from centre to centre of bolsters is 40 ft., and with a truck wheel base of 5 ft. 4 ins., the total wheel base becomes 45 ft., 4 ins. Inside the car is of ample dimensions, measuring inside of lining 50 ft., 4¼ ins., and width 9 ft. The height of the floor to the top side plate angle is 10 ft. The door opening is 10 ft. wide by 9 ft. 5 ins. high. The length over the running board is 51 ft. 8⅞ ins. The distance from top of rail to top of brake mast is 14 ft. 7 9/16 ins., which is practically the clearance of the car. Altogether the furniture car is a good example of an excellent design of vehicle intended for a special purpose.

NEW STYLE OF FURNITURE CAR FOR THE ERIE.

Assured Future.

A benevolent Buffalo lady does some charitable work among newsboys. She heard lately about Johnny Flynn, both of whose parents had been sent up for drunkenness, so she sought out the urchin and began by remarking: "Johnny, when your father and mother forsake you, who will take you in?" "The police," promptly answered Johnny.

Motive Power Problems.*

The problems frequently met in the motive power department of one road may be unimportant on another. I recently had an interesting conversation with a gentleman who for about five years was in charge of the motive power department of a short but important railroad in the tropics. I found that in addition to the work that usually falls to the motive power department he had a good deal to do with sanitary problems, such as hospital equipment, the building and operation of ice machine plants and other work of a mechanical nature incident to life in the tropics. Such problems are seldom met with in temperate climates by railway motive power men, but on the other hand we have to maintain and occasionally use snow plows and to meet other problems, as of heating and ventilation, which gave him no concern.

The functions of the department, broadly speaking, are of design, construction, maintenance and operation. The engineering phases are generally questions of design, though you will find traces of engineering throughout the entire list. Briefly speaking, the work of the motive power department consists of the design of freight and passenger cars, locomotives and shops, their construction, which in the case of cars and locomotives is mostly done in the shops of contractors, and the maintenance of cars, locomotives and other equipment.

Some railroads go very much into details in matters of design, while others depend largely, or almost entirely, upon the builders for their designs. The railroad usually has a pretty definite idea, however, as to the character of the equipment and construction wanted, and the builders are at least given limitations either of weight, capacity, or price to which they work. Like other engineering work, there are certain standards and practices generally observed, as in the case of car axles, freight car wheels, brake shoes, air brakes, locomotive injectors and similar equipment, so that it is not necessary for the designer to work up all the details.

I once knew a structural steel draftsman who invariably refused to use a formula or a table of weights, moments of inertia or logarithms which he had not personally checked. He was a fine mathematician and thoroughly capable of deducing formulas and logarithmic tables, but he consumed so much time in unnecessary computations that he was not of very much use as a designer. Our experience teaches us that a six-wheel passenger truck with journals of a certain size, and with proper lubrication, can be depended upon to carry a certain weight under normal conditions; that a certain size of locomotive injector is capable of supplying water to a boiler of a certain size and intended for some particular service, but that under different conditions a larger or smaller injector may be used to advantage; that with one kind of coal a locomotive intended to haul a given train may require a grate area of 80 to 100 sq. ft., while with a different kind of coal a much less area is ample. It would seem, therefore, that railway engineering design was very largely a matter of experience, but the fundamental principles can certainly be much more easily acquired in an institution like this than in any other way.

As for the question of shop design it does not very often happen that we have an opportunity to lay out a shop as we would like to have it; there are usually limitations with respect to property lines, topography, finances or the utilization of existing buildings that have to be taken into account.

WHO REALLY BUYS SUPPLIES.

The purchase of material and equipment on railroads, and in other large organizations, is usually left to a purchasing agent, who consults more or less freely with the officers of the motive power department and other departments for whom he buys, and as a general thing this material, or equipment, is bought to the specifications of the department using it, and is inspected by the same department. In order to meet this need for inspection, a test department is maintained on most of the larger railroads, and the material is either inspected at the mills or at the laboratory of the railroad, the nature and thoroughness of the inspection depending very largely on the amount and kind of material under consideration. This inspection is extended to material, used in the construction of new equipment and equipment itself is usually inspected during construction by

*Abridged, from address by Mr. F. H. Clark, '90, General Superintendent of Motive Power, Chicago, Burlington & Quincy Railroad. Delivered before the Faculty and students of the University of Illinois.

men taken from among the workmen of the railroad and especially detailed for the purpose, boiler work being inspected by a competent boilermaker, machine work by a machinist, the steel work of a car by a man familiar with such work, the air brakes by a man familiar with air brake work and the painting by a practical painter. The inspection and testing of material and equipment is frequently performed by the employees of the various bureaus organized for that purpose, and who maintain a sufficient force of men of various qualifications to cover the work in hand. A railroad will frequently furnish its own inspectors for a part of such work and depend upon the inspection bureaus for the remainder.

OPERATION AND MAINTENANCE.

Assuming that our equipment has been designed, purchased and delivered, the questions of operation and maintenance begin to arise. Our locomotives are put into service and from the start require a considerable amount of attention at terminals. In order to provide the necessary attention, engine houses or roundhouses are furnished where the engines are provided with coal, water and sand, and given such repairs as their condition requires. These day to day repairs, or running repairs as they are generally called, are performed by machinists, blacksmiths, boilermakers, hostlers, oilers and various others. An engineer bringing in an engine is usually required to fill out what is commonly called a work report, on which he indicates the repairs or other attention needed. On arrival at the engine house inspectors go over the engine tightening up nuts and doing other work which can be quickly and easily done by means of a hammer or wrench, and making note of any work that may have been overlooked by the engineer. The roundhouse foreman, or his assistant, takes these reports, assigns the work to the various men interested and has the engine prepared for another trip.

The cost of locomotive repairs varies widely, depending upon the age and general condition of the power, as well as the size of the equipment and service in which it has been used. It usually falls between 3 cents and 15 cents per mile run, with an average perhaps of 6 cents or 7 cents per mile, and as a general thing the cost of repairs is about equally divided between roundhouse, or running repairs, and shop or general repairs.

It is quite possible that your attention has never been specifically called to the importance to the railroads of their roundhouse or enginehouse facilities, though you may have all had opportunities to visit railroad repair shops and have been interested and impressed with the work done. There are about 60,000 locomotives in the United States and their cost of maintenance is approximately $2,500.00 each per year, or a total for all of $150,000,000.00. About one-half of this work, amounting to $75,000,000.00 is done in the roundhouse. In addition to this running repair work the roundhouse organization is required to perform such service work as may be necessary, including the movement of engines, the washing of boilers and tanks, the cleaning of flues, firing up, and coaling, sanding and watering, etc. The cost of this service varies between wide limits, and averages something over $1.50 per engine or approximately $500.00 a year for each engine owned. This adds about $30,000,000.00 to the amount expended in roundhouses and makes a total of $105,000,000.00.

Assuming the cost of repairs to locomotives to be $150,000,000.00 a year, the cost of repairs to freight cars about $125,000,000.00 a year and the cost of repairs to passenger cars about $50,000,000.00 a year, makes a total of $325,000,000.00 a year expended by railroads for the repairs of locomotives, and passenger and freight cars. Of this amount $75,000,000.00, or 23 per cent., is spend for roundhouse repairs, with an additional $30,000,000.00 for service.

REPAIRS TO EQUIPMENT.

The repairs to passenger equipment are handled in somewhat the same manner as locomotive repairs, the minor, or running repairs being made at terminals, and heavy, or general repairs at shops where facilities are provided for repairing or removing worn, decayed or broken parts, and for painting, varnishing and doing other work necessary to preserve a good appearance. The terminal repairs consist very largely of washing, dusting and cleaning, and the renewal of brake shoes, journal bearings, wheels, axles and other parts subject to wear. Freight car repairs are handled similarly.

Freight cars are interchangeable between the various railroads of the country, and I suppose that if we were to go to the nearest large freight yard we would find cars belonging to the railroads of all parts of the country. On some railroads you will find that 75 per cent. or more of the cars in service are foreign cars, or cars owned by other railroads, while on other roads you will find not over 10 per cent. of foreign cars. In order to facilitate the movement of freight cars, and to make the best possible use of them, the railroads agree not only to interchange their equipment under mutually accepted rules, but to make repairs to the freight equipment of one another, the charge and credits involved being agreed upon through the Master Car Builders' Association.

One of the present day problems, as you may be aware, has to do with the relations between employer and employees. It is not altogether a question of wages, but largely a question of working conditions and arrangements. It is unnecessary to go into details, or to make any suggestions other than to point out to you the importance of an understanding of human nature. This has been the basis of a great many successes not only in the handling of labor, but in salesmanship, politics and in fact any line of work in which you have to deal with and get along with other men. Most men in high places in railway or other corporations are good executive officers, they may incidentally be engineers, but they hold their places not alone because they are good engineers, but because they possess the faculty of successfully planning and directing the work of others. A man's success depends not on what he alone can do, but upon his ability to interest others in his plans and ideas, and to get them to co-operate with him in carrying them out.

Having thus briefly indicated to you the nature of the problems of the department some further remarks may be in order as to the considerations necessarily involved in their solution. It is the business of the railroads to provide means of transportation, both for passengers and freight, and to make their service as efficient and attractive as possible. The management of a railroad is necessarily specialized or divided into several departments, all working with the same end in view. They must therefore work in harmony and with due consideration for the conditions and requirements of the other departments. This makes it necessary for the motive power department to keep in sight some of the problems of the transportation and traffic departments; it means that our freight locomotives shall be so designed that they can make their trips over the road in reasonable time and haul trains heavy enough to make it possible to do business at a profit; that our passenger engines must be so constructed that they can comfortably haul a reasonable number of passenger cars and maintain a schedule usually fixed by competitive conditions. The freight cars must be designed with reference to the service for which they are intended and the convenience of the shippers.

One of the problems that is always with us is that of making reductions in the cost of doing work. We cannot make such reductions by reducing the pay of the workmen, but may be able to do so by changes and methods of doing the work, which may involve the purchase of new machinery. I think I have said enough regarding our problems and hope that what has been said will not lead you to think that the work is disagreeable. The most of us, on the contrary, find it exceedingly interesting, because perhaps of the variety of the problems involved.

The best-regulated home is always that in which the discipine is the most perfect and yet where it is least felt.—*Smiles.*

Kansas City Freight Station.

Recently a contract has been let by the Chicago & Rock Island Railroad for a splendid new freight station to be built in Kansas City to provide for the constantly increasing freight traffic, inbound and outbound, which has to be handled. Mr. H. T. Hawk, architect for the Rock Island lines, drew the plans for this station. Following other experiences in reinforced concrete building construction, he specified Ferro-lithic plate, consisting of dove-tailed cross-ribbed steel sheets, which act both as form and reinforcement. The concrete is applied on the upper side, while a good plastering surface remains on the lower side.

A great saving in time is secured by this construction, since no wooden forms are needed. It also saves the waste lumber inseparable from wooden forms. This construction is to be used for the ceiling of the second floor of the new station, which will be used by the office force. The building is now in course of construction, the contractors being Messrs. George B. Swift & Co. of Chicago. As the result of this step in concrete construction taken by the chief architect of the Rock Island lines, it is expected that similar buildings erected by the railroad along its route will include similar specifications. The Kansas City freight station is planned as a model in up-to-date railroad building construction, and an object to the Middle West.

Not Paid For.

Ebon Johnson rose in prayer meeting one night and said he desired to tell the dear friends present of the great change of heart that had come over him, so that he now forgave, fully and freely, Deacon Jones for the horse he had sold him.

Deacon Jones was too shocked at first to reply. He soon recovered himself, however, and he rose in his pew and said:

"'I am, indeed, glad, dear christian friends, to have gained Brother Ebon Johnson's forgiveness but all the same he ain't paid me for the hoss yet.'"

Graphite for Railroads.

A new booklet has just been issued by the Joseph Dixon Crucible Company, of Jersey City, N. J., setting forth the advantages of the use of graphite on railways. It covers the Dixon line of products that are widely used in railroad service. The object of the book is to name and describe under one cover all the various products in the Dixon line that are of interest to the various mechanical departments of railroads. These include various graphite lubricants, protective paint, crucibles, facings, etc., all of which have been found by actual service to give satisfactory results.

The booklet runs to 40 pages, and is quite attractively illustrated by means of photographs showing different views of railroad stations and yards, different types of locomotives, stretches of tract, signals, bridges, etc. If you are interested in the use of any graphite products about the railroad, you should write for copy of this booklet, which will be sent free to those desiring it.

Practical Railroad President.

As an illustration of the practical ways of Mr. Daniel Willard, president of the Baltimore & Ohio, in looking after everything that makes for the best interests in the road, it is related that on his way home from New York he left his private car and went into the cab of the engine, in which he made the rest of the journey. Being an expert engineer himself, it was not long before he discovered that the locomotive was not doing its best work. This was no fault of the man in charge. On reaching Baltimore he had the engine turned over to test experts. The fault in the locomotive was soon discovered and rectified, but this did not suit the wide-awake railroad chief, and he gave orders for the similar testing of all the passenger engines.

Transactions.

The Transactions of the American Society of Mechanical Engineers for the year 1909 has just been published. It contains 1,069 pages and covers a great variety of engineering subjects. The Hudson-Fulton Celebration, which took place in New York in September, 1909, was participated in by the society to the extent of presenting a very interesting collection of models of the early steamboats used in this country. The principal ones of this collection are illustrated in the Transactions. This book may be obtained from the secretary of the society, Mr. Calvin W. Rice, 29 West 39th street, New York.

Treatment of Boiler Feed Water.

An illustrated pamphlet has just been issued by the Dearborn Drug & Chemical Works, 193 Michigan avenue, Chicago, wherein their five methods of analysis of water is described and illustrated. An admirable feature of this company's work is the fact that before providing any of their solutions to minimize the pernicious effects of the various mineral substances unavoidable in almost every kind of boiler feed water, a careful analysis of a sample of the particular kind of water is made and the solution best calculated as a counter agent is supplied. A perusal of the pamphlet will convince anyone that the impurities in water have a much more deleterious effect than is generally supposed, apart from the loss of heating power, one-sixteenth of scale, which consists mostly of carbonates, occasioning a loss of no less than 12 per cent. of effective heat. Copies of the pamphlet may be had on application.

An Artist in Smoke.

Among the clamorous claimants for heavy damages on account of the smoke from locomotives there is an artist hailing from Weehawken, N. J. While at work on a canvas and while he was overlooking the classic Palisades on the Hudson River, and drinking in the lovely scene, he says his work was damaged beyond remedy by the grimy smoke of the passing locomotives blurring the speckless wonder of his cobalt sky. Has he forgotten, or perhaps he does not know, that in the temperate zone, especially in the vicinity of the larger cities, a certain penumbra is necessary to give color to the scene? In the dappled dawn it is golden gray. As the sun rises heavenward the orient flame glorifies the hazy atmosphere until it shines like burnished copper. Then comes the golden afternoon, and at sunset crimson fading into opalescence. If he only knew how to use smoke properly it would make a dozen pictures. He may have an eye for heavy damages, but he has no eye for heavy coloring. His suit will end in smoke.

Removal Notice.

Owing to greatly increased business the H. W. Johns-Manville Company, of New York, announce the removal of their offices now at 85 Shelden street, Houghton, Mich., to more commodious and convenient quarters at 96 Shelden street, where they will be better prepared to serve their patrons. As in the past, Mr. S. T. Harris, who has been associated with the company for a number of years, will be in charge of the offices at the new address.

M. C. & L. P. A. Proceedings.

The Proceedings of the Forty-first Annual Convention of the Master Car and Locomotive Painters' Association, held at St. Louis, Mo., last September, have just been published in a handsome volume of 150 pages. In addition to the reports of the various officers there are nearly twenty separate papers and essays printed in full, with the details of the debates on the same. Much of the matter is of real value to those interested in the best methods of painting and preserving the painting on locomotives and cars, and it is interesting to note the marked improvements as shown by the results of the methods coming into vogue of recent years. The officers for 1910-11 are Mr. J. H. Pitard, president; Mr. J. P. McCracken, vice-president; Mr. John Hartley, second vice-president, and Mr. A. P. Dane, B. & M. R. R., Boston, Mass., who fills the double office of secretary and treasurer, and to whom applications for membership should be sent, as well as orders for copies of the Proceedings.

Turntable Tractors.

The increasing use of Mallet locomotives of great weight and length has brought the railroads face to face with the difficult problem of turning these locomotives. In the first place, they are

ERIE NEW FURNITURE CAR.

very heavy, the weight running to 350 tons and over, but what makes the problem of turning them even more difficult is the great length of wheel base. Furthermore, if a table but slightly longer than the locomotive is used, it will be very much more heavily loaded at the end under the locomotive than under the tender, even when the tender is fully supplied with coal and water. To make it possible to balance such locomotives under all conditions would require the construction of turntables of excessive length, the direct and indirect expense of which would be enormous. The other alternative is to turn the engines on tables merely long enough to carry them without making any attempt at balancing. When one realizes that this means carrying an unbalanced load of upwards of 50 tons in some cases on the trucks at one end of the table, it will readily be seen that not only must a powerful tractor be used, but one having enormous tractive effort. Messrs. Geo. P. Nichols & Bro., of Chicago, have recently developed an electric tractor for this class of service, which in general arrangement and appearance is similar to their standard electric tractor, but with its tractive effort increased to meet the severest requirements of the service referred to above.

The line of railroad heretofore operated by the Hunter's Run & Slate Belt Railroad Company has been surrendered and transferred to the Gettysburg & Harrisburg Railway Company, and has been operated by the latter company from midnight of October 31, 1910.

The Spread of the English Language.

According to figures given in an Italian paper the English language, which a century ago was spoken by twenty million individuals, is now the means by which no less than a hundred millions give expression to their views on things. French, on the other hand, has spread less than any of the chief European languages, for whereas it was used by thirty-four million people at the beginning of the nineteenth century, it is now spoken by forty-six million. Seventy million individuals speak German to-day, against thirty-six million a hundred years ago; six-nine millions Russian, against thirty millions; thirty-two millions Italian, against eighteen millions; and forty-four millions Spanish against thirty millions.

Woodworking Machinery Catalogue.

"J. A. Fay & Egan Co., have just issued a new catalogue, No. 84, containing 384 pages. It is printed in two colors, profusely illustrated with fine half-tones plates, and the whole is elegantly bound in a five-color cover. This catalogue is a reduced reproduction of the company's large general catalogue. It will make a valuable addition to any woodworker or mill man's library, as it shows the very latest models in all kinds of machinery for working wood. It is sent free to any address upon receipt of a request to the manufacturers, the J. A. Fay & Egan Co., Cincinnati, Ohio."

One More.

A patient in an hospital had been kept on low diet for a couple of weeks, and naturally he longed for a square meal. One morning the doctor found him so much better that it seemed his appetite could at last be safely appeased. "Do you think you could eat a small chicken to-day, Tim?' asked the doctor. "Faith an' Oi could, sor," eagerly responded the patient. "And what would you like to have it stuffed with?" queried the doctor. "If it's all the same t' yez," answered Tim, "Oi'd loik to have it stuffed with another chicken, sor."

Bulletin No. 1007.

The American Locomotive Company have just issued their bulletin No. 1007, dealing with four-cylinder balanced simple engines, as typified by engine No. 1040, built for the Chicago, Rock Island & Pacific Railway. The details of construction of this engine are fully described and it is illustrated by half-tone and line cuts. A profile of the road over which the engine operates is also given. An interesting feature of the bulletin is a very comprehensive table of a comparative test, showing relative fuel consumption of a two-cylinder simple engine, a four-cylinder balanced compound and a four-cylinder balanced simple superheater locomotive. The tests from which this table is compiled were made in severe winter weather. The company will be happy to send a copy of this bulletin to anyone who makes a direct request for one.

Railroad Ships.

Quite an artistic calendar for 1911 has been got out by the Canadian Pacific Railway, its main feature a painting of a great ocean-going steamship fleet, 67 vessels, all flying the house-flag of the railway. The ships of this fleet, if placed one after another, would form a line three and one-half miles long, and it takes 12,000 men to man them, and 3,000 tons of coal are burned in them every day. The Canadian Pacific owns or controls over 16,000 miles of railway, maintains sixteen hotels and gives employment to 75,000 persons. The house-flag of the company is something like six squares out of a checker board alternately red and white. This house-flag, as it is called, is worn by all ships of the Canadian Pacific Railway, and is flown at the mizzentop.

M. C. B. Proceedings.

The Proceedings for 1910 of the Master Car Builders' Association was received about the middle of last month. This is No. 44. It is a bulky volume of 853 pages and contains the numerous reports which were presented at the last annual meeting with the discussions given verbatim. The standards of the association and the recommended practice are also given. Copies can be obtained from the secretary of the association, Mr. Joseph W. Taylor, 390 Old Colony Building, Chicago. Price, $1.50.

The Porter's Dilemma.

The porter was greatly perplexed. At High Polsover a lady with a lorgnette entered the train. She was a middle-aged, tall, angular, tailor-made woman, and she looked sternly at the commercial traveller in the seat opposite through her lorgnette. Before seating herself she opened the carriage window. At Hudson Cross another woman came in.

She had fluffy hair and an appealing look in her blue eyes. She sat down and glanced at the open window and shivered pathetically; then she looked at the commercial traveller.

"I shall be frozen to death!" cried the fluffy-haired lady.

"If this window is closed I shall suffocate!" cried the other woman.

The porter opened his mouth. He started to raise the window. Then he retreated. Dazed, he turned appealingly to the commercial traveller. Both the women also turned to the commercial traveller. That gentleman rose, passed by the ladies, opened the door to the platform and went out, followed by the porter.

"And what, sir," said the porter, "would you say as 'ow I should do, sir?"

"It's quite simple" said the commercial traveller. "Leave the window as it is, open, till one lady is frozen to death; then close it and suffocate the other. I'm going forward for the rest of the trip."

More McKean Motor Cars.

The Pennsylvania Railroad people are experimenting with McKean motor cars on certain of their branch lines, and the experience has been so satisfactory that motor car service is likely to be established on many parts of the Pennsylvania Railroad system. The Long Island Railroad, with its numerous short branches, offers an excellent field for motor cars, as the intention is to employ them largely in the near future to replace steam-moved trains that carry few passengers.

The McKeen motor car people inform us that one of their 55-ft. motor cars has been delivered to the Woodstock and Sycamore Traction Co., of Sycamore, Ill. This is the second car the traction company now have. Recently a new 70-ft. gasoline motor car, "Greeley," for the Denver, Laramie & Northwestern Railroad, left Omaha, propelled by its own power. This car went to Denver, via the Burlington Railroad, but will be operated on the lines of the Denver, Laramie & Northwestern Railroad in regular service between Denver and Greeley, Colo. This is the ninety-third car turned out by the McKeen Motor Car Company. Another 70-ft. motor car for the Denver, Laramie & Northwestern Railroad will be delivered during this month. These two cars will be used to handle the passenger business between Denver and Greeley and will supplant the present steam service. This makes 94 McKeen motor cars in service at the present time.

Worshipping Flying Machines.

It is said that aviation is not considered orthodox among Mussulmans. M. de Caters has given his impression to a Paris contempoary of his visit to Constantinople. He says the Turks and Arabs greatly amused him. "The Koran says that only God is able to exalt himself above men, so one can imagine how awestricken Turks were when they saw me in my aeroplane above their capital. They looked upon me as a demigod. As to the biplane, most of the Turks did not dare approach it. Those who did made their salaams to it."

Help the Roundhouse Foreman.

In the course of a recent tour of the Middle West we had occasion repeatedly to admire the utility and convenience of Brownhoist Locomotive Cranes. No roundhouse where as many as thirty locomotives have their ash pans cleaned daily can afford to get along without one of these cranes. It is used not only to handle pit ashes, as no other method can approach, but it is a ready help in lifting the numerous heavy articles that have to be handled about roundhouses or the adjacent yards. Every roundhouse fore-

BAS O BISPO CUT, PANAMA CANAL.

man reading this item who is suffering from want of a Brownhoist crane should get after his master mechanic to order one and the demand should be insisted on till it is filled. No modern lavor-saving appliance pays better.

Specializing.

He was an American visitor, and as he sauntered into the barber's shop he freely criticised British methods of work and business.

"You don't specialize," he said; "you should stick to one branch of a thing and master it completely."

The barber said nothing, but lathered his face very liberally, and then sat down to read.

"Well, why don't you shave me?" inquired the American, after five minutes.

"We only lather here," was the response; "you must go into the next street for a shave."—*Tit-Bits.*

Record of Recent Construction.

Bulletin No. 68, Record of Recent Construction, was issued last month by the Baldwin Locomotive Works and fully maintains the high standard of illustrations and presswork which has always distinguished their publications. There are sixteen types of the Mallet articulated locomotives shown. These range from the comparatively light engines built for the Little River Railroad. These locomotives weigh about 70 tons, and have a tractive force approaching to 12 tons. The largest type shown are those now in operation on the Atchison, Topeka & Santa Fe and weigh 231 tons, with a tractive force of 480 tons. A fine feature of the Bulletin is the sectional drawings showing the details of the steam pipe from the superheater to the low pressure steam chest. Copies may be had on application to the Baldwin Locomotive Works.

A Seasonable Story.

Frederick C. Boyer, a well-known Cleveland editor, told at a recent press banquet a newspaper story.

"A Medina editor died," he said, "and was, of course, directed to ascend to the Abode of the Just. But during the ascent the editor's journalistic curiosity asserted itself and he said:

"'Is it permitted for one to have a look at—er—the other place?"

"'Certainly,' was the gracious reply, and accordingly a descent to the other place was made. Here the editor found much to interest him. He scurried about and was soon lost to view.

"His angelic escort got worried at last, and began a systematic search for his charge. He found him at last seated before a furnace, fanning himself and gazing at the people in the fire. On the door of the furnace was a plate saying : 'Delinquent Subscribers.'

"'Come,' said the angel to the editor, 'we must be going.'

"'You go on,' the editor answered, without lifting his eyes. 'I'm not coming. This is heaven enough for me.'"

4,000,000 In Use.

"Four million Tate flexible bolts in service," is one of the very striking claims made by the Flannery Bolt Company, of Pittsburgh, Pa. It is put forth on a neat little circular that this company is sending to their many friends and prospective buyers. The front page of the folder is practically a short and to-the-point business letter from Mr. B. E. D. Stafford, the general manager.

The inside sheet gives two views of a completely flexible firebox, if one may so say. The box is one used on the boiler of an Atlantic type engine in which all but the crown stays are the Tait flexible bolts. The boiler record of this locomotive is summarized in the letterpress below the illustration. Write to the Flannery Bolt Company if you would like a copy of the circular.

Discrediting Railways is Bad Business.

The United States Post Office officials are prosecuting a get-rich-quick concern in New York which is said to have swindled the public of $100,000,000 in the last five years. The question is suggested. How did so many people come to invest in worthless securities? During the time that vast swindling has been going on, railway bonds have been greatly discredited by the acts of politicians and others assailing railway rates and railway interests generally. Capital is naturally timid, and foolish people with money to invest who had become accustomed to hear railway securities abused, took the risk of purchasing stocks they knew nothing about. People who are suffering from the loss of the property that has gone into the hands of the noted swindlers have the prevailing anti-railway sentiment to blame for their misfortunes.

Here You Are.

Superintendents of machinery looking for means of reducing expenses ought to look into the cost of having castings and forgings made by the Steel Car Forge Co., Pittsburgh. From what we have learned of this company they are prepared to sell these things cheaper than they can be made in any railroad shop. Considering the noisy public demand prevailing for railroad companies to reduce the expense of repairing rolling stock, it seems to us that this opportunity should not be neglected.

New Version of Jonah's Escape.

The old method of whaling is almost a lost industry. In the April *Harper's* Clifford W. Ashley relates his experience on a long whaling voyage, and incidentally reports the following remarks of the mates on whales and the adventure of Jonah:

"There are only two kinds of whale," said Mr. Hicks. "One of 'em is the sperm whale, the rest of 'em is the other. The sperm whale is mainly valuable for his oil (sperm oil, you understand); has teeth only on his under jaw like a cow, fights at both ends, has one forward spout, and lives only in warm country. Now right-whale oil ain't worth beans; you hunt him for bone. He's got a whole sieve made out of slabs of bone in his mouth instead of teeth. Then he only fights with his flukes; but you bet he can use them pretty lively. Never known of a right-whale's crossing the line. Swallow Jonah? Humph! Well, a sperm whale could a-done it, but how'd you like to swallow a woolly worm? No wonder it went again' his stomach."

Where They Make Stocks and Dies.

The Armstrong Manufacturing Co., Chicago, makers of stocks and dies and a variety of other shop appliances, have greatly increased the capacity of their shops in the last two years. They used to depend upon outside concerns for drop forgings and were frequently embarrassed by delay in filling orders, so they added a drop forging plant to the works and it is now in full operation. Some large tool holders recently made in the shops are the finest drop forgings we ever examined.

To See the Wind.

Seeing the wind is a rare but easy feat. The object wherewith it may be seen is a common saw. On any blowy day—the wind being, say, in the north—hold your saw with the ends pointing one to the east, the other to the west. Take the saw as if you were going to cut the air upward, and let the teeth, which are on top, tilt over till the flat part of the saw is at an angle of 45 degrees with the horizon. You will then see the wind. Looking along the teeth of the saw, you will see the wind pour over them as plainly as you may see water pouring over a fall.

Make Steel Passenger Cars Noiseless.

Railroad officials ordering steel passenger cars ought to compare the asbestos car board lining furnished by the Franklin Manufacturing Co. with other lining on the market to be used for the same purpose. Lining of street passenger cars is one operation where cheapness in first cost produces by far the most expensive work in the end. The thin, cheap car board supplied by some concerns rapidly falls apart through the vibrating of the car and from the first it has no effect in reducing the noise naturally conveyed through the steel sheeting. Steel passenger cars are slowly making their way into public favor and every care should be taken to reduce the noise. Substantial lining is the very best promoter of comfort in such cars.

"Clinging" Recollections.

"I'll slap that reporter," growled old Weston Nurox over the morning paper.

"Why, popper," replied his daughter, who had her coming out reception the night before. "I thought he wrote me up real nice."

"But he spoke of ye as wearin' 'some soft, clingin' material,' an' that reminds me too much o' the time I was tarred and feathered out in Montanny."

Fireless Locomotives.

The Hanover Machine Company, at Hanover-Linden, Germany, are constructing fireless locomotives in new forms, and these engines are coming into special favor in factories and works where there is danger of fire. They are also very suitable for shunting purposes about dwellings, sheds and workshops. They are distinguished from stoked locomotives by their water and steam reservoir, which takes the place of the firebox and boiler. The water is heated by attaching a pipe to a stationary boiler plant. The heating or charging does not occupy more than fifteen minutes, and the locomotive is ready for service. Of course, when in service, the pressure sinks gradually. A full descriptive catalogue may be had on application.

The Un-Appian Way.

At a pageant recently given in Shropshire commemorating Britain at the time of the Roman occupation, a young woman spoke to a tall, burly and shivering man whose Roman toga hardly protected him from a raw, penetrating east wind.

"Are you Appius Claudius?" she asked, eagerly.

"Me, miss?" he replied, dismally. "Me 'appy as Claudius? Oh, no, miss. I'm un'appy as 'ell."—*Harper's Weekly.*

Storrs Calendar.

The Storrs calendar, which reaches this office regularly every three months, is always welcome and is a never-failing source of reference. A unique feature about this calendar is that it gives the dates and locations of all the railway conventions and club meetings. It has saved us a great deal of time usually wasted searching for the date and place of meetings, for which we are duly thankful. The calendar is quite as reliable as Storrs Mica Headlight Chimneys, and it makes no more breaks than the chimneys do.

Change in Signal System.

Mr. W. H. Elliot, signal engineer of the New York Central, gave evidence before the Public Service Commission, second district, at the final hearing in the case of the proposed Buffalo, Rochester & Eastern. Mr. Elliot said that the New York Central has decided on a signal system from Croton to Buffalo which will eventually cost $3,000,000.

The blocks will be shortened to an average length of one mile. At present they are about 8,700 ft. The average daily number of trains now operated on the main line tracks is 58. On tracks Nos. 1 and 2 there are trains for passengers, and 30 freight trains on tracks Nos. 3 and 4.

When the automatic signal equipment is completed, Mr. Elliot said, it will increase the capacity of the western division 25 per cent., and the Hudson division 100 per cent. He added that if it were possible to still further shorten the blocks to a length of 4,200 ft. the carrying capacity of the road would be increased 200 per cent. more than at present.

By changing the present mode of moving trains and having the two east and westbound tracks together, the tonnage and train capacity of the road could still further be increased. To do this it would be necessary to have all the present freight and passenger stations relocated.

Law Worthy of Imitation.

There was once in Scotland one known as Good Queen Margaret, who interested herself actively in elevating the condition of the people. She had a law passed that any bachelor over twenty-one years of age was under a penalty of one hundred marks should he refuse to marry any maiden who asked his hand. The penalty was remitted if he proved that he was engaged to be married to another woman. The women of Scotland took care that the law was strictly enforced and remarkably few unengaged young men were to be found running about loose.

Origin of the Pigtail.

The report that the Chinese Department of State Affairs contemplates issuing an order directing officials, soldiers and police to give up their queues and to wear their hair short recalls that the queue was introduced into China by the Manchu dynasty nearly three centuries ago. It is said to have been originally suggested to the Manchus by their sense of gratitude to the horse, that animal having played a great part in the Tartar conquests. In short, the "pigtail" was a method of establishing a relationship between human beings and horses.

Decrease of Tips to Car Porters.

An important item of railway news alleges that the sleeping-car porters connected with the Pullman Palace Car Company have requested that their pay be raised owing to the increasing tendency of passengers to reduce the magnitude of the tips. In other words, people who ride in Pullman cars are beginning to adopt the policy that it is the business of the sleeping-car company to pay their employees and not burden others with the duty.

Made Small.

A station master on the Pennsylvania Railroad got a holiday about Thanksgiving time and went out into the woods to hunt. When he reached the depth of the forest a terrific rainstorm came on. He found a hollow tree into which he crept with much difficulty, but when he attempted to get out after the rain stopped he found himself trapped. He tried all means in his power to emerge from the hole until he was thoroughly exhausted, then he concluded that he must end his days in that hole. With the prospect of death he began thinking over his sins. "I thought of all the pranks I had played as a boy," he remarked afterwards, "then the thought of all the mean things I had done as a man, then I remembered that I had voted the Democratic ticket at last election and it made me so small that I fell out of that hole."

Corrugated Firebox.

The Wood Loco. Fire Box Co., of Media, Pa., have issued an illustrated circular showing the construction of Wm. H. Wood's patent locomotive firebox and tube plates. These firebox plates are corrugated, that is, they are pressed into ridges and hollows, and it is in each of the hollows that a line of staybolts is placed. Mr. Wood's claim is that this increases the flexibility of the sheet and adds very materially to the heating surface. The flue sheets are made flexible at their edges so that, as Mr. Wood explains, the expansion and contraction of the tubes is properly taken care of. Write to Mr. W. H. Wood, engineer, Media, Pa., if you would like to get a copy of the folder.

Suffering Enough Already.

Dolly—"There's no end to the impudence of some men. One of those political agents called on me this afternoon, and asked me if I would persuade my husband to vote for women's suffrage." Polly—"And what did you say?" Dolly—"Say, my dear? I told him pretty quickly that I thought women have to suffer quite enough as it is, and I shut the door in his face."

Profitable Mining.

"I think you said, 'Rastus, that you had a brother in the mining business in the West?"

"Yeh, boss, that's right."

"What kind of mining—gold mining, silver mining, copper mining?"

"No, sah, none o' those; kalsomining."

Substraction.

"Now, in order to substract," the teacher explained, "things have always to be of the same denomination. For instance, we couldn't take 3 apples from 4 pears, nor 6 horses from 9 dogs."

"Teacher," shouted a small boy, "can't you take 4 quarts of milk from 3 cows?"

Magnetic Myths.

Some of the magnetic myths seem quite plausible considering the scientific knowledge of the time, while others are so far-fetched that we can hardly conceive of their having been taken seriously by the great thinkers of the day.

For instance, we may very easily excuse the great Greek philosopher Aristotle for believing that submerged magnetic rocks might attract ships loaded with iron nails, even to the point of sinking them. Indeed, this notion was so strongly believed that in certain vessels sailing for Tapiobane the nails were replaced by wooden pegs. But when he also maintains that some lodestones attract gold, silver, copper, and tin, we smile at this scientific inaccuracy; and when he says, further, that there are even lodestones which attract the flesh and bone of man, we must put him down as repeating one of the numerous magnetic myths of his time. Most of these related to supposed magnetic rocks and magnetic mountains, others to magnetic ores which were said to attract human flesh—so-called "flesh magnets."

Another and evidently popular myth which we find seriously reported in several books issued as late even as the sixteenth century tells us, with all seriousness, how the ancient temple of Serapis in Alexandria (Egypt) had a lodestone fixed in its roof so that an iron statue was suspended in mid-air touching neither floor nor ceiling.

Parallel to this is the legend of Mohammed's being magnetically suspended with his tomb.

Another series of myths, apparently originating in Sweden, sought to explain the fact that the compass needle does not point to the geographical north pole of the earth by telling of a strongly magnetic island to which it pointed.

Other myths, now equally as funny, with our present-day knowledge of the subjects, were the Italian ones about the "Ethiopian magnets" which were said to repel iron; also the French ones about rubbing a diamond to make it attract gold and about the effect of garlic on the magnetic needle. Coming nearer our own time we find one English writer telling of magnetic cures for wounds, while another wrote a whole volume to refute the idea that the earth is a gigantic globular magnet. At Amsterdam one of the seventeenth-century authors held that everything in the world had the magnetic power of attracting or repelling, and that the sun was the most magnetic of all bodies.

Then when in 1677 a German writer worked out a scheme of perpetual motion by means of magnets we have the connecting link between the myths of the past and of the present. For even to this day there are some in every country unscientific enough to believe perpetual motion possible and imaginative enough to look to magnetic means for realizing this sole survivor of a long series of myths.—*Popular Electricity.*

Air Brake Questions.

We are always pleased to give special attention to questions asked by our correspondents, and always make an effort to answer them through the Question and Answer columns, especially if it is likely to be of general interest. Some questions are answered by letter, among them those that relate to some local condition, but while answering any of them an effort is made to keep the answer entirely free from individual opinion.

If the question is of such a nature that it has been encountered within the range of our own practical experience, we do not hesitate to answer accordingly; however, if the question has been covered by papers or tests submitted to the Air Brake Association, we have no hesitancy in quoting the result as an authority.

If not positive as to whether the question asked has been conclusively answered by a series of air brake tests, we do not hesitate to call upon the Westinghouse Air Brake Company for the information, and if they have nothing definite on the subject presented, they are always eager to conduct a test for the purpose of obtaining a reliable record of their own as well as furnishing the information asked for.

At the present day personal opinions are not seriously considered; everyone has a right to his opinions. But for information of practical value the results of tests are accepted as the conclusion; especially is this true regarding air brake problems.

There is but one man today whose word is accepted by air brake men as an authority on that subject, namely, Mr. W. V. Turner, but he does not answer questions asked him by expressing opinions.

That his word is accepted as authority is due to the fact that by ability as a practical air brake man, he has designed and perfected the modern brake equipments in use, which alone qualifies him to speak with authority.

When questions asked through our columns are of such character as to warrant it, the advice of Mr. W. V. Turner, chief engineer, and of Mr. P. H. Donovan, engineer of tests of the Westinghouse Air Brake Company, will be placed before our readers. Calling attention to errors or any criticism of these columns is appreciated, as mistakes and misprints are liable to occur in any publication. It is our aim to have as few of these as possible and our aim has been very satisfactorily realized.

The Westinghouse Electric & Manufacturing Company has just issued its Part Catalogues Nos. 6141 and 6143. No. 6141 lists parts for the Westinghouse type 306 Interpole Railway Motor for direct current circuits. No. 6143 lists Standard Metallic Brushes for A. C. and D. C. circuits.

Liberal Both Ways.

"Give me more bread, waiter," exclaimed a diner in the elevated station restaurant. I eat a good deal of bread to the meat." "Yes," replied the waiter, "you eat a good deal of meat to your bread."

Railway and Locomotive Engineering

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The Penhorn Creek Viaduct.

In our issue of July, 1910, we gave a detailed and illustrated description of the open cut through the Bergen hill on the Erie Railroad. The cut contains four tracks and is one of the great engineering works that the railroad may well be proud of. This month our frontispiece shows a view of the four-track steel viaduct which the Erie Railroad has built to connect with the open cut, and the viaduct carries the road down to the level of Jersey City.

The original tunnel was slightly higher in elevation than the terminal and it was reached from the station by tracks elevated through the streets of Jersey City but coming down to tunnel level about 500 ft. east of the west portal. On account of economy in freight operation and in construction it was decided that the elevation of the new cut at its easterly end would be made 40 ft. above the old tunnel and so bring the tracks down to the grade of the elevated structure in the city on a four-track viaduct. This viaduct is known as the Penhorn Creek viaduct, and extends from the portal of the cut 2,550 ft. east, making a change in elevation of 22.6 ft. on 1 and 1¼ per cent. grades. The easterly 754 ft. is on a timber trestle, which is part of the original elevated structure in the city. This will be filled in later. The remaining 1,776 ft. is occupied by a heavy steel structure. The work was begun a year ago and it has recently been completed. The new cut is immediately alongside the old tunnel, so that the viaduct is nearly over the old main line of the railway.

FOUR-TRACK VIADUCT ON THE ERIE RAILROAD OVER THE PENHORN CREEK, LOOKING EAST TOWARD JERSEY CITY.

The heavy four-track steel viaduct consists of alternate 30 and 61-ft. plate-girder spans, supported on transverse girders, which rest on three columns, standing on concrete pedestals. With the exception of the two 66-ft. crossings at Monmouth and Coles streets, respectively, the columns are spaced laterally to suit conditions.

Under the old arrangement freight and passenger trains were run through the tunnel, the passenger trains keeping on the main tracks to the Jersey City station while the freight trains were switched either to the north or to the south to the freight yards on each side of the passenger station. The new arrangement uses the four-track line for passengers only, and the freights will run through the two-track tunnel, taking the same switch on the north and the south tracks at a point nearer the tunnel. As the viaduct is directly over the old main-line tracks it was necessary to shift them before construction could be started. At a point some 200 ft. east of the portal of the old tunnel a curve of larger degree was put in, bringing the two tracks to the south of the old line to a tangent, parallel to the old straight line, but about 25 ft. south of it. The north one of the two old tracks has been used in the erection of the viaduct, and the other one, being outside of the line of the viaduct, has been used for construction purposes and for a through line for the regular railway traffic.

Old-Time Railroad Reminiscences.

By S. J. Kidder.

In keeping good my promise made in the June issue to relate what I saw up the Union Pacific Line and some of my experiences while there it has, I fear, got me into a state of perplexity for as my thoughts wander back to those strenuous days so many incidents present themselves that I am led to wonder whether space can be found in Railway and Locomotive Engineering to print them. However, an endeavor will be made to keep my writing lever "hooked up" in the shortest cut-off and be as brief as possible.

It was a desperately cold day when I boarded the train at Omaha for North Platte, 291 miles away, and the occasion is doubly impressed on my mind as two very important events in my career occurred, one being my employment by the Union Pacific Railroad, the other becoming of age and a full-fledged voter.

The night's ride was without incident and on the morning of December 31, 1867, the train pulled by engine No. 2, a little 14 x 22 Danforth & Cooke, Joe Young engineer, rolled into North Platte, where we stopped for breakfast and to change engines, and not long after resumed our journey westward with a small Hinkley, No. 15, George Thomas, known far and wide as "Whalebone," at the throttle.

The town of North Platte, situated in the fork of the North and South Platte rivers, was the second division station west of Omaha. The track reached this point in the fall of 1866, when building operations began there, and not more than six months later it had expanded into a pretty good sized place. The buildings were all of wood, some of logs, other than the round house and shop, which were of brick construction, the town proper lying south of the railroad with nothing north of the track but a freight house, the round-house and shop.

The business houses, hotels and saloons, the latter a very important adjunct to frontier towns of that day, stood in a row parallel to and facing the railroad and perhaps a hundred feet from it, this space being unoccupied. The railroad hotel was quite a large, pretentious affair, being used in the treble capacity of a public house, restaurant for passengers and a depot. Owing to the rapid growth of the town from a barren waste and the fact that the population was composed very largely of young, unmarried men employed by the road, there were comparatively few private houses and as a consequence boarding houses and restaurants were quite numerous. Many of the employees were far away from home and bent only on making a "stake" that they might again get back into civilization and, as may be surmised with the average individual, it was not so much a question of paying board bills as it was to jump the country with their pocket book well inflated with greenbacks.

Board and room bills were largely a matter of credit, to be settled when the pay car arrived, and which occasionally skipped a month or two between trips, and to prevent employees when leaving the service between times from collecting their due at the paymaster's office in Omaha, thus leaving their board bills unpaid, an arrangement existed between the purveyors of board and lodgings and the paymaster whereby the latter was promptly notified by telegraph the amount due the creditors, whenever a man in their debt boarded a train for Omaha. Under this arrangement the sums reported to the paymaster were held out of the late employees stipend and subsequently delivered to the landlord to which it belonged. The scheme operated so satisfactorily that it did not take long for the restaurant keepers to discover they could expand their revenue both coming and going, it being a very simple matter to inflate the board bill materially, leaving the late boarder no redress when drawing his pay. That this "hold up" did not always pan out is illustrated by the "coup" performed by Tom M. Tom had objected to a month's board bill of some seven dollars more than he could reconcile with the account he had carefully kept in his notebook, and when he took exception to the overcharge the restaurant keeper insisted his own record was correct. "Well," said Tom, "you have got the best of me, but I will get even." "All right," said the landlord, "if you think you can get even with me, you are welcome." Tom laid off when the first of the month came round, though kept right on boarding at the old place until he had run up a bill of seventeen dollars, then took his time, went to Omaha and called for two months' pay. The paymaster directed Tom's attention to the board bill, to which he replied it was all right, but that he didn't want what pay was coming the present month, he was only after that for March and April. The paymaster evidently assumed that Tom had worked up to the time of quitting the service and promptly handed him the amount asked for. Then Tom returned to his hotel, and wrote a letter to the restaurant keeper to the effect that "you were seven dollars ahead of me on that board bill, now I am seventeen dollars ahead of you." "I have collected all the money due me from the U. P. and you can collect yours out of the balance (?)." At other points on the road meal tickets costing three for one dollar were used, which precluded misunderstandings such as above recited. Small change was little, if any, used west of the Missouri river, as usually the most insignificant things sold for two bits, an equivalent of twenty-five cents. Sleeping accommodations in North Platte were far from the best, and one never knew when he returned to his room whether any of his belongings would be found where they had been left, as there seemed to be a sort of general sentiment that when a chap needed clothes he could help himself to the other fellow's provided he got the chance. As a consequence, many of the men had each a box made 7 x 4 x 2 ft. in dimensions, with hinged covers, which could be closed and locked. These boxes were scattered about that portion of the round house used for a carpenter shop and in the receptacles the owners slept and kept their wearing apparel when not in use.

The only sure crop raised in the Platte River valley was fever and ague and during my time there it was a quite prolific one. At the most unexpected moment cold chills would be experienced, meandering up one's spinal column. As to whether quinine was procurable or not the writer does not know; but as an antidote the unfortunate quickly made his way to the boiler house and in company with a dozen or twenty others similarly afflicted stretched himself under the projecting boiler shell, which cleared the brick floor some two feet, and there endeavored to combat his bodily agitation, though oftentimes with but indifferent success.

The Lodge Pole Division, where I was engaged during my stay on the plains, extended from North Platte to Sidney, Neb., 123 miles. The route was along the South Platte river some ninety miles, then a few miles further on struck and followed Lodge Pole creek to Sidney. Throughout the entire distance not a tree or even a bush knee high was to be seen, not a furrow of ground was turned up, nor was there any sign of human habitation other than at the railroad stations.

The stations were from 15 to 19 miles apart and, with two exceptions, consisted of a small frame depot building, a water tank, a "doby" house, in which the station agent, section hands and the men who pumped water by hand into the tank resided, and a passing track. Ogalalla had in addition to this a coal shed and Julesburg could boast of a number of buildings scattred about, having been the year before a town of some thousands of people, most of whom had later moved to Cheyenne, bag, baggage, buildings and all.

The doby houses were of frame construction, their sides and ends, other than the space occupied by a door and windows, being covered with sod piled from the ground to the eaves hard against the building and some two feet thick, thus making a sort of improvised fort for protection against the Indians. Adjacent to the house and perhaps one hundred feet away was an excavation in the ground, about the size of an ordinary room, and some five or six feet in depth. At intervals across this hole were timbers resting upon the surface of the ground and covered with planks, upon top of which was two or more feet of dirt and sod, this arrangement providing openings between the timbers, the spaces being several inches in height from the ground to the planks. An underground passage extended from the house to the larger excavation, to which the occupants could flee and have more effectual protection in case the house became untenable from Indian attacks, while at the same time the party attacked could, with reasonable safety to themselves, discharge their rifles and carbines at the redskins through the long, narrow apertures under the planking.

The track of the Lodge Pole Division, although passing through the first winter following its construction, was in fine condition and well provided with locomotives of various builds, consisting of Rogers, McQueen, New Jersey Locomotive and Machine Company, Hinkley, Manchester and Lancasters. The cost of operating these engines was somewhat excessive, as all the coal had to be obtained from Illinois, Wisconsin and Iowa, then transported from 500 to 1,000 miles, and ranged in cost from $28 to $42 per ton delivered at places for use, while wood for firing up cost from $18 to $22 a cord by the time it reached the firebox. But one engine was a wood burner, the No. 8, and that she was a *wood burner* indeed those who fired or ran her could testify. She would start out with dry red cedar wood piled on the tender high above the cab roof and a flat car immediately behind with some ten or twelve cords. During the latter part of the trip the two brakemen would carry the fuel along the car to the tender, the fireman mounted on top of the tender threw it to the pit, while the engineer both ran the engine and endeavored to satisfy the insatiate maw of the old McQueen, everybody meantime wondering whether the supply would hold out until their destination was reached.

The water along the road was strongly impregnated with alkali and at various places the ground was covered with it, many acres in extent, and sufficient in quantity to give the surface an appearance of being overspread with snow. The alkali contributed largely to the engine raising its water and foaming.

Its use, too, when endeavoring to perform the necessary abulations at the end of a trip, was fraught with drawbacks, as soap had little effect and much of the coal dust and other foreign matter on the face and hands finally found lodgment on the towel, much to the disgust of the landlord whose wash room was being used.

Alkali also seriously afflicted many by affecting the eyes and to an extent that a necessary precaution when retiring was to have a vessel of water within convenient reach of the bed with which to soak the eyes upon awaking, this being the only method of getting the firmly sealed lids separated.

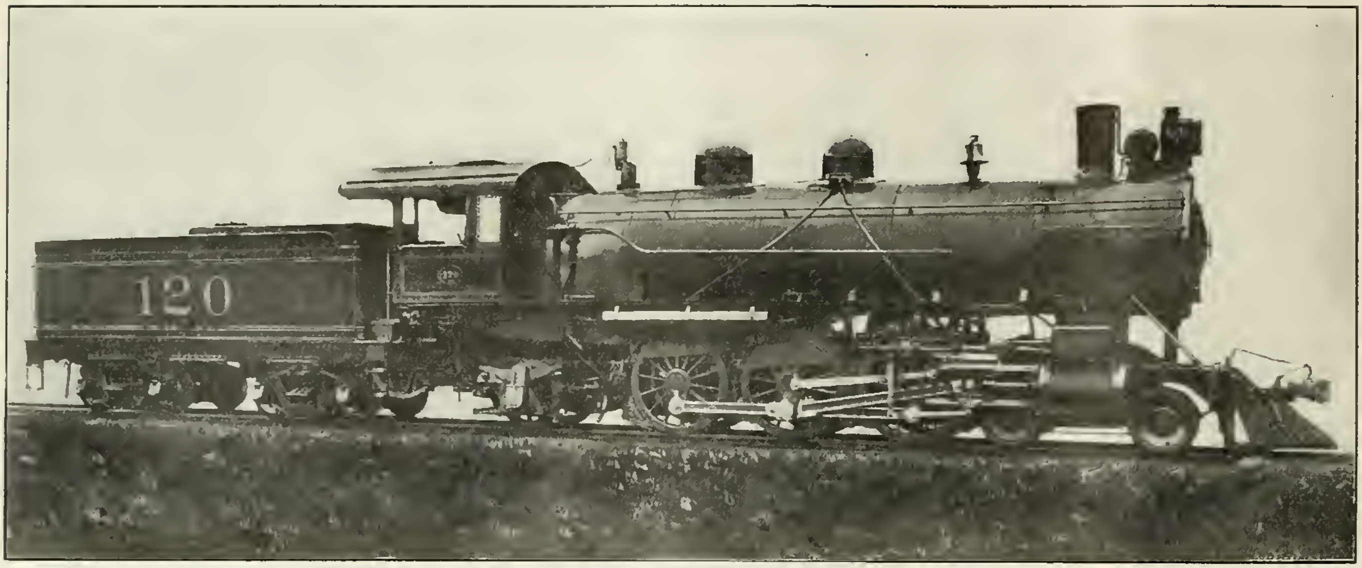
Lightning Proof.

A very interesting example of the effect upon lightning of the presence of points is the Temple of Solomon. Josephus tells us that the roof was ornamented with points covered with gold; the points, probably, were intended to prevent birds from settling and so soiling the roof. But the unintended effect was that the Temple was perfectly protected from lightning, and in a country in which thunderstorms are severe and frequent it stood undamaged for a thousand years. When the Roman Emperor tried to rebuild it, leaving out the points and the gold, it was "struck" at once. If, then, we ask why lightning-conductors do, as a fact, get struck, the answer is that the point has not sufficient time to dissipate the electric discharge. The cloud charge above and the earth charge below are developed towards each other so rapidly that the point cannot keep pace with the accumulation.

VIEW OF MEADVILLE FREIGHT YARD DURING THE MARCH FLOOD, 1910.

Pacific Type for the Mexican Railway.

The main line of the Mexican Railway extends from Vera Cruz, on the sea coast, to the city of Mexico, a distance of 264 miles. The road traverses a mountainous country and has maximum grades of 3½ per cent. and curves of 16 degs. Two daily trains are run in each direction, and they cover the distance between termini in about twelve hours, making 29 and 31 station stops respectively.



C. H. Burk, Locomotive Superintendent. 4-6-2 ENGINE FOR THE MEXICAN RAILWAY. Baldwin Locomotive Works, Builders.

For passenger service on this road the Baldwin Locomotive Works have recently built three Pacific type locomotives, one of which we are able to show in our illustration. These engines exert a tractive force of 31,000 lbs., and use moderately superheated steam at comparatively low pressure. With their ample boiler capacity, large cylinders and medium-sized driving wheels, they are well adapted to mountain service.

The boiler is designed for a pressure of 180 lbs., but in service the safety valves are set at 155 lbs. The shell is composed of three rings, which have longitudinal seams on the top center line, and are welded at the ends. The outside firebox shell slopes towards the rear, so that while the side water legs are inclined slightly outward at the front they are vertical at the back. The firebox is radially stayed, with one row of inverted T-bar, hung on expansion links, supporting the front end of the crown sheet.

The superheater is of the well-known Vauclain type, and is located in the smokebox. The gases are compelled to circulate among the superheater tubes by a cylindrical deflector, which is centrally located in the smokebox and is closed, at the back, by a cone-shaped extension. The stack has a downward extension, which communicates with the space enclosed by the deflector. A very liberal area of netting is provided. The exhaust nozzle is single and of moderate height, and the stack has a minimum internal diameter of 18 ins. The smokebox as well as the boiler is jacketed.

These locomotives are equipped for burning coal, but oil tanks are also furnished so that they can be changed to burn liquid fuel if desired. The grate is arranged to rock in four sections and has drop plates at the rear. The ashpan hoppers have sliding bottoms, and front and back dampers are provided.

The cylinder castings are strongly ribbed and secured to the smokebox and to each other by double rows of bolts. The steam distribution is controlled by balanced slide valves, driven by the Baker-Pilliod motion. This gear has been redesigned and simplified and the angularity of the eccentric rod materially reduced. The motion work is supported in a cradle, placed outside the leading drivers. The valves are set with a constant lead of ¼ in.

The frames are of hammered iron, with double front rails and separate rear sections of the same material. The equalizing beams and beam fulcrums are of cast steel, as are also the driving-wheel centers and driving boxes. The wheel centers have bronze hub liners. The back truck is of the Hodges type, with outside journals.

The tender frame is composed of 12-in. channels with wood bumpers. The trucks have cast steel side frames and bolsters, triple elliptic springs and solid rolled steel wheels. The water tank is U-shaped in plan and carries 6,000 gallons of water, while the oil tank, which is furnished in case it is desired to use liquid fuel, has a capacity for 2,500 gallons. Fuel, 8 tons of coal.

Further particulars of these engines are given in the accompanying table:

Cylinder, 23 x 28 ins.

Valve, balanced slide.

Boiler—Type, straight; material, steel; diameter, 74 ins.; thickness of sheets, ¾ in.; fuel, coal; staying, radial.

Firebox—Material, steel; length, 114⅛ ins.; width, 60¼ ins.; depth, front, 72 ins.; back, 62½ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water Space—Front, 4½ ins.; sides and back, 4 ins.

Tubes—Wire gauge, No. 11; number, 318; diameter, 2¼ ins.; length, 19 ft. 6 ins.

Heating Surface—Firebox, 176 sq. ft.; tubes, 3,637 sq. ft.; total, 3,813 sq. ft.; superheating surface, 388 sq. ft.; grate area, 47.7 sq. ft.

Driving Wheels—Diameter, outside, 63 ins.; journals, main, 10 x 12 ins.; others, 9 x 12 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6 x 12 ins.; diameter, back, 42 ins.; journals, 8 x 14 ins.

Wheel Base—Driving, 11 ft. 10 ins.; total engine, 31 ft. 4 ins.; total engine and tender, 60 ft. 9 ins.

Weight—On driving wheels, 141,000 lbs.; on truck, front, 40,000 lbs.; back, 35,000 lbs.; total engine, 216,000 lbs.; total engine and tender, about 335,000 lbs.

Tender—Wheels, diameter, 33 ins.; journals, 5½ x 10 ins.

Grade Crossings Eliminated.

Not long ago the public service commission ordered nine grade crossings to be abolished by the Long Island Railroad on their north side division in Flushing. The Legislature at its last session appropriated $200,000 for such work in Queens County, inasmuch as the law requires that the city and State shall each pay one-quarter of the cost. The remaining half is to be paid by the company. With the amount thus available the commission could only order an improvement to cost not more than $800,000, but inasmuch as the commission substantially approved the plan submitted by the Long Island road for a general improvement covering about 13,000 ft. of roadbed, which the city's engineers also approved, the company agreed to pay the extra cost, which will bring the entire amount to more than $1,000,000.

so made that when they would be secured to the spout of the oil can they could be so made that they would hold firmly to the spout of the oil can. T. J. Pratt.

Paterson, N. J.

Engines on State Roads of Chile.

Editor:

I am an old and enthusiastic reader of Railway and Locomotive Engineering. I enjoy very much knowing the railway progress in every sense. Your paper tells me what happens in several

SPARK ARRESTER OUTSIDE.

places of the world in connection with railway lines, but it tells very few over this country, one of the foremost of South America, where ran the first steam locomotive on Caldera-Copiapo Railway. At present this old American locomotive is on exhibition at National Exposition, held in Santiago, the country's capital. I enclose a few photographs of locomotives that run over State railways. There is plenty of variety between them—French, German, English, Scotch, American and Nationals. If you find that they are of any interest for your paper I shall feel very much pleasure.

Heriberto Hunoze.

Talca, Chile.

Locomotive Design.

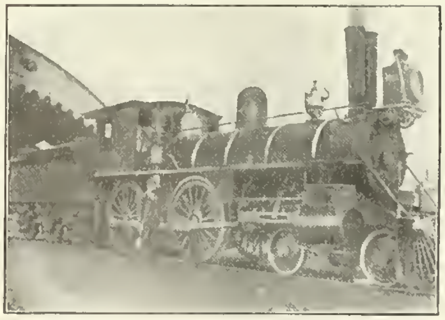
Editor:

At the present time nearly all of the large trunk lines have their special design of Pacific type locomotive for heavy fast passenger service. These engines have many features in common, but differing only in details and standard practices. The most noticeable feature is the huge boiler, with its big grate area and large reserve boiler capacity, with dimensions in diameter that are close to track limitations. The piston valve and Walschaerts valve gear are a conspicuous part of the equipment of nearly all of these engines and this combination gives a steam distribution which is far from being ideal, but meets present service requirements with a fair degree of economy.

Let us consider why it was necessary to adopt this type of locomotive when its predecessor, the Atlantic type, was a faster and more efficient engine. The public demand for all the luxuries of the modern hotel, in travel, together with a desire for speed, has put a tremendous tax on the twentieth century locomotive. Not only must the heavy train of steel cars be kept in motion at a high speed, but it must be heated, lighted, ventilated and braked as well. All of these are important considerations, as they cause a constant drain on the locomotive boiler. The steam consumption of auxiliaries is so great that locomotive designers have been forced to consider it in selecting power for limited trains.

It happens that the drain on the boiler from auxiliaries is greatest in winter; the time when the train resistance and radiation from the boiler amounts to the most. In winter the horsepower consumed by auxiliaries is about 300 for a ten-car train, which may be divided as follows: 75 h. p. for operating the two 9½-in. air pumps; 60 h.p. for operating turbo-generators for train lighting, and 150 h.p. for heating and ventilating. The total of 300 h.p. calls for the combustion of about 1,500 lbs. of coal per hour. It is common for Pacific type power in this service to consume 8,000 lbs. of coal per hour. Hence we may say that about 18 per cent. of the coal consumed is used by auxiliaries.

The Atlantic type engine had its limitations of weight and power. The boiler capacity could not be increased without increasing the weight per axle above the allowable limit. Hence it was necessary to adopt the Pacific type of locomotive. Even this type of engine has developed to the full extent, and in the future, if service requirements become more severe, a new type will have to be perfected—probably some design of Mallet compound. The limitation of the Pacific engine is somewhere in the neighborhood of 2,000 h.p., with a rail weight of 60,000 lbs. per axle. Assuming that the most satisfactory factor of adhesion is 5, we have 36,000 lbs. as the maximum tractive power available with this type of engine. Increased tractive power necessitates increased tractive weight, and the latter can only be obtained by the addition of another driving axle, which means a longer rigid wheel base.



ENGINE WITH TWO SMOKESTACKS.

A long rigid wheel base is undesirable in passenger service, and hence when it becomes necessary to add more driving axles to passenger engines the Mallet type will most likely have to be used. The Pacific type of locomotives in service on the Pennsylvania Lines are probably the largest engines of that class which will ever be built, as the tractive weight has been carried to the extreme limit.

It is still the consensus of opinion that the Atlantic type is the ideal passenger locomotive, and that the Pacific type is a necessary evil. There have been many instances where engines of the 4-4-2 class have been able to make better running time with moderately heavy trains than the larger and more powerful 4-6-2 class engines could do. Why this should be so is not difficult to ascertain. The six-coupled drivers of the Pacific type engines act as a break in preventing further acceleration, and at high speeds the centrifugal force of the rods produces such high pressures that the rod and pin friction absorb a considerable portion of the work, and at speeds of eighty miles an hour and more, nearly the entire power of the engine is consumed in moving itself.

Speeds of eighty miles an hour are rare indeed with the Pacific type engine, and then they are attained only under the most favorable conditions. The internal friction of this type of engine is something enormous at high speeds. This is easy to conceive when we consider the friction of the large driving bearings—10½ ins. in diameter and 14 ins. in length—as well as the 8 x 14-in. journals of the trailer, which travels much faster on account of their smaller diameter.

The Pacific type engine possesses merit as a time freight engine, and already several roads have adopted them for this service. The capacity of the Pacific type engine can be greatly increased by use of the superheater, and

SCOTTISH ENGINE, ATLAS WORKS.

some of the late designs have been provided with a fire-tube superheater. Simple engines of this type have been more satisfactory than compounds.

W. Smith,

Roundhouse Foreman, C. & N. W. Ry.

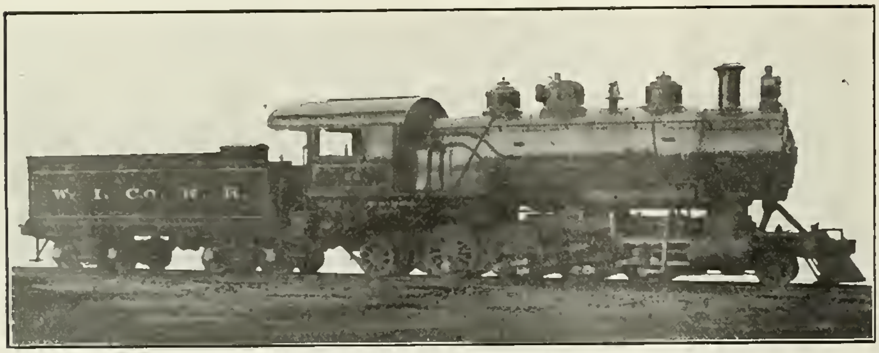
Clinton, Ia.

Baldwin Engine All Right.

Editor:

I take the liberty of enclosing herewith negative No. 3396 of the Baldwin Locomotive Works, the last locomotive delivered to our company, thinking it might be of interest to your readers, if you care to reprint it without cost to us. These engines are working on three to four per cent. grade and fifteen degree curve and have been extremely efficient. The cylinders are 22 x 28 ins., the driving wheel 51 ins. in diameter and with a working pressure of 200 lbs. this gives a tractive effort of 45,173 lbs. and a factor of adhesion of 3.9 with 178,200 lbs. on the drivers.

A. H. Woodward,
Vice-Pres. Woodward Iron Company.
Woodward, Ala.



BALDWIN 2-8-2 BUILT FOR WOODWARD IRON CO.

Packing Throttle Stem.

Editor:

R. A., Indianapolis, Ind., in your October number asks what to do if the packing should blow out of the throttle suffing box, and your answer, would, if acted on, take at least one hour to pack the stuffing box again. I have had this failure and packed the stuffing box without blowing the boiler down, that is, packed the stuffing box with a full head of steam in about 15 minutes.

The throttle gear was of the kind that pulls out to open the throttle valve and is pushed in to close the valve.

This is how the work may be done by pulling the valve open to its fullest extent. Pull up reverse lever to the center and set brakes. It will be found that the steam and water will stop blowing and the gland can then be removed and packing put in; the gland and nuts are then replaced. The reason that the steam and water stops blowing when the valve is pulled out as far as possible is that the portion of the throttle rod passing through the stuffing box is kept free from scale, but the part between the stuffing box and the bell crank gets covered with scale and when the rod is pulled out as far as possible this scale forms a steam-tight joint between the rod and the inside end of stuffing box

It would be possible to pack a throttle stuffing box without stopping if on an incline where the throttle could be pulled wide open and hooking lever up to or near the center. But it is better to stop, as the vibration when running may cause the point to blow.

Of course, a new engine with a clean rod could not be packed this way. But why could not the rod be enlarged just inside the stuffing box so that it would have a tendency to form a joint with inside end of stuffing box when the valve is pulled open while standing. It would, of course, be necessary to put the reverse lever on the centre and brake hard on before opening throttle valve to pack the gland. E. E.

Rockhampton, Australia.

Disconnecting Engines.

Editor:

I will thank you if you will send me at your earliest convenience information desired herein. First, what disconnections should be made on 6-wheel connected engine which has main rod connected to rear pair of drivers. Second, when on the middle drivers, main rod not being attached to same drivers as eccentrics, what would do in the way of disconnecting in case main rod should break or should strip one side, and would it be possible to move engine some distance safely under the circumstances? R. H.

Springfield, Ill.

[In view of the very interesting article from Mr. F. P. Roesch, which appeared in our November, 1910, issue, page 452, we have printed part of the letter from our correspondent, R. H., and we would be glad to have the comments of those who have had similar disconnections to make. Write us your experience or say what you would do. Where the eccentrics are not on the main driving axle it is necessary to keep a side rod for connecting the main driving wheels and those carrying the eccentrics, or the engine could not be moved. Look at Mr. F. Nihoof's letter to the editor, page 488 of the December, 1910, issue.—Editor.]

Differences in Similar Engines.

Editor:

The peculiar differences in operating locomotives of the same design and built by the same makers, noticed by your correspondent, Mr. O. P. Angelo, in your issue of January, 1911, are due to several causes. In order to obtain satisfaction in the running of a locomotive, or any other engine, it is essential for its parts to be accurately and strongly fitted. If the fitting has been carelessly done it will be impossible to run the engine freely for any length of time. Some important part is sure to work loose, or get out of line, and cause more or less trouble. The engine must be properly cared for by the attendant. A wonderful difference is noticed whenever we run an engine that is properly cared for by an engineer who attends to his business properly and an engine in charge of one who is careless and spends no more time with his engine than is absolutely necessary. I have noticed the same differences in the behavior of machines made by the same firm from a single design and I have, in most cases, found that the peculiarities observed were due either to bad fitting or careless attendance on the part of the engineer. Providing conditions of fuel, water, atmospheric phenomena and handling skill are uniform, I think your correspondent will find that if he will take two or three of the locomotives he referred to in his letter and have them overhauled by a good mechanic and then tested that they will do similar work. Then if the engines are run by less careful men for a few weeks and are again tested there will be marked differences in the results. My experience has shown me that the character of the man in charge of a machine is a great factor in the smooth and economical running and efficiency of the machine. An expert engineer whose heart and soul is wrapped up in his engine and who strives to keep it in the best possible running order will get far superior results in running the engine than another man will who has less interest in the machine. To a practised eye, the machine proclaims the character of the man who has charge of it. A. Selwyn-Brown

New York.

Saving a Little Coal.

Editor:

With the coal bill a close second to the wage bill, if we could only save a little each day, say just a few hundred pounds, by being a little more careful in handling the engine, it would do some good.

The first place to start is at the coaling station and put a stop to overloading tenders with coal and having it fall off, endangering employees working along the track when engine is leaving terminal or coaling station. Now if only one hundred or two hundred pounds of coal fall off the tender each day in a month it will amount to at least $5 per engine, and nothing to show for it.

Then have the coal properly prepared for the fireman so that he can put all his time on the fire without having to put in from three to six shovels of coal in order to have time to break up coal which ought to have been already prepared for him so that he can get better results out of the coal which he burns, and will use a smaller amount in getting over the road. Saving is effected by seeing that the fireboxes are all cleaned out, flues bored when needed and the front end is kept tight.

Carrying too much water in the boiler will not help out the coal question and not operating the cylinder cocks properly, that is, always open them before starting so the condensed steam will not wash all the oil off the cylinder walls and valve faces.

In pumping an engine always try to maintain as near a level as possible. It is better to lose a little when you are going up a hill and going to drift down on the other side as the fire can be kept up in better shape for starting out.

If your engine blow-off around a station. Put on your heater and blow the steam back into the tank and save that instead of letting it go to waste. This can be done by using a little judgment so as not to get the water too hot. Now if we can only save say about ten dollars each month, and the company has say two thousand engines, it will amount to $20,000 per month. C. F. Sundberg.

Sioux City, Ia.

Valve and Cylinder Lubrication.

Editor:

In the January issue of your esteemed paper I notice an article by Mr. O. M. Foster relating to the lubrication of valves and cylinders of superheater engines.

The principal feature of Mr. Foster's device seems to be that by means of a valve operated by the throttle lever live steam from the dome or a dry-pipe is admitted into the oil pipes to assist the delivery of oil to the steam chest, which he maintains ordinary lubricators will not do.

As early as the latter part of 1898 I patented a device which is operated by the throttle lever and by means of which live steam from the dome is admitted into the oil pipes of the lubricator, in addition to the current of live steam passing through the auxiliary pipes and usual choke plugs in the lubricator.

This device has never been put into use because shortly after it was patented I discovered that by equalizing the pressures between the steam chest and the delivery end of the lubricator, by the very simple means of choking the outlet at the steam chest, the lubricator will successfully deliver the oil under the most disadvantageous conditions, and, as a matter of fact, even in connection with superheater engines.

It is my conviction that complicated means are not at all necessary for the purpose of successfully lubricating superheater engines, and that if the choke plug is taken out of the lubricator and live steam is allowed to flow in full volume from the equalizing pipes into the oil pipes, maintaining the choke at the steam chest, the lubricator will reliably and infallibly deliver the oil to the steam chest, even on engines with a high degree of superheat. L. Kassander,

Mechanical Engineer. Nathan M'f'g. Co.

New York, N. Y.

Enamel on Semaphore Blades.

Editor:

On page 8 of the January issue of Railway and Locomotive Engineering Mr. T. J. Pratt suggests enameled semaphore blades in place of painted blades. The Manhattan division, Interborough Rapid Transit Company, have used and are still using enameled targets on pot signals. These were made in England and are always in good condition; are easily kept clean and keep their color. The management is replacing these at the most important places with semaphores, which have to be repainted about twice a year. Some signals, on account of setting very low and catching the brake dust, have to be painted four or five times a year.

Right here I would like to ask why builders of signals do not put a small step or bracket of some kind on the front of the post so that repair men and signal painters can work with some degree of safety. In most cases when painting the red side of a blade, on poles having two or more signals, a man is in danger of being thrown down when the lower blade moves.

I reiterate what your correspondent states, "A man has to be almost an acrobat to paint them," and I want to add that a man has to be almost a monkey to get around them.

F. H. Sommer.

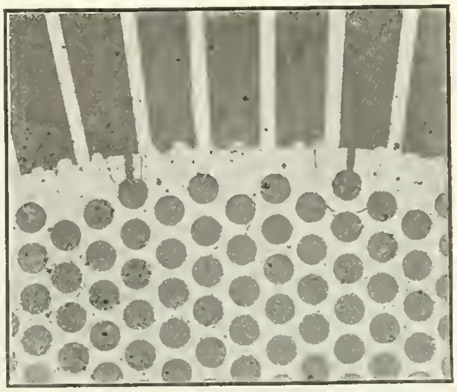
New York City, N. Y.

A Novel Weld.

Editor:

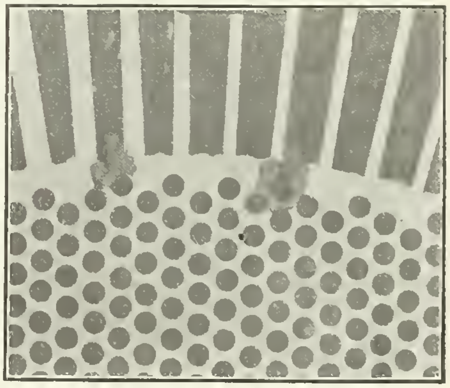
Cracks in the flue sheet of a locomotive boiler welded with Thermit without removing flue sheet.

The accompanying photographs show the cracks and weld before and after the process. These pictures were taken by flashlight from inside the boiler next to the front flue sheet, as can be seen by the crown sheet and bolts in upper part of each photograph. The cracks had been



CRACKS IN FLUE SHEET.

made larger in order to make room for the Thermit used in the welding process. The plugs seen in the other picture above where the cracks had been are the surplus compound which had been used in welding in order to insure a sufficient



FLUE SHEET AFTER WELDING.

amount having been run into the openings in the flue sheet. This, of course, was chipped off after the weld was made. The locomotive has been in constant service pulling passenger trains on the Buffalo & Susquehanna Railroad for the past four months and has given every satisfaction in so far as the weld is concerned.

Wm. Jones.

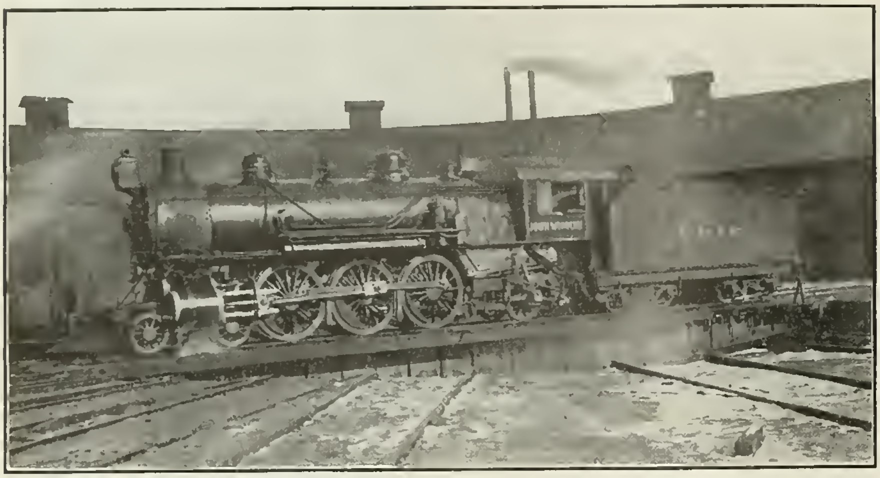
Galeton, Pa.

A Japanese Smoke Preventer.

From Japan come particulars of the invention of a smoke-preventing furnace in which compressed air is supplied to the fire through tubes forming an upper grate. The fuel is first deposited on this grate and partly consumed; the combustion gases pass downward through the grate, meeting the supply of compressed air. By means of a reciprocating agitator the partially consumed fuel is caused to fall then upon a second grate of the ordinary type, where combustion is completed.

Erie Names Engines after their Prominent Locomotive Engineers

The Erie Railroad management, which may always be depended upon to perform some kindly act towards old employees, has recently made the hearts of several of the old engineers beat happily by putting the name of each upon the engine he operates. Our illustrations shows one of the standard passenger engines with the name of "John Wonderly" painted on the cab below the window. Mr. Wonderly is one of the veterans of the throttle.



ERIE ENGINE NAMED THE "JOHN WONDERLY."

The compliment is peculiarly gratifying to Mr. Wonderly on account of one incident of his early experience. When he was first employed as fireman, many years ago, it was customary to name engines after the directors of the company. On one occasion an engine so named passed the one Mr. Wonderly was firing, and his engineer said to him, "Do you suppose you will ever live to see your name on an engine like that?" Mr. Wonderly answered in the negative, but he nevertheless went on during all these years working steadily and gradually building up a reputation for ability and good work which has been recognized by the company by giving him the honor which was in olden days reserved almost exclusively for directors and the higher officers of the company. We are able to present to our readers a picture of Mr. Wonderly's engine. It is a 4-6-2 and is used in passenger service. Two other engines are similarly named, and the men who run them are thus "honorably mentioned" by order of the Erie Railroad. The engine named after Mr. Harvey Springstead is a ten-wheeler and the one bearing the name of Jack Brunner is a ten-wheel engine, also in passenger service. The name on each engine is not only a fairly won honor by the men concerned but it has the effect of keeping before other employees the fact that good service on the Erie will be and is recognized in a very suitable and pleasing manner.

ERIE ENGINE NAMED AFTER JACK BRUNER.

Apparent Size Due to Distance.

There is an old poetic saying that "Distance lends enchantment to the view," and this is true in a more or less real sense as the distant mountains, steeped in a bluish haze, have, as it were, their sharp outlines softened and the ravines and profoundest depths are dulled and darkened into somber hues. Distance, however, does something much more tangible than simply stimulating the poet's thought. It makes an object apparently shrink in size as the distance between it and the observer becomes greater, and as the observer nears the object it apparently increases in size.

This growing and diminishing of the object as the distance from the observer to it is increased or lessened follows a law of nature. This can be proved in a very simple way. For example, the disk of the full moon is a circle with a diameter of about 2,160 miles and hangs in the heavens at an average distance of 240,000 miles from the earth, yet its brightly glowing silvery surface can be entirely obscured by a circle 1 ft. in diameter at a distance of 110 ft. from the eye. It can also be entirely shut out by a coin the size of a quarter of a dollar at a distance of about 3 ft. from the eye.

The fact that so large a body as the moon appears relatively so small is owing to two reasons; first, there is no other object whose size we are familiar with in the heavens near the moon, and second, the apparent size of an object varies inversely with the distance. This means that an object presenting a certain magnitude at say a distance of 50 yards will appear to be only half as large at 100 yards. At 150 yards it will appear one-third the size it was at the first interval. This is the reason why the rails in a track appear to run together in the distance. As a matter of fact, they are 4 ft. 8½ ins. apart all over the line, yet on a mile or two of tangent they seem to have met or to have but a small space between them. This is very marked, of course; but the fact that men or horses appear smaller to us at a distance from the cab windows of a locomotive is not so pronounced because they are surrounded with familiar objects which have grown apparently smaller with them while maintaining a strict proportion between them all.

In our December, 1910, issue, page 498, we alluded to the diffusion of light as following what is called the law of the inverse square. That is, as the distance from the source of light increased, the intensity of the light became less in proportion to the square of the distance. Light of a certain intensity at 50 yards became only one-quarter as strong at 100 yards or at twice the distance. We showed that one object of the parabolic reflector of a locomotive headlight was to concentrate all the reflected rays of light and pour them forth in as nearly as possible a parallel cylinder of solid light and so prevent diffusion and defeat the law of the inverse square.

It is rather a curious thing that even with a good headlight and a solid beam of light thrown from it upon an object there are two sources of loss which are encountered before the object can be seen. The first of these is the apparently reduced size of the object due to its distance, and the other is the loss of light coming from the object to the observer, and obeying the law of diffusion or that of the inverse square. When we speak of the apparent reduction of size, owing to distance, we know that the object itself does not shrink or grow large, but the angle the rays of light make with each other in passing through the lens of the eye does actually alter, and this is the reason for the apparent change in size.

To illustrate this point, suppose a man of known height stands 50 yards from the observer, the rays of light from his hat and from his boots pass through the lens of the eye and make an image on the back of the eye, let us say one-quarter of an inch high, and width in proportion. Now at 100 yards, or double the distance, the rays of light from hat and boots crossing each other in the lens of the eye make just half as great an angle with each other that the first pair did and they cause an image of one-eighth of an inch to fall upon the retina or back of the eye. This change of angle in the rays of light from the object is what causes a distant object to appear small and this change of angle varies inversely as the distance. At twice the distance the object apparently is half as large. This is not the law of the inverse square, and must not be confounded with it.

Although the headlight is pouring a concentrated cylinder of light upon the man, he gives back to the observer less light than he receives. In fact, as far as the observer is concerned, the man becomes the source of light, as he "shines," if one may so say, by reflected light. The light which he gives back at 50 yards, whatever it may be, is reduced at 100 yards by the operation of the law of the inverse square, and at 100 yards, or twice the distance, he only appears one-quarter as bright, and at that point he is apparently only one-half as large, the angle he subtends in the eye being only half what it was at 50 yards.

We have here the operation of two very interesting laws. The first governing the apparent size of a body, upon which perspective depends, is such that although the actual magnitude of a body does not change, it appears to become proportionally smaller as the distance increases, as may be seen in a line of telegraph poles beside a level straight track. And the other law, that of the inverse square, takes care of the amount of light which a more or less distant object can supply to the eye of the observer, and this determines to a great extent how clear or dim it may appear.

The apparent size of an object, as the distance increases, is like a man walking down under the slightly sloping roof of a freight shed, with his feet on the ground and his head touching the roof. As he goes from ridge pole to outer wall, he gradually shrinks with the slope of the roof. The other is like the variation in the size in the floors of a church steeple with a few feet of floor area at the top, increasing in size as each floor is reached in the descent until a comparatively large area is found where the steeple rests upon the solid walls of the tower.

Queer Taxes of Other Days.

Henry VIII. taxed beards, and graduated the tax according to the status of the wearer. For example, the sheriff of Canterbury was constrained to pay the sum of three shillings and fourpence for the privilege of sporting his venerable whiskers. Elizabeth likewise fixed a similar tax on every beard of over a fortnight's growth. Elizabeth was also bent on making the country of a religious turn of mind, and all who stayed away from church on Sunday rendered themselves liable to a fine. In 1695 it was decided that the arrival of every child into the world should be greeted by a tax. The birth of a child to a duke cost the proud, but harassed father £30, while the advent of a commoner's child into the world was hailed with a tax of two shillings. Moreover, it was an expensive matter to die, and bachelors and widowers also were compelled to pay for the privilege of single blessedness. With the advent of more constitutional days freak taxation did not cease. It was due to William Pitt that the window tax was instituted. In the reign of George I. it was necessary to have a license in order to sell hats. Then there was the tax on hair powder and the tax on watches and clocks. In the reign of George III. a duty of two shillings and sixpence was imposed on bricks. At a later period in the same reign bricks were divided, into common and dressed brick, the duty was proportional to size.

ERIE RAILROAD PASSENGER ENGINE "HARVEY SPRINGSTEAD."

Suburban Trains for India.

The railways serving the city of Bombay, the second in size of the British Empire, have naturally a large suburban traffic which has considerably increased during the past few years, despite the competition of electric trolley car lines on the island of Bombay itself. As in other towns, the development has taken place owing to the utilization of the central portions of the city for purely business purposes and the consequent removal of the residents to more desirable localities in the suburbs.

Bombay City is built on a long and narrow island not unlike Manhattan in shape, but differently situated. It runs parallel north and south with the mainland, the magnificent harbor being between. At the northern end only a shallow creek intervenes, and this is crossed by the railways and highways on embankments and bridges.

The Great Indian Peninsula Railway, which handles a very considerable portion of this large suburban passenger traffic, has put into service a series of seven-car trains, which have some novelties in their arrangement and construction. They have all been built at the Parel shops which are within city limits, and they were designed to meet the exceptional conditions of the service. The railway being one of the earliest in India, although built to the wide gage of 5 ft. 6 ins., has only a 12-ft. spacing of tracks, centre to centre, consequently with the type of carriage originally adopted and built on the English plan with cross compartments and outward opening doors accidents often happened owing to side doors being left open by the careless native staff, and thus allowing them to strike passing trains on the adjacent track. This difficulty was aggravated by the projecting "sunshade" of the old cars.

As stated, each train consists of 7 cars with bodies 62 ft. long and 10 ft. wide, built on steel underframes, 60 ft. over headstocks. Each train consists of a combination baggage and III class car at each end, three full III's, one combination II and III and one combination I and II, these being found from experimental running to give approximately the correct accommodation required, viz.: 20, I class; 91, II class and 537, III class each. Commencing with the end brake compartment the adjacent portion of the vehicle is allotted to the use of fishwomen carrying their fish and also ordinary luggage. The remaining half of the carriage is reserved for females only and is provided with a lavatory. The next three vehicles are full III's, while the fifth is a II and III with lavatory for the II class. The sixth vehicle is a I and II with a small reserved compartment for ladies. The last vehicle is exactly like the first and the compartment spoken of as being reserved for females in the first vehicle is similarly reserved in exchange on the return journey, it being the custom for women to always travel at the rear of the train. All the seats in the train I, II and III are of the "turnover" type, and this permits of all passengers facing the engine and consequently the breeze. The cars are vestibuled together and a passageway runs throughout the train to conform to government regulations for vehicles 10 ft. wide, a dimension which has given a roomy car with standing accommodation for the crowded trips. The handrails, handles, etc., are sunk flush with the panels so that the sides of the train present a smooth and uniform surface, reducing resistance to movement and rendering the carriages less noisy.

INTERIOR OF SECOND CLASS CAR, GT. INDIAN PEN. RY.

All the doors are 2 ft. 4 ins. wide and are constructed largely of metal so as to secure thinness as they open inwards for the reason already explained. The thin doors do not unduly infringe on the clear openings of the doorways more than 2½ ins.

GREAT INDIAN PENINSULA RAILWAY, BOMBAY CITY SUBURBAN SERVICE.

All the windows have movable glass frames as well as "Venetian" sun shutters, the former dropping whilst the latter are arranged to lift.

To protect the cars from the tropical sun they have a lining of hard asbestos slate "Nacolite" introduced between the outer sheeting and the internal wood lining.

As regards lighting arrangements, the majority of the trains are equipped with electric axle-light, current being generated by two dynamos, one under each end car; about 750 c. p. is distributed throughout the train and electric fans are provided in the I class and also in the II class ladies' compartments. Those trains not equipped with electric light are fitted with gas and have incandescent lamps in the upper class cars. The cars are available for military hospital purposes.

The car superintendent of the road, Mr. A. M. Bell, is responsible for the design of these cars.

Gauges Old and New.

By Allen G. Wood.

In early times the varying changes of pressure were very crudely indicated. The absolute standard has always been the weight of mercury expressed in pounds per square inch. One of the first pressure gauges in use was a simple U-shaped glass tube, partly filled with mercury, pressure admitted to one side, lowering the level in that side and raising it in the other; measurements made between the two levels determined the pressure. The calculations were based on 2.0376 ins. at 60 degs. Fahr. for one pound per square inch. When it was not desirable to graduate directly on a glass tube, recourse was had to a metal tube with float and independent scale. This made a very crude gauge, and when heavy pressures came into general use it was found inadequate. The mercury gauge in amplified form is, however, the fundamental test to this day. The most elaborate and accurate test is a perpendicular iron tube, starting from the bottom of a sealed pot of mercury at the ground and running high in the air. The pressure from a pump is applied to the surface of the mercury and causes the latter to travel up the tube to a distance proportionate to the pressure applied. At each point of graduation on the tube an insulated platinum point is inserted and connected with an electric register. The mercury being one pole of the battery, registers at each point of contact, making an absolute and instantaneous record, and the gauge, which is calibrated, being connected to the same pressure which actuates the mercury, must of necessity show a pressure corresponding to that registered by the electrical contact. This electro-mercurical column is in use in the factory of one of the prominent gauge manufacturers.

As to the practical use of the open tube, it is interesting to note that the French Government, about 1843, demanded its use for engines using under four atmospheres (about 60 lbs.) and for steamboats using under two atmospheres. A sealed tube was allowed on higher pressure. On account of its defects and disadvantages, the tube of mercury gave way in time to gauges of mechanical construction for practical use. The designs and modifications of the latter were numerous.

For years there were two principal types, viz.: the Bourdon tube and the Diaphragm. The former was almost identical with the barometer designed by Bourdon, of Paris, in 1849. The barometer tube was exhausted of air and then sealed. The Bourdon single tube is in the form of an incomplete circle, somewhat similar to a horseshoe, made of flattened tubing bent into that form.

The single spring Bourdon gauge was open to objection from two main causes. The end of the tube, after passing the center, became a pocket for water and was damageable by frost. As the tube was long, and sensitive to motion, it was useless on a locomotive or any moving machinery, as the jolt or jar kept the pointer in such constant vibration as to prevent a correct reading of the pressure. Many attempts were made to improve this gauge, each improvement consisting mainly of cutting off a piece from the end of the tube. Finally the center was reached and the "pocket" difficulty was overcome. The vibration was reduced, but at a sacrifice of the motion of the spring. This resulted in the introduction of the double spring Bourdon gauge, which consisted of two half Bourdon tubes brought nearly together at the top and there connected by a multiplying device to actuate the movement to the same degree as would have been the case with the single tube type but without many of its disadvantages. All tube spring gauges are dependent for action on the fact that pressure admitted to a bent tube tends to straighten it. A familiar illustration is a coil of garden hose showing a strong tendency to straighten when pressure is admitted.

The single Bourdon tube in recent years has been much improved for practical use in modern requirements, the most prominent improvement being the addition of what is known as an auxiliary spring, and which consists of a small coil spring attached to the free end of the tube and to a stationary part of the gauge movement or to the case. This spring serves to obviate to a large extent the vibration of the movement.

The other historic type referred to was the diaphragm gauge, invented in 1849, the spring being as indicated by the Greek derivation of the word "a partition through." This gauge was made in several forms, in one of which the diaphragm or spring partition was in a compartment below the gauge. In another, it was in the back of the gauge.

The objection to the diaphragm was that being made in flattened disc form and fastened rigidly at the circumference, it was inpossible to make allowance for the drawing in toward the center when pressure was applied. The sure result was a cracked spring, corrugations only postponing the fracture. Another interesting variety of the historic diaphragm gauge had a compartment divided by a spring partition, with an excess of corrugations on one side of the center. The pointer being fastened rigidly to the partition, would tip to one side, as pressure was applied, and indicate the latter on a scale.

The next move was a radical one, being the invention of a spring box capsular in form, with the circumference of the heads flanged and locked in an elastic band at a point above and below the spring head. This fastening acts as a hinged joint. The point is best illustrated by placing a strip of paper (½ x 3 in.) flat on a board and fastening the two ends tightly to the board. Lift the center and see how far it will move without a break. Cut a second strip and fold up ½ in. at each end at right angles. Fasten by the extreme ends or upper points so the two ends may swing as the center lifts. This is the fundamental feature of the capsular spring gauge, and has been used since 1865, when it superseded the diaphragm spring. The capsular spring has two heads where the diaphragm is single, the diaphragm therefore requiring double the motion for the same result.

Various and varied are the patents, improvements, monstrosities and changes; good, bad and indifferent have followed one upon the other in the effort of mechanics and others to adapt the gauge of yesterday to the requirements of to-day. The three best types of gauges now in use are those with the capsular spring, the double Bourdon tube and the single Bourdon with auxiliary spring, and all have their places in the field, some being better adapted to special uses than others.

The layman does not realize the vast numbers of gauges in use at the present time; for instance, gauges are today essential and almost an absolute necessity for locomotives and automobiles, steamships and launches, submarines and flying machines, air brakes and beer pumps, city water works and house heating boilers, ice machines and coal mines, and so the list might continue indefinitely. We cannot travel or stay at home, keep cool or get warm, prepare our food, or, in fact, do any of the everyday things we have to do in these enlightened times, without encountering a gauge which is doing some of the work essential, directly or indirectly, to our welfare.

The gauge is undoubtedly one of the most abused of all delicate instruments. We would not think of fixing a clock or watch with a monkey wrench. A clock merely tells us the time of day in order that we may, perhaps, not miss our train. The gauge is a safety device.

Catechism of Railroad Operation

(*Continued from page* 17.)

Question 24.—What constitutes an efficient fireman?

A.—The first requisite is a strong, healthy man who can continue to handle a large quantity of coal over a long division, without being worn out by the hard work. A man, who becomes prostrated with the work before a trip is finished, cannot perform the duties satisfactorily. The fireman being physically equal to the work, ought quickly to acquire the skill and knowledge which enable him to make the fuel thrown into the firebox burn so hotly that it evaporates into steam as much water as possible. There are other attributes which enhance the value of a man as a fireman, but the ability to keep up steam is of greatest importance.

25.—Is scientific knowledge necessary to make a man a good fireman?

A.—It is not essential that a man should understand science to make a first-class fireman, but knowledge of the science of combustion will often enable him to overcome difficulties of steam making and make the best of a hard steaming engine. The best fireman I ever knew did not know the difference between oxygen and nitrogen, but he did his work in a highly scientific manner.

26.—What is the most important mental quality a fireman should possess?

A.—Good judgment. A man may become a skillful fireman without understanding the principles of combustion, but lacking of good judgment is a fatal defect. Good judgment is an aid to success in every calling, but it seems essential in a fireman, because he is left to his own resources almost entirely after learning in a crude way how coal ought to be supplied to the firebox. In the course of a run over any division, a locomotive pulling a heavy train has to meet so many varying conditions in the demand for steam, that the successful fireman must exercise good judgment to keep the fire just right for the demand to be put upon it. Some of the best educated firemen I have encountered on the bootboard have failed to become good firemen through lack of good judgment.

27.—What is an ash pan and what is its use?

A.—An ash pan is an oblong vessel of sheet iron made to fit on the foundation ring of the firebox. It has a door at each end called a damper intended to admit or exclude air. The principal purpose of the ash pan is to catch the ashes and cinders falling through the grates and to prevent sparks from falling upon the track.

28.—What is the object in putting movable doors upon the ash pan?

A.—The purpose of these doors is to regulate admission of air to the bottom of the fire. When the engine is working steam the dampers ought to be kept open; when the engine is not working steam and there is a likelihood of the steam rising so that the safety valves will begin to blow, the dampers should be kept closed. Some engineers prefer to run with one damper open and the other closed.

29.—What kind of a fire should be made up for starting with a train?

A.—That depends upon circumstances. A hard and fast line cannot be established, because the conditions under which a start is made must influence to a great extent the kind of fire that must be on the grates. A heavy hard-pulling train starting upon an ascending grade through the streets of a town or through a long yard will call for a fire different from that which is necessary when the train is light, and easy grades are met at the start without yards and streets that demand the fireman to look out for signals. Good judgment will settle the kind of fire necessary to meet existing conditions.

30.—What are the principal things a fireman should do in getting the engine ready for the trip?

A.—Whatever kind of a train may be destined for the engine, and no matter what the physical conditions surrounding the starting point may be, the fireman ought to reach the engine in time to see that the foundation of a good fire is on the grates, that the ash pan is clean, and that the grates have been cleaned properly, leaving no dead ashes or clinkers to obstruct the free admission of air.

The coal ought to be sprinkled with water sufficiently to keep down the dust, and put in condition for firing without needing to be broken up after the start is made. Lumps of coal as large as the fire door opening do not make steam so freely as when they are broken to about the size of a man's fist. An ambitious fireman will see that the coal is put in the best condition for steam making.

I need hardly mention that a good fireman is careful to see that the deck of the cab is swept clean, the seats dusted, that there is water in the tender, sand in the sand box, the oil cans are filled also the lubricator, and that all the necessary tools are in their places.

31.—What is a blower?

A.—A jet of steam injected through the smoke stack from its base.

32.—What is the purpose of the blower?

A.—Principally to stimulate the fire, but frequently to draw the fire gases out of the cab, when the engine is not working steam.

33.—Is there such a thing as abuse of the blower?

A.—Yes; if the blower is used to the extent of stimulating the fire till blowing off of the safety valves results, then there is abuse of a convenient device.

34.—What is the purpose of a safety valve?

A.—To prevent more than a certain pressure of steam from accumulating in the boiler.

35.—What is a steam gauge?

A.—An instrument connected with the boiler to indicate the pressure of steam.

36.—How could you tell that the gauge indicates the correct pressure?

A.—If the pointer failed to move up regularly as the steam pressure increases, the chances are that the gauge would be out of order and it would be proper to report the irregularity.

37.—On what principle does a steam gauge work?

A.—There are two forms of steam gauges. One, the Bourdon gauge, is actuated by the tendency of a flattened bent tube to straighten itself under pressure of steam inside. The gauge pointer receives movement from suitable mechanism connected with the tube. The other form of steam gauge has a corrugated diaphragm upon which the steam presses, the movement of the diaphragm operating the pointer connections.

38.—What do you understand steam pressure to be and how is it formed?

A.—Steam is formed by the heat of the fire boiling the water inside the boiler. Having no means of escape, the steam accumulates and presses upon the confining surface according to the volume generated.

39.—What is usually done with the steam after it has been formed?

A.—It is passed through the dry pipe inside the boiler, when the throttle valve is opened, and thence to the steam chest from which it enters the cylinders and acting on the piston imparts motion to the engine.

40.—In what condition should the fire be kept upon the grates to insure free steaming?

A.—There are different methods employed of maintaining the fire to promote free steaming, but I consider what is called level firing to be productive of the best results.

41.—Has any systematic attempt ever been made to demonstrate what was best steam-making form of fire?

A.—Yes. Conflict of opinion having arisen among the road foremen of engines and certain firemen employed on the Pennsylvania Railroad concerning the most economical form of firing, the company carried out a series of tests in their testing plant and it was proved that level firing generated more steam for the coal burned than any other practice.

42—In the practice of so-called "level firing" is the fire kept as nearly level as possible?

A.—As nearly level as possible, except that the sides close to the sheets are filled a little heavier than the other parts.

43.—Why are the parts close to the sheets loaded more heavily than the other portions of the grates?

A.—Because there is a tendency of air to pass close to the sheets and it has a chilling effect unless restrained by a bed of fuel.

44.—What is bank firing?

A.—Bank firing is a practice of loading the back part of the firebox with coal, making a steep gradient towards the front. It is supposed to aid in preventing the formation of smoke.

45.—Does a fireman perform his whole duty when he "keeps her hot"?

A.—He does not. The one-idea firemen delight in hearing the safety valves screaming regardless of the fact that every minute the safety valves blow represents the waste of twelve pounds of coal. An ideal fireman strives to make the steam necessary without wasting coal and that means as little noise from the safety valves as possible.

46.—Do you consider smokeless firing practicable?

A.—This question will be answered according to the belief and the experience of the fireman under examination. Most of the examiners require an answer in the affirmative, although there exist on nearly all roads conditions in which smokeless firing is impossible.

47.—Have you read anything concerning the practice of smokeless firing? If you have, tell your impressions about books or treatises concerning smokeless firing.

A.—This question must be answered on the basis of his belief and his experience.

48.—What effect on coal consumption has the practice of smokeless firing?

A.—The absence of smoke, when a firebox is at work converting water into steam, is not an infallible sign that the coal is being burned under conditions that will produce the greatest possible economy; but it is fair to assume that smokeless firing is good firing.

49.—What causes the drumming noise frequently heard when an engine is idle burning a fierce fire?

A.—That noise is caused by the gas distilling out of the coal, making a series of minute explosions. It can be stopped by closing the dampers or by putting the firebox door upon the latch.

50.—In making station stops, should a fresh fire be put in at the time steam is shut off or at starting?

A.—At the time of shutting off steam.

51.—Why is that the preferable practice?

A.—Because it obviates the necessity for firing when the train is starting. When firing is done at the time the engine is starting a train into motion, the violent exhaust draws big volumes of cold air into the firebox, with danger of causing leakage of flues and damage to firebox sheets. Besides that, when a train is starting a fireman ought to be looking out for signals or watching the yard movements.

52.—In what condition should the fire be kept when a train is in motion?

A.—In the condition that will generate the volume of steam necessary to do the work.

53.—In approaching a siding where delay is expected, how should the fire be handled?

A.—The fire should be permitted to burn down, but leaving sufficient live fuel upon the grates to make up the kind of fire required when the starting time comes.

54.—Does the condition of the grates influence free steaming? What effect has broken grate fingers?

A.—The condition of the grates has very decided influence upon the steaming of an engine. They should be kept as free as possible from clinkers or ashes and obstructing material. Broken grate fingers permit local admission of cold air, that prevents free steaming.

55.—For what are grate-shaking appliances used?

A.—To break the clinkers that readily cover the grates when burning some kinds of coal and to shake accumulations of dead ashes into the ash pan.

56.—In what manner should the shaking of grates be regulated?

A.—Some firemen are inclined to shake the grates too much, thereby wasting fuel. It is well for a fireman to shake the grates slightly soon after starting to prevent them from sticking. Then the grates should be left alone until indications appear that clinkers are beginning to obstruct the admission of air. The grates are then gently shaken during the remainder of the trip at intervals sufficient to keep the fire as clean as possible. Violent shaking of the grates should be avoided, for long movements of the shaker bar moves the clinker up and down without breaking it. Short, sharp jerks are most effective. Good coal requires no more shaking than what is necessary to break open the clinkers to admit air. Coal that contains a great deal of ash should have the grates shaken lightly and frequently, so that the openings may be kept free to permit the ashes to fall through.

57.—In approaching a long, descending grade, how should the fire be regulated?

A.—It ought to be permitted to burn as low as circumstances will safely permit.

58.—In approaching a steep, ascending grade, how should the fire be regulated?

A.—A heavy fire ought to be gradually made up, having a depth of fuel that will not be disturbed when the engine proceeds to work hard. When this is not done the heavy exhaust will sometimes turn the fire, as it is called.

59.—Will the system of firing described always prove successful?

A.—Not always. Inferior coal and a variety of circumstances may call for other methods, which must be worked out by the skill and good judgment of the fireman.

Plain Method of Smoke Prevention.

The smoke prevention inspectors of cities are frequently very troublesome to railroad companies as unreasonable in their demands concerning smoke prevention. An exception to this rule is Mr. Harris, smoke inspector of Chicago. He is recently reported to have made the statement that he had never seen any patented device that would prevent a locomotive from creating smoke. He expressed the belief that a good brick arch, steam jets on the side of the firebox and a good fireman formed the best smoke-preventing appliance that could be used.

Waterproof Glue.

Two good recipes for making glue are as follows: To 0.5 pint of the best Scotch glue add 1 oz. bichromate of potash. This glue cannot be remelted after cooling. The second recipe is melt and mix together 1 part beeswax and 2 parts rosin. Stir into this hot whiting rubbed fine until a stiff mixture is obtained. This is made into sticks and used like sealing wax.—*Electric Traction Weekly.*

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Flue Failures.

Flue failures is a condition that has pursued railroad companies ever since locomotives have come into use and the cause of such failures has been discussed as much as any subject interesting to railroad men, yet no effectual remedy has ever been brought out for the defects which cause flue failures. It has been the duty of the writer to read volumes of papers and discussions on flue failures and he is willing to admit that he has received more sound and useful information from a paper by Mr. J. W. Kelly, foreman boilermaker of the Chicago & North Western Railway, read at a meeting of the Western Railway Club, than he ever received before. We very much regret that the paper, which is profusely illustrated, is too long for our pages, and we heartily urge persons interested in keeping flues from leaking to apply to Mr. Jos. W. Taylor, Old Colony Building, Chicago, the secretary of the club, for a copy of the paper.

The opening of the paper says: "Flue failures start in a great many cases in the designing room of the factory, by crowding in too many flues, placing them too close to the heel of the flange or with too small a bridge." That may be taken as the text of the paper and it is illustrated by sixteen engravings. These display many peculiarities of the effect of setting and expanding the tubes, one surprising thing being the tendency of the flue sheet to move upwards under the stresses due to repair operations.

The conditions which bring about flue failures are described in a graphic fashion, which must appeal to every roundhouse foreman who is generally powerless to prevent the vicious practices complained of. When the powers in control are shouting "Get that engine out as quickly as possible," conservation of flues and of heating surface frequently receive little consideration.

The part of the paper that appeals most forcibly to the roundhouse force reads: "Now, we know this engine is perfectly clean and free from scale and we must keep her so by removing all washout plugs, and especially those in the front flue sheet, and wash between the flue, clean, right back to the back flue sheet. Watch and be sure that the long nozzle is used in every hole, because if you let it go until the space between the flues is filled up solid you all know what happens—flue failures after flue failures, cracked bridges also, for want of water. These flue failures are all up to the roundhouses, but as we are going to keep the engine clean I will try and show why she still fails on account of flues leaking.

"The engine arrives at the terminal with only a fair fire, not very much steam, and a half glass of water, not leaking, and is therefore not reported. The hostler gets on engine and finds these conditions, rushes it to the cinder pit, puts on blower and gets fire out quickly so as to get it into the house before the steam is gone—the water is also going fast. When he reaches the table he starts the injector and fills up the boiler until injector breaks, and what has happened? Every flue has started to leak badly, which means the whole set must be expanded before the engine leaves the house. But maybe it is the only engine in and the roundhouse foreman has ordered it out, because he looked at it on arrival and knew it was not leaking; and there is a failure of flues, either by holding and doing a proper job, which should be done every time, or by taking a chance and telling the boilermaker to calk her up, or dry her up and let her go. The engine goes out on the main line and ties up everything, due to another flue failure. Right here I want to say this kind of a failure can be stopped by compelling all engineers to leave their boilers full of water before stopping, a good fire and plenty of steam. The engine is towed to nearest roundhouse and the boilermaker is ordered to do the necessary work. He starts by using a mandrel which is termed pin, and pins out flue and calks same with a beading tool, which is altogether too large, and has no bearing on bead but only cuts and grooves flue sheet and spoils bead. The engine is started out and fails again on account of flues leaking. This pinning of flues and improper beading tools have caused a great many failures and every foreman boilermaker should watch this matter very closely and stop it.

"About two hours later the fill-up man finds no water in the glass and connects up hose on blow-off cocks which is located near throat sheet, and as the engine is ordered out, fills her up quickly with cold water, fires up and pulls out of house with heavy fire. The engineer cannot see the flues, and when the boilermaker makes inspection they appear to be tight. At the station the fireman calls the engineer's attention to the flues leaking, and there is another flue failure."

Cab Signals and Automatic Stops.

The committee on the subject of automatic stop and cab signals, which reported at the last convention of the Railway Signal Association, after briefly describing several systems which have been devised, went on to say:

"The instructions to the committee were to 'bring up to date all literature and actions suggested or ordered at the last annual meeting.'"

There is no question in the mind of the committee that a system of automatic stops or cab signals designed and installed in accordance with the requisites adopted by this association will meet all the requirements of actual service on a railroad, but the committee also believe that in the present state of the art such a list of requisites as would allow greater freedom in design and installation would have a tendency to promote progress without admitting undesirable schemes or anything that could impair the safety of railroads, employing a system designed and installed in accordance with the association requisites.

This belief is borne out by the fact that a number of systems of train control devices which do not comply with several of the adopted requisites are now in service or have undergone exhaustive tests, but even these devices give a much greater degree of protection from accidents than it is possible to obtain without them. This does not refer only to systems installed on lines of specialized and uniform traffic, but to lines of a general and irregular description such as would be met with on the majority of roads of this country.

The committee endeavored to harmonize the adopted requisites of installation with the ideas of the members as expressed in the discussion of the report of 1909, and in so doing they modified certain of the adopted requisites and added some further requirements.

In the discussion of this subject by the committee it appeared to them that some of the requisites should not be so classed on account of their being nonessential to the safety or reliability of the system. The committee deemed it proper to present a list of desirable characteristics or adjuncts, in addition to the essential characteristics, or requisites.

Furthermore, the difference between the requisites of installation for systems of automatic stops on steam and electric lines seemed so slight that it was decided to combine the two. The committee presented for discussion several requisites and other desirable characteristics as being in accordance with the instructions of the executive committee. A number of "requisites" were appended to the report.

Fitting a Smoke Stack.

There is more in fitting a smoke stack properly than appears at the first glance. Where the base is separate from the body of the stack, the base may be readily leveled, and presuming that the engine frames are level all that is necessary is to have the exhaust pipe bolted into place and a plumb line suspended from the center of the smoke stack base and passing through the exact center of the exhaust pipe. With the base thus carefully set it should be chalked around the lower edge and marked off with hermaphrodite calipers, care being taken to hold the calipers perfectly level while making the line around the smoke stack base. It is good practice to make center punch marks along the line, as the chalk readily falls away during the chipping operation.

In the case of smoke stacks where the base and the stack are one casting the operation has to be gone about with a greater degree of care. A leveling of the upper edge of the smoke stack is not sufficiently reliable. The casting will likely be more or less uneven and the best method is, after finding the exact center of the upper end of the stack and suspending a plumb line from that point to the center of the exhaust pipe, to test with the calipers the relation between the inner sides of the stack and the centrally suspended line, observing that the stack is equidistant from the central line at various points along the inner surface. The relation of the stack to the exhaust pipe should be as exact as the relation of a cylinder to a piston rod. It should be borne in mind in fitting a smoke stack that if there is any possibility of the jet of exhausted steam striking any particular point of the smoke stack more forcibly than another, the effect, however apparently harmless it may be on the smoke stack, has a most pernicious effect on the fire and leads to endless trouble and loss of fuel. The spirit level may be used on the top of the stack in a general advisory way in setting the stack in its proper position, but the exact adjustment of the stack to the central line should be the final test, and the line should be reapplied after the fitting is presumed to be finished.

In chipping the fitting strips it is advisable to leave the inner strip slightly below the straight surface of the outer strip. This allows a more ready fitting of the outer edge of the bearing and when the stack is bolted in place the smoke box sheet will draw slightly but securely towards the stack as the bolts are tightened. A careful fit of the outer strip is absolutely necessary, as the tendency to draw air at the slightest opening in any part of the smoke box is very great, and the effect of drawing cool air into the smoke box while the engine is at work is to heat the sheets and lead to combustion, causing a warping of the smoke box appliances and frequently inducing still greater leaks in the smoke box. There are various substances used, putty being among the most common, in helping to secure the joint between the smoke stack base and smoke box sheets, but it will be found that a careful fitting of the two bearing surfaces is the best preventive of the troubles arising from leaky joints.

Material From Which Flues are Made.

When a train is behind time and keeps getting farther away from the schedule, the real cause of the delay is reported to be leaky tubes. The locomotive fails to make the necessary steam because the tubes are leaking.

There are many causes that produce leaky flues, rough usage on the cinder pit being best known, but there is one fertile cause of this defect which receives too little attention. That is inferior material in the tubes. We hear complaints in all quarters that the material from which flues are made is not what it used to be, but the complaint is uttered cautiously, as if it was a dangerous subject to stir up. Is there any mystery connected with the material employed in flue construction? Almost every master workman and boiler maker will testify that charcoal iron, good cold-drawn seamless steel tubes, are the only materials fit for boiler tubes, but some of them will whisper the suspicion that Bessemer steel is more frequently used than charcoal iron. To purchase Bessemer steel tubes instead of charcoal iron is one of the most expensive forms of expensive cheapness that railroad companies are guilty of. One engine disabled through failure due to inferior flues sometimes incurs expense that would pay for several sets of good flues.

When inferior flues are purchased instead of flues made from good suitable material there is something wrong, for there is a Railway Master Mechanics' Association standard for flue material that admits of no inferior substitute. The specifications for iron tubes says "tubes are to be made of knobbled, hammered charcoal iron, lap-welded." The physical appearance required of the tubes is given and the weight for the different sizes. Certain tests are specified which are very exacting and certain to ensure good material, for nothing else would pass.

There are also specifications for steel tubes to be cold-drawn, seamless or made of open-hearth steel of the following composition: "Carbon, 15 to 20; manganese, 45 to 55; sulphur below .03; phosphorous below .03." If that specification is adhered to it will make a good tube, that will stand successfully the severe physical tests that are also specified. We hear constant complaints among boiler makers that the tubes furnished crack in bending. That will not happen if the tubes are made of the material specified and there is no difficulty in having the chemical and physical tests made, for if a railroad company does not have a testing department there are outside concerns always ready to undertake such work. Seamless cold-drawn steel tubes are generally what they are reputed to be. There was long a prejudice among railway master mechanics against steel tubes, so they bought stuff that was called charcoal iron, but was Bessemer steel. A high mechanical official discussing "failure of flues" lately spoke of iron tubes that were not iron. He evidently knew what he was talking about.

Shop Layouts.

At the meeting of the New York Railroad Club, held at the Engineering Building, New York, on Friday evening, January 20, Mr. H. H. Maxfield, master mechanic on the Pennsylvania Railroad, Trenton, N. J., presented an able and interesting paper on the "General Layout for a Modern Locomotive Repair Plant."

The great weight of modern locomotives and the desire to concentrate heavy repairs of such engines in one place, has resulted in the building of many new shops. While all have resulted in economy and efficiency, with regard to maintenance of equipment, in the opinion of Mr. Maxfield few if any have entirely come up to the expectation of their designers, and even in the case of the few there are undoubtedly many features which later experience shows might be modified advantageously.

Supposing the site available for either a cross or longitudinal shop, Mr. Maxfield expresses a preference for the latter. In his opinion, it affords greater flexibility, more economical use of track, space and a correspondingly greater output for a given amount of such space.

Assuming 750 locomotives as the number to be maintained, Mr. Maxfield presented a complete plan of shops which embodies all the recent improvements in shop construction with some additions cleverly suggested, the most notable being what Mr. Maxfield termed an "After-trial" shop. This innovation is a growing necessity, as it is well known that after the repairs to a locomotive have been completed it is not only necessary to fire the engine up and thoroughly try it on the road, but also to remedy any minor defects that may develop. Sometimes vacant stalls in engine houses may be available for this work, but very frequently the roundhouse is at some distance from the repair shop, and it is not uncommon to see skilled mechanics remedying some minor defect in the mechanism in the open air, exposed to such climatic conditions are are not calculated to enhance the perfection of the finishing touches on a locomotive. In the machine shop itself it is often the cause of much delay in preventing the bringing in of other locomotives, while the smoke and gases are a general objection.

The general plan of the ideal shop as presented by Mr. Maxfield is an excellent one and shows how thoroughly he had conned the subject, and it would be well for those interested in the construction of new locomotive repair shops to give the document and its deductions careful consideration. Much depends, of course, on the property available for the erection of such works, but the opinions of men of practical experience, like Mr. Maxfield, should be preferred as against the untried and frequently fantastic theories of embryotic engineers.

The Moment of Inertia.

A subscriber has written to us asking that we tell him plainly what is the meaning of the expression "Moment of Inertia." From the fact that he specified a plain explanation and takes it for granted that we can give him a clear definition of the obscure phrase, we believe that he does not take kindly to the usual mechanical engineers' pocketbook definition, which reads something like this: "Suppose that the shortest distance from the neutral axis to each single individual particle of the body has been measured; also that each of these distances has been squared and that each square has been multiplied by the weight (or for a surface, by a minute area), to which the distance was measured; also that all these last products are added into one sum. That sum is the moment of inertia for the body."

This definition gives one of the ways and, in fact, the original and elementary way of finding the moment of inertia, but it does not throw any light on what the moment of inertia really is or what good it does after you have found it by this very laborious process. The use of the moment of inertia, beside being one of the factors in several formulas, is that it enables one to make an approximate comparison of the relative strength of two or more beams or columns or other structural shapes, owing entirely to the form of such shape. That is the way in which the material composing the beam is disposed. It has nothing to do with the material of which the beam is composed or with the ultimate strength of the beam, but it concerns itself entirely with form and, therefore, the moment of inertia for the surface of a section would be the same for wood as it is for steel if the shapes are exactly alike.

The influence of any particle of matter in helping to form the moment of inertia, stands in the same position and exerts a similar influence on the strength of the section, hence the moment of inertia gives the basis of comparison of the strength of a section owing to the disposition of matter in it.

As an example, suppose a plank 8 inches wide and 2 inches thick be thrown down over a small stream as a bridge or even over a roundhouse pit. Let us suppose that the neutral axis of this plank is horizontal and passes through the centre of the plank. The moment of inertia found for such a rectangular shape is 5.33, while if this same plank was turned up on edge, as we would say, with the 2 inches on the top, and 8 inches deep, we would get a moment of inertia of 85.33. That means that the plank on edge with neutral axis as before, is about 16 times stronger than when laid flat. This is due entirely to shape, and the same reasoning holds good if the plank was a bar of iron. The on-edge position makes it 16 times stronger than when laid flat with load on the upper surface and the neutral axis passing horizontally through the centre of the bar.

It is often said that some of the bones of a bird are stronger than they otherwise would be because they are hollow. This means that with a given amount of bone, the hollow form is stronger than the solid, and here the moment of inertia can be asked to step in and prove it. Suppose that we have a hollow cast-iron pipe. It is 6 inches outside diameter and 4 inches inside diameter. That leaves the walls of the pipe 1 inch thick. The axis, of course, is considered to be horizontal. This pipe would have a moment of inertia of about 51.06. If the amount of material used in making this hollow pipe were cast as a solid bar, it would have a moment of inertia of about 19.87, or, in other words, the hollow pipe would be more than 2½ times as strong as the solid one, due entirely to the disposition or form of the metal and not to its tensile or crushing strength. Its ultimate strength is determined by the way it is loaded and its ability to stand tensile and compressive strains. This same amount of metal could be made into an I-beam about 15 ins. deep with a moment of inertia of about 511, or over ten times as strong as the hollow pipe or more than twenty-five times as strong as the solid bar.

We have spoken of wood, cast iron and steel in our various examples, but the reasoning holds good for steel all the way through as far as strength being dependent upon form goes. The moment of inertia enables us to study the disposition of matter in a structural shape so as to get the best results for the work to be done. Probably the I-beam is the strongest form in which metal can be placed so as to withstand the strains which come upon it when used as a beam. Various combinations, however, suit certain conditions and it is here that the practical knowledge of the constructing engineer comes into play.

In dealing with this intricate and important subject in this brief way we can only again point out that the moment of inertia is a necessary factor in other calculations; it does not of itself form more than a convenient method of comparison between shapes of the same material, iron with iron, steel with steel. After the comparison has been made and the more suitable form selected, the calculation as to the amount of deflection in the loaded beam, its safe load and its breaking strain will then begin, and be based upon other considerations than that concerned with the shape or form of the beam, the channel, the angle or the tee.

Reducing Heating Surface of Boilers.

Very serious mistakes have frequently been made by locomotive designers in arranging for all the heating surface they can possibly crowd within the flue sheets of a boiler. In a paper by Mr. J. W. Kelly, read at the Western Railway Club, he demonstrated very plainly the disastrous effects that resulted from putting the upper tubes too close to the crown sheet, which is one of the phases of trying to put more tubes into a boiler that can be used with advantage.

Another practice that has produced unsatisfactory results is placing the flues so close together that there is too little water space left between them. When the water space is too restricted, the tubes fail to evaporate the quantity of water they ought to convert into steam, for the simple reason that a coating of steam prevents the water from reaching the heating surface. The evil of this practice has been repeatedly proved by experiments.

In the discussion that followed the reading of Mr. Kelly's paper, Mr. W. T. Bently, assistant superintendent of motive power and machinery of the Chicago & North Western, remarked: "Mr. Kelly says: 'If it is possible to run an engine with the bottom flues plugged and she still does good work, and is light on coal, why not leave these flues out? They will not be there to contract a leak'."

"Mr. Kelly is a very persistent man and he bored the life out of us until we left out fifty flues at the bottom of the boiler and since then our flue troubles with engines so treated have stopped. It has also resulted in a tremendous improvement in the boilers of these engines as a whole. Many an engine died because the bottom flues were leaking. Now they do not leak because the flues are not there and the other flues do not seem to cause so much trouble and the engines seem to steam just as well. Leaving out a number of bottom flues is our standard practice now on certain engines and we are securing better results from them."

Substitute for Coal.

They have found a substitute for coal in Egypt and the Soudan. It is nothing more or less than the Nile weeds. The upper reaches of this river are almost completely blocked with dense masses of vegetation, consisting of the papyrus and other reeds. These weeds are so thick in some places that it is impossible for a steamer to force its way through, and the government has had to constantly dredge the channel.

The work is difficult and the "studd," as these aquatic weeds are called, is constantly encroaching upon the various channels and a regular fleet of dredges has had to be maintained in order to cope with the situation. Coal is as high as $16 a ton at Khartoum, and that point is 800 miles from where the dredges operate, so that the discovery of a substitute for coal was very welcome indeed.

The process consists in cutting the reeds from the river, drying them and then chopping them up into a fine sort of chaff. This is compressed into cakes resembling briquettes of brown coal. The studd briquettes are about four-fifths of the density of coal briquettes, and their heat-giving qualities amount to about two-thirds the heat value of the coal briquettes. The studd briquettes contain 46 per cent. of carbon, about 4 per cent. of hydrocarbon and 6 per cent. of ash. The heat-producing value in per cent. is about 33 less than coal, but the cost is between 35 and 40 per cent. below that of coal.

About 35,000 tons of coal are used annually in this region. With cheaper and more plentiful supplies of fuel, such as the studd briquette foreshadows, the cotton and other industries will be able to expand and flourish. It is difficult to estimate the value of this new fuel as seen from a commercial point of view, especially in a land like Egypt, where the natural resources have to be carefully guarded and worked for the good of man.

Book Notices

The Proceedings of the Eighteenth Annual Convention of the Traveling Engineers' Association, held in 1910, has just been published in a handsome volume of 400 pages, suitably bound in leather. The book amply sustains the high standard of interest which the productions of this association have created among railroad men. Of the six original papers read and discussed at the meeting, it may be said briefly that all are of a high order of merit, presenting, as they do, the experiences of men who are in the very best position for observation and who are neither prejudiced by precedent or shackled by interest. These subjects embrace superheating, training of firemen, development in air brakes, lubrication, valve gearings and fuel economy, besides able debates on the essays. These subjects are among the most vital at the present time in railroad engineering, and those who are interested in present-day practice would do well to obtain a copy of the book, which may be had from the secretary, Mr. W. O. Thompson, New York Central Railroad, East Buffalo, N. Y.

The "Practical Engineer" Pocket Book and Diary for 1911 was issued last month by the Technical Publishing Co., London, England.

It is a compact and handy volume of over 900 pages, in flexible covers, and contains a mass of information beyond what is usually found in diaries. Nearly 1,500 subjects are treated of, and it would be difficult indeed to think of an engineering subject that is not discussed in this valuable publication. As a handy reference volume to the busy engineer it has long been held in high favor, and the present volume surpasses any of its predecessors. Copies may be had direct from the publishers at 50c. each.

The "Automobile Mechanician's Catechism," by Calvin F. Swingle, M. E., and published by F. J. Drake & Co., Chicago, is an elegant book of 112 pages, in flexible leather cover, the price is one dollar.

It is a valuable contribution to the automobile literature of our time, and should become a popular favorite, especially with chauffeurs who desire a compact and comprehensive epitome of the latest systems of ignition and other details that are constantly being improved on. A feature of the work is a full description of steam automobiles, which appear to be coming into favor. The work contains a number of folding plates, where all of the parts of the leading automobiles are numbered and named.

The "Locomotives of the Great Northern Railway," by Geo. F. Bird. Published by the Locomotive Publishing Co., 3 Amen Corner, London, England. 228 pages, profusely illustrated. Price, 90 cents, including postage.

Very few railroads are fortunate in having an historian who rises to the occasion as Mr. Bird has done. The history of the locomotives of this great British railway is the best epitome of the development of the locomotive itself as far as British form and service is concerned that we have seen, and the book cannot fail to be of great value to all who are interested in the mechanical progress of the wonderworking locomotive. An interesting feature of the work is the marked individuality of the chief of the mechanical department. During a period of seventy years, several eminent men have filled the position and each marked distinctive epochs in British locomotive construction and their individualities are finely portrayed in Mr. Bird's able work. The book has already met with much favor among British railway men, and should be in the hands of all who are interested in the progress of the locomotive from its first appearance to the present time.

The art of saying appropriate words in a kindly way is one that never goes out of fashion, never ceases to please and is within the reach of the humblest.—*F. W. Faber.*

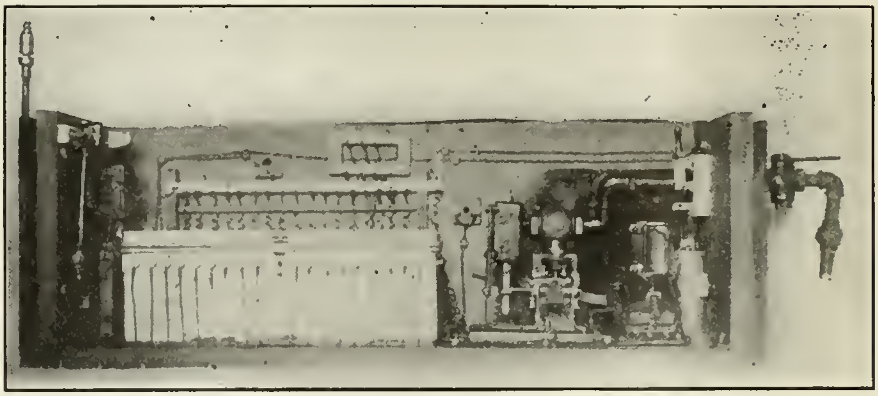
Prentice System of Wireless Train Control on the C. P. R.

A very interesting experiment has recently been made in the matter of train control by wireless waves. The necessary apparatus was installed on a two-mile stretch of track in the vicinity of Toronto, by the Canadian Pacific Railway. The system was invented by Mr. Frank W. Prentice, a resident of Toronto. The fundamental principle involved is the Hertzean radiations from a wire laid in the center of the track, picked up by antennæ on the engine and the electrical impulse used to hold a brake pipe closed. When the "wireless waves" no longer flow, the valve opens, the brake is applied and the train stops.

To the average observer the distance from the air brake of a moving train to the roadway beneath is but a matter of feet and inches. To experimenters in the field of automatic train control, however, it is a formidable interval, that cannot be measured in ordinary units of magnitude. Many are the inventors who have witnessed the inches in which they themselves first estimated this extent of space, apparently grow to miles when they tried to span it with some form of energy.

The results of this have been that knowledge of the conditions and requirements under which automatic control systems must operate is much more general than when interest in the subject was first aroused, and a more wholesome respect is entertained for the gap between the train pipe and the rail.

The scientific basis is the discovery by Hertz that electric oscillation produced in a circuit which possesses capacity and inductance, creates in the surrounding ether a disturbance which is styled an "electric wave." This wave causes the metallic filing tube, commonly called a coherer, to become a conductor of current when it is brought into the radius of influence of the wave. Our illustration, Fig. 1, shows three blocks of double track equipped with the apparatus. The system is an adaptation of the main principles to certain conditions. There are two parts to this system: first, that part which is on the track, and second, that part which is on the engine.



LOCOMOTIVE EQUIPMENT FOR WIRELESS CONTROL.

The essential features of the road portion are the track circuit and the generator of the wave. The manner of controlling the wave by the track circuit relays will be evident from an inspection of the diagram. The generators, as a whole, include the transformer T, the condenser C, and the discharge points PP, commonly known as oscillators. One of these generators is placed at the end of each block, and a wave wire is extended for a block length in the rear. This wave wire is No. 12 aluminum, and is run in a trunking in the center of the track, midway between the rails. The generator is controlled by the track circuits of the block in advance. As long as the flow of current through the track circuits is not broken or short circuited, the alternating current relays, R, keeps the generator connected with the alternating current feed wires, stepping the 110 volts up in the ratio of 200 to 1, causing a static discharge to continuously take place between the oscillators, PP.

Connected to the oscillators is the wave wire, W, and pick-up wire, U, extending along the track in the relative positions shown. All the track blocks are provided with the ordinary form of vane type relays and A. C. track circuits. It will be seen that the wires W and U are charged with the wave-producing current only when the block in advance is clear. This is in accordance with the closed circuit principle upon which the whole system is contrived.

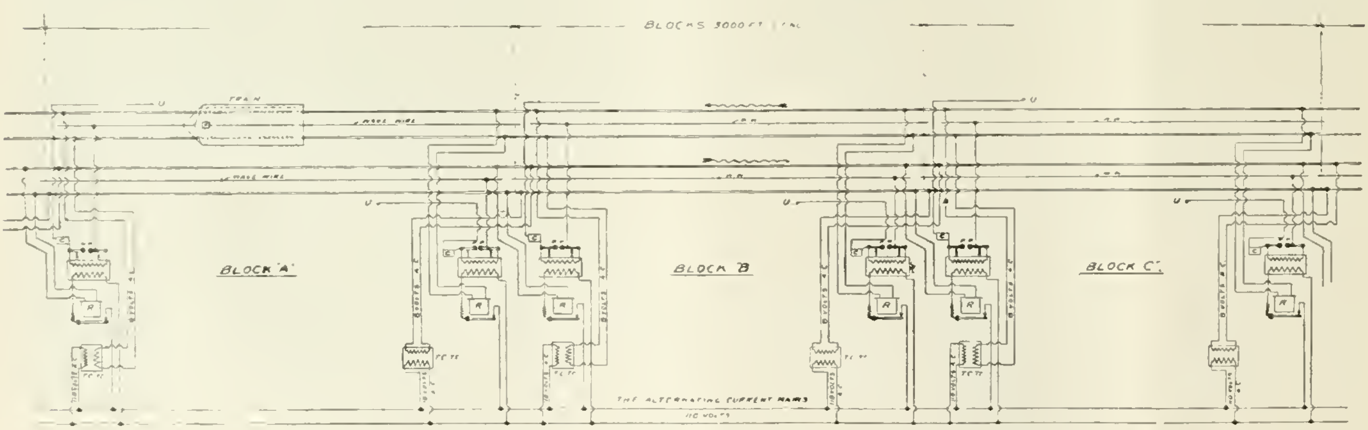


FIG. 1. WIRING DIAGRAM SHOWING POSITION OF GENERATORS, ETC.

The wave wire W is insulated from the track, and its preferred position with reference to the track is along the middle of the ties. On single track the wave wire is placed near the end of the ties. The maximum length of the wire which can be charged with one oscillator is measured by miles, so it is plain that the lengths of the blocks are governed, in actual operation, only by the requirements of traffic.

The maximum distance for A. C. track circuits is 16,000 ft., while that of direct current track circuits is 3,000 ft. The installation on the C. P. R. is the first to use alternating current for track circuits on steam roads; heretofore its use had

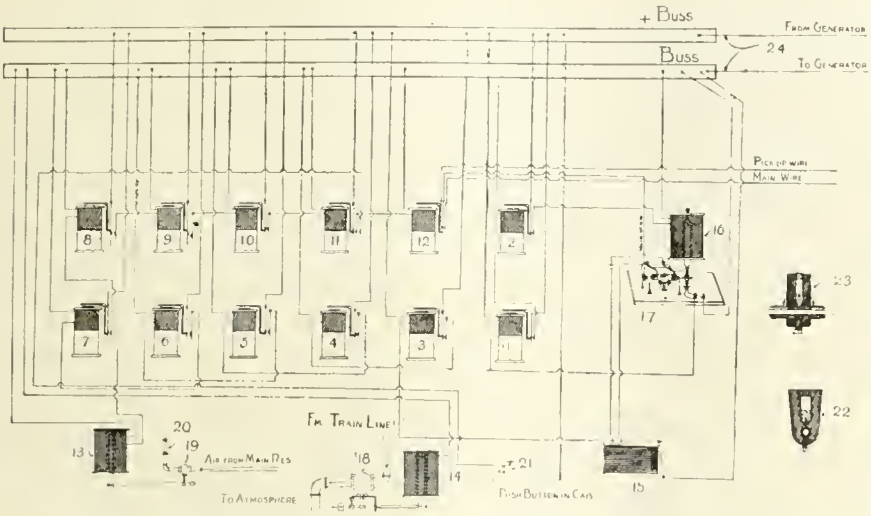


FIG. 2. DIAGRAM OF ENGINE EQUIPMENT.

been confined to electric lines. The oscillatory wave wires and generators may be applied to any forms of track circuits which are in general use. They do not interfere with existing forms of block signals. The Prentice system has no fixed signals on the ground. It may, however, be employed in conjunction with block and other signals.

The track installation on the C. P. R. consists of eight blocks, from 2,000 ft. to 4,500 ft. each, four blocks on the west bound, and four on the east bound track, beginning at Queen street subway and ending at Royce avenue, a distance of two miles; generators being placed at the intervening streets. These generators have been in constant service since March 25, 1910, without interruption. The expense for current is said to have been two cents a day per block. There being no batteries in the track installation, the cost of maintenance is consequently very much reduced.

When the installation consists of a wire which extends throughout a block, and is charged with wave-producing current, it makes the wire the center of a series of outwardly extending concentric impulses, having a constant radius of influence at any point along the wire, it remains only to run a train carrying antennæ and coherer into the block, and at the instant this antennæ enters the zone of the wave it causes the coherer to become a conductor of electricity.

The gap is bridged by the Hertzian wave. Intangible, mysterious though the wave may be, it is nevertheless a fact that it furnishes an actual and positive connection between train and track. More than this, its field of influence can be definitely confined; the radius of the zone can be limited to one or two or five feet if desired, as easily as to a mile. This, of course, is accomplished in the generating apparatus. It is necessary to prevent the receiving by a train on one track the wave intended for a train on the other track and to make it impossible for a train going in one direction to be interfered with a wave intended for a train going in another direction.

The part of the system which is carried upon the engine comprises first of all the main antennæ, 19 ft. long, suspended from the boiler braces by three hangers, the antennæ consisting of an aluminum plate 4 ins. wide and hanging directly over the wave wire 2 ins. above the level of the pilot or 7 ins. from the wave wire. Second, a pick-up antennæ suspended in like manner on the right hand side, beneath the cylinder cocks, 13 ins. outside of the rail and directly over the pick-up wave wire at the end of each block. Third, a turbine generator giving 6 volts and 20 amperes of current for supplying the working force of the wave responsive apparatus. Fourth, the train control mechanism, the salient feature of which is the coherer, consisting of a wood fiber receptacle having a hole in the center, two lugs inserted in its bottom ¼ in. apart.

In the coherer are the "wave-responsive" filings, sufficient to fill in the aperture between the lugs. The coherer is rotated upon an axle through 90 per cent. of space by a solenoid rack and pinion. It is held in the upright position 2 seconds by means of two hold-relays, the filings during that time resting between the lugs. Normally, these filings are a non-conductor of current, but when the Hertzian wave emanates from a wire in their zone the resistance on their outer surface is broken down and a current flows through them, closing the master relay, 15. Once these fillings are cohered they will retain such cohesion until they are jarred, to restore their non-resisting qualities, hence the rotating coherer is intended to cause them to fall into a loose mass again. The coherer is in constant operation as long as an engine is in service. The master relay, 15, opens and closes every three seconds when the wave is being received. Connected to the master relay is a series of ten hold-relays, Nos. 3 to 12, inclusive, on the diagram, Fig. 2. These relays hold their magnetism one second each after the cur-

TRACK SHOWING WAVE WIRE AND PICK-UP WIRE.

rent is broken, and being in parallel series, relay 12 releases its contact 10 seconds after the master relay ceases to be operated by the wave-controlling influence.

Relay No. 7 through its contact energizes solenoid 13, whose plunger holds closed through a fulcrumed lever valve 19, which stops the air from the main reservoir blowing whistle, 20. Relay 11 through its contacts energizes solenoid 14, which through its fulcrumed solenoid holds closed balanced valve 18, preventing the escape of air from train line through a 1-in. port. Relay 17 has a front and back contact and a "common" connecting with coherer 17. When relay 12 is closed its common is in connection with the main wave wire antennæ under the engine, and when disengaged is in connection with the pick-up antennæ located under the cylinder. Solenoid 14 is also subject to control of the engineer, by a push button, 21, in cab of engine.

As an example, suppose engine No. 798 leaves Toronto on its trip to West Toronto Jct. It has its solenoid, coherer, 16 and 17, in operation. There being no electric wave between Simcoe street and Parkdale, master relay 15, hold-relay 3 to 12, solenoids 13 and 14, are de-energized, whistle 20 is blowing. Train line valve is held closed by push button 21 to keep brakes released. Entering wave zone just west of the Queen street subway, if the block is unoccupied, pick-up wave wire is unengaged and the wave jumps to the pick-up antennæ, the wave reaching the coherer through its contact on relay 12, closing master relay 15, which closes relays 3 to 12. The coherer thus being automatically connected with main antennæ under the engine, solenoid 13 stops the whistle from blowing, solenoid 14 closes valve 18 and the engineer can then remove his finger from push button 21. In the experiments the holding of push button and the blowing of the warning whistle when out of the electric zone were arranged for so as not to cause annoyance.

The engine is now under control of the wave, and as long as the wave is being received master relay 15 will be opened and closed every three seconds, 2½ seconds closed and ½ second open; consequently relay 3 and its trailing relays 4 to 12 remain closed. The wave is being received from the generator at Lansdowne avenue, the generator in turn being controlled by the alternating current track circuits being fed from the Golden avenue block station.

Suppose there is a train standing in the block between, say, Wallace avenue and Golden avenue. The wheels of the train shut off the current from A. C. relay at Golden avenue, stopping the wave between Golden avenue and Lansdowne avenue, the coherer fails to receive the wave, the master relay remains open, in one second relay 3 opens and relays 4, 5, 6 and 7 open successively, each a second later than its predecessor, and in five seconds after entering the block at Lansdowne avenue solenoid 13 drops its valve, 19, and the whistle, 20, blows; four seconds later relay 11 opens, de-energizing solenoid 14, and the train line valve is opened, and ten seconds after entering this block the brakes are applied to the engine, which will be brought to a stop without closing the throttle, as the power of the air brake is greater than the steam. Relay 12 has opened and the coherer is now connected with the pick-up antennæ under the cylinder, which is 3 ft. 5 ins. from the main wave wire in the center of the track. The engine is brought to a stop unless the engineer, when the whistle starts to blow, closes push button 21, holding solenoid 14 closed, thus preventing the application of the brakes. If the engineer is incapacitated it is obvious that the train will be brought to a stop. Suppose that before the engine reaches Golden avenue the train in Block A has cleared, when the other engine gets over pick-up wire at Golden avenue, the second engine is again placed under control of the wave.

TRACK, GENERATOR BOX, "WAVE WIRE" IN CENTRE, AND "PICK UP" AT END OF TIES.

However, suppose that block A is still occupied, the pick-up wire at Golden avenue is not energized and engine enters the block with its coherer still connected with the outside antennæ, and as the waves from the main wave wire in the centre of track will not jump over 12 ins., the apparatus on the engine is irresponsive, and the train runs in and through block A under the caution whistle and engineer acts accordingly.

Engine No. 147, we are informed, has covered 5,000 miles with the apparatus intact. One hundred and four hours' continuous run of the equipment has been made on Engine No. 798 without stopping. Engine 798 is in service from 6 a. m. Monday until 8 p. m. Sunday, handling from 20 to 60 cars per trip. Stops are made daily with wide open throttle. The train line valve is set for 25 lbs. reduction, and it requires this reduction to make a stop with light engine. With 12 cars at 50 miles an hour a reduction of 17 lbs. is made in the train line. With 30 cars the valve only makes 13 lbs. reduction; with 40 cars 8 to 10 lbs., and with 60 cars 5 lbs., the valve simply mechanically making the amount of reduction necessary to make the stop. Among the basic features of the invention is the fact that all track devices and all train devices are on the closed circuit principle. It is evident that the train pipe is kept closed by a balanced valve, and the moment the wave ceases it drops open by gravity. It is not pulled open.

The coherer, always working, is the watchman of the apparatus. It delivers a report that all is well every two seconds to the master relay. It ceases reporting when all is not well. The coherer is perpetually being up-drawn to keep it in prime condition for the wave influence, which is received by the antennæ on the engine. The whistle valve and the train line valve are forcibly retained in the presence of the wave, and opened and dropped by gravity in case of current cessation. A failure anywhere means a stop, except the locomotive engineer be in possession of his senses and uses the push button to keep the train line closed.

Under any circumstances, in case of the cessation of the wave the air whistle blowing is a constant reminder of the necessity for caution and of danger ahead. A train entering a block when the next block is occupied is brought to a stop unless the locomotive engineer intervenes.

Locomotive Running Repairs

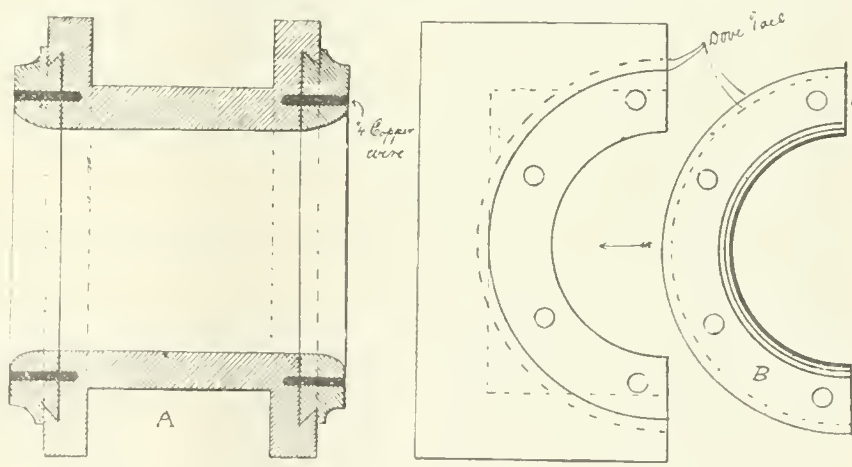
XII. Readjusting the Main and Connecting Rods.

The rapidity with which the bearings of the rods are worn renders it necessary that they should receive careful and constant attention. Beginning with the main rod, the tendency to increase its length is very great, since every time the keys are driven for the purpose of tightening the brasses the length of the rod is increased. By the length of the rod, it will be understood that the distance between the centers of the bearings is referred to. When the locomotive is new, or newly repaired, it is usual to mark the points on the upper guide at which the piston touches the cylinder heads. The distance between these striking points may measure from a quarter to half an inch more than the stroke of the piston, and the rod should be so adjusted that the space in excess of the stroke will be divided evenly so that there will be an equal amount of clearance at each end of the stroke. If there be any variation it is safer that the lesser space should be in the back end of the cylinder, as the lengthening of the rod already referred to will tend to equalize the amount of clearance. The exact spacing between the working point of the crosshead and the striking point should be maintained as nearly as possible. Apart from the danger of the piston colliding with the cylinder head, a variable space imparts an irregularity to the exhaust, which may not be a serious loss in power but is certainly no kind of gain.

In refitting the brasses in the front end of the main rod they should be left at least one thirty-second of an inch open when fitted to the wrist-pin. This leaves some allowance for driving the key as the brasses wear. In attaching the front end of the main rod care should be taken to note that the rod is not loosely attached to the wrist-pin but should be keyed snugly to a sufficient degree of tightness so that the rod may be moved up or down with little effort beyond the weight of the rod. A loose bearing in the front end of the main rod is a sure beginner of trouble and often leads to serious fractures. The danger of the bearing heating is not great, except in the case of driving the key too tightly, as the movement of the bearing is only a small part of a revolution.

In closing and refitting the brasses on the back end of the main rod care should be taken to retain the square adjustment of the brasses to each other, so that when they are returned to the strap they do not require the pinching pressure of the key to bear equally. The key should be driven in the strap before connecting the rod to the strap and it should be noted that the brasses revolve readily but not loosely around the crank pin. No lost motion is required in the adjustment of the main rod. It should be closely fitted, and frequently refitted, as the incessant shocks to which it is subjected rapidly wear the bearing parts.

In regard to the inevitable wear of the sides of the main rod and other brasses, the life of the brasses may be prolonged by soldering semi-circular strips to the sides of the brasses. These should be held in place by four or five pins of brass or copper, for which holes may readily be drilled through the reinforcing patches into the brass itself a depth of over a quarter of an inch, care being taken that the pins fit snugly in the holes. When these side patches are attached to the brasses the opportunity should be taken to close the brasses sufficiently together so that they may be bored out, the patches being also faced off to the proper size of the crank-pin bearing. It may be added that the patchwork, like the mending of a worn garment, has not the durability of the original, but it is better than allowing the rapid reduction of the brasses to go on without applying some remedy.



ROD BRASS WITH DOVETAIL PIECES FOR WEAR.

A more substantial method of patching rod brasses than by soldering is shown in the accompanying illustration, A representing a sectional or end view of the brass, which, it will be noted, has been reduced in the lathe and a dovetail groove cut into the metal. B shows the patch, which, as may be readily imagined, is cut in a circular form and divided into two pieces at CC. The patches, when fitted to the proper size by templet or otherwise, are readily put in place on the brass and held in position by copper wire driven into holes that penetrate a short distance into the body of the brass. This method of patching or reinforcing will be found to be more durable than soldered pieces, and if the patches are made to a standard size and kept in stock little delay need be experienced in refitting the brasses.

Coming to the refitting of the connecting rods, the brasses should be left so as to move more freely than the fitting of the back end of the main rod already described. The vertical vibrations incidental to the action of the springs, the oscillations arising from variations in the track and the ever-changing tractive effort essential to variable velocities all combine to render a certain amount of easiness in the joints of the connecting rods a mechanical necessity. This is readily observed in the case of rods where the brasses are solid bushings, all that is necessary being that the bushings should be at least one sixty-fourth of an inch larger than the crank pins, and if properly lubricated they will run many months.

It should be remembered that while the original exact adjustment of the wedges and driving boxes is a primal necessity in the subsequent successful running of the locomotive, it does not follow that the wheel centers will remain in their perfect relation to each other. It is a well-known fact that the wedges and even the driving boxes do not all wear alike. The variations between the right and left sides of a locomotive in wear and tear are peculiarly variable, but they can be largely accounted for from the irregular thrust of the main rods, the left side following that of the right side at one quarter of a revolution when the engine is running forward, thus leaving three-quarters of a revolution unsupplied with equal moving power. The fact that two strokes of the piston are necessary to each revolution does not eradicate the eccentricity of the movements. Engines that run as much backward as forward wear more equally in all of their bearings.

The fact that variations do arise should neither be laid to the fault of the constructor nor should they be neglected. In setting up the wedges preparatory to readjusting the rods the wheel centers should be trammed, and variations, if any, should be rectified. The front wedge or shoe lends itself readily to adjustment by the use of liners, and when the wheel centers are correct the engine should be moved until the right main crank pin is on the forward center. This will bring the left main crank pin on the top center, and presuming that the connecting rods on the left side are removed from the crank pins a fine string suspending two small weights may be hung over the crank pin and the engine may be moved until the crank pin is exactly central, the suspending strings showing an equal distance from the center of the axle. When this position has been carefully attained the main driving wheel should be securely blocked with small pieces of iron jamming the wheel securely in its place on the rails. Wooden wedges are of poor service, the wood bending readily if raising the other wheels is necessary. In trying the other driving wheels with the suspended string it will likely be found that the crank pin is not exactly central. In raising the wheels for the purpose of moving them to the exact position so as to correspond with the main driver it is good practice to block the space between the bottom binders and the driving boxes, as the wheels will be lifted more readily and the engine will retain almost its level position. When the crank pins are exactly plumb on the left side, the adjustment of the rods on the right side may be proceeded with. In addition to the careful fitting of the brasses already alluded to, the importance of snugly filling the space between the crank pins should not be overlooked. It is better that the rod should fit tightly than loosely, especially if the boiler is cool. The expansion of the frames when the engine is heated is small, but it has its effects on the rods, which remain comparatively cool under this condition. A loose rod imposes a great strain on the bolts in the straps, while a rod that is snugly fitted will convey the strain directly to the crank pins.

When the connecting rod is attached it should not be difficult to move either end of the rod sidewise by tapping the rod with a piece of hardwood, taking care to avoid the pernicious practice of striking the rods with a soft hammer that is soft only in name. Rods that are battered and bruised by hammer blows are not only unsightly but are a sure indication of unskilled and careless workmanship. When the adjustment of the rods on the right side is completed the engine should be moved to bring the left crank pins on the front or back center. A point that is well worth observing is the testing of the rod when one end is attached in order to show whether it points exactly to the center of the corresponding crank pin. A marked deviation from this point is a serious drawback and can be readily rectified by the skilful mechanic. If the deviation is particularly marked a slight bending of the rod near the further end may be readily accomplished by the use of a screw press, or a slight variation may be overcome by a careful refitting of the brasses by removing a small quantity of the metal at the part of the bearing required to allow the rod to point centrally.

When the front end of the rod is connected it should also be observed when the strap of the other connection is pushed over the butt end of the rod for the purpose of driving in the bolts whether there is any twist on the rod or not. If any obliquity in the alignment of the rod and strap is visible the brass at the other end should be refitted and a perfect adjustment secured before driving the bolts. It will readily occur to the thoughtful mechanic that both ends of the rod should be tested in this way, as one end is as likely to be in error as the other.

In testing the movement or degree of slackness of the rods time need not be wasted testing the engine in other than the central positions. It is only when at the dead centers that the connecting rods are free from the great strain of moving the engine and are necessarily pulling in one direction or the other, and should not be expected to be moved easily except when the strain is removed. In brief, no exact idea of their adjustment can be got on any other point except on the centers, and it is safe to presume that if the rods pass the centers easily there is hardly any possibility of difficulty at any other point.

When the brasses are closed in refitting it should be seen that the opening for the oil way is sufficiently enlarged so as to insure a clear space for the oil readily reaching the crank pin without a projecting impediment of a portion of the brass obstructing the opening. A portion of the brass overlapping the oil hole becomes a ready receptacle for the collection of dust or other matter and a stoppage of the lubrication with serious results speedily follows.

The growing tendency of increasing the size of the crank pins in locomotives and fitting the connecting rods with massive bushings of the best material is a good one. The degree of perfection to which the machines used in the location or quartering of the crank pins is such that the relation of the parts is assured with absolute certainty, and with the correct adjustment and maintenance of the wheel centers in their exact position the adjustment of the connecting rods becomes a matter of simple attachment. This is more, however, than can be said of the main rod which remains in all kinds of locomotives the subject of constant and careful readjustment.

Questions Answered

SERIES OF QUESTIONS.

7. J. F. B., West Philadelphia, writes: Please describe the construction of the piston, describe the packing rings, etc., etc., etc.—A. We do not think answering a series of questions such as you have propounded will do you any very great permanent good. You ought to make a more extensive study of the locomotive and for that purpose we would advise you to look over our little publication called the "Book of Books." It is sent free to anyone who writes in and asks us for it.

VAPOR SYSTEM OF CAR HEATING.

8. Subscriber, Covington, Ky., writes, Please explain the vapor system of car heating as applied to passenger trains.—A. We presume, of course, that you refer to the very ingenious system devised and put on the market by the Gold Car Heating & Lighting Company, of New York. This system was very fully described and explained in an illustrated article which appeared in our January, 1909, issue, page 36. We cannot do better than refer you to that article for a full and accurate description of the vapor system of car heating.

CENTRE OF GRAVITY AND NEUTRAL AXIS.

9. Subscriber, Covington, Ky., writes, Please explain plainly the meaning of the centre of gravity and the

expression neutral axis.—A. (1) The centre of gravity is the point in a body, or system of bodies, rigidly connected together, where the weight of the body may be supposed to be concentrated. It is that point about which, if suspended, all parts of the body will be in equilibrium; that is, there will be no tendency to rotation. In bodies of equal heaviness throughout, such as a perfect balanced wheel, the centre of gravity will also be the centre of magnitude; that is, it will be at the centre of the wheel.

(2) The neutral axis of a beam, for example, may be described this way. Suppose a steel I-beam supported at each end and loaded either uniformly or in the middle, the particles at the top of the beam will be in compression while those at the bottom will be in tension. The greatest compression and the greatest tension will exist on the surfaces of the top and lower flange, respectively, the compression strain will diminish as one goes toward the center of the web and the tensile strain, greatest in the particles of the lower flange, will diminish as one goes up the web of the beam. The neutral axis is the point where these two strains meet and neutralize each other, so that along the neutral axis there is neither compression nor tension, or no strain at all. In a rolled boiler plate the outer skin of the plate is slightly extended, while the inner side becomes slightly shorter. The neutral axis is the plane through the center of the sheet, which does not become longer or shorter, but remains of the same length, unaffected by the rolling of the plate.

MOMENT OF INTERTIA.

10. Subscriber, Covington, Ky., writes, Will you please explain plainly the meaning of the expression Moment of Inertia as applied in figuring the strength of beams?—A. You will find this expression dealt with in Kent and other engineering pocketbooks. We have, however, tried to comply with your wish by preparing an article on the subject, which appears in another column of this issue.

POSITION OF INJECTOR.

11. W. S., Atlanta, Ga., writes: We have had some discussion here in regard to the location of the injector. Has the injector's position on the locomotive any particular effect on operation? —A. No. The location of the lifting injector is a mere matter of convenience. The important points are that the supply of steam should be from as high a point as possible in the boiler. and it is also preferable that the supply of steam should come from an independent pipe or stand rather than from a box or head from which other appliances may be supplied with steam. A high point in the boiler insures dry steam. An independent supply pipe insures an unvarying supply.

STOPPING PASSENGER TRAINS.

12. J. B. I., Whitmore Lake, Mich., writes: What is the shortest distance in which a train of cars can be stopped with the quick-action brake and in what distance can it be stopped with the high-speed brake with the L. N. equipment and with the P. C. equipment?—A. There is no record of air-brake tests that will give this information as you desire it, principally because the late brake equipments were designed with a view of meeting conditions imposed by heavier rolling stock and higher speeds, rather than in an effort to stop trains from any speeds in shorter distances than they could be stopped thirty years ago. However, the following, taken from records of high-speed stops, will convey an idea of the advancement in air-brake efficiency. In the year 1878 a stop was made from a speed of 60 miles an hour in 1,130 ft., but weights of rolling stock increased to such an extent that the average train of 1900 could not be stopped from a speed of 60 miles an hour in less than 1,400 ft. by the quick-action brake, but the high-speed brake stopped this train in 1,050 ft.

In 1908, under conditions in which the high-speed brake stopped a train of cars from a speed of 70 miles an hour in 1,900 ft., the L. N. equipment stopped the train in 1,680 ft., and in the year of 1909, when heavier locomotives and cars running at speeds of 60 miles an hour could not be stopped by any air brake in less than 1,300 to 1,500 ft., the P. C. equipment stopped the train in 1,100 ft. All of the foregoing refers to emergency stops on level tracks and the work of the P. C. equipment is regarded as marvelous by air-brake men; but if the problem is regarded as merely a matter of miles an hour, records will show that trains were stopped from speeds of 60 miles per hour in 1,020 ft. in the year 1875, but stopping a modern train with the brake of 1875 would be an entirely different matter.

COLOR OF AIR-PUMP PISTON.

13. S. N. S., Fitchburg, Mass., writes: I have noticed that if the air cylinder of a 9½ in. pump is in first-class condition the steam piston rod is of a rainbow blue color and if the cylinder is in poor condition the piston rod is pale or dull-looking. Is this worth considering during the daily tests to determine the condition of the air pump?—A. The colors you have reference to are due to differences in temperature and these differences are generally due to difference in pressure in the air cylinder. The color conditions are produced by causes and combinations far too complex to be of any practical value. The degree of temperature in an air cylinder may be due to the condition of the pump, but not necessarily so, as an increase in pressure will result in an increase of temperature in the cylinder of a pump that is in good condition. However, one phase of the color situation that can be observed is that the highly polished blue rod is the result of a temperature that exceeds but slightly, if at all, the natural degree of heat incident to compression, while if the pump becomes sufficiently overheated the blue color is, so to speak, burned out of the rod as the discharge valve cavities in the cylinder are burned and discolored by an intense heat. It is evident that the coloring is due to temperature rather than condition of the pump.

GOOD METALLIC PACKING MATTER.

14. W. R. C., Cleveland, Ohio, asks: What is the best mixture of metals to make the most durable kind of metallic packing for pistons or valve rods?—A. We would not care to venture an opinion on what is the best mixture of metals for packing, but a good combination is 100 parts of tin, 10 parts of copper and 6 parts of antimony. The alloy is improved by fusing the metals in separate crucibles. When the copper and antimony are mixed the tin should be poured in last and the mixture should be well stirred with a piece of green wood which will not readily burn. Iron or steel rods should not be used for stirring, as particles of such rods will readily mix with the alloy and produce hard spots in the metal. Lead should not be used. Its softness renders it readily affected by dust, which adheres to the metal and hastens the wear of the piston or valve rod.

GAIN IN SUPERHEAT AND COMPOUNDING.

15. J. R., Laramie, Wyo., writes: Has any real gain been made by the introduction of superheating and compounding in locomotives, and if so, what is the percentage of gain?—A. All authorities agree that a gain variously estimated from 15 to 25 per cent. has been made in the matter of fuel economy by the use of superheated steam in compound locomotives. There was a tendency at first to overestimate the gain, as is usual, in all new improvements or changes, the extra cost of constructing, operating and repairing being to some extent overlooked. This was especially so in Germany, where the use of superheated steam was systematically adopted and claims of gain as high as 50 per cent. were made.

Air Brake Department

Conducted by G. W. Kiehm

Back Pressure on Air Pumps.

While considering the subject of "air pump piping," a committee appointed by the Air Brake Association deemed it advisable to investigate the amount of back pressure encountered in the exhaust pipe, in connection therewith.

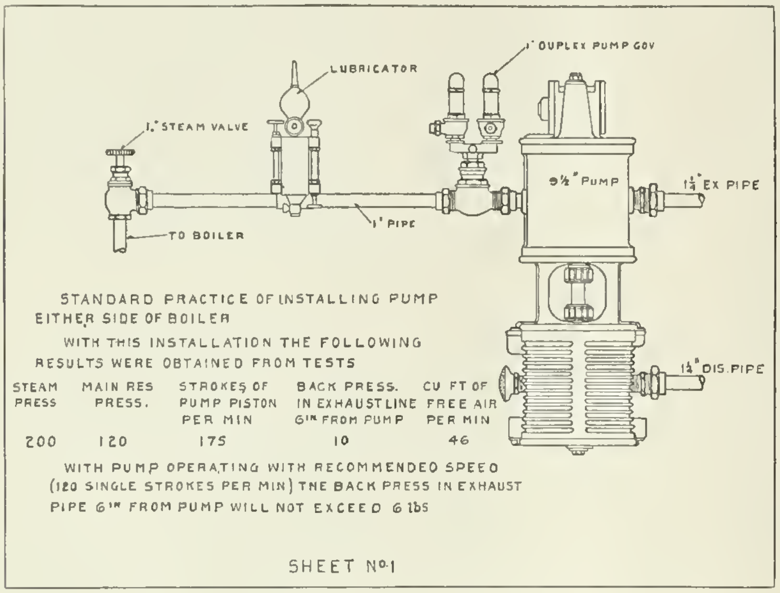


FIG. 1. STANDARD PUMP INSTALLATION.

It was found that with 22 ft. of 1¼-in. exhaust pipe containing one elbow, a back pressure of 10 lbs. per square inch was effective on the exhaust side of the steam piston of the 9½-in. air pump, when the single strokes per minute were 175 and 200 lbs. steam pressure working against 120 lbs. air pressure.

With the 11 in. pump running at a speed of 136 single strokes per minute, with 200 lbs. steam pressure working against 130 lbs. air pressure, a back pressure of 12 lbs. was encountered. With the 8½-in. cross compound pump, pumping against 130 lbs. air pressure with 200 lbs. steam pressure and a speed of 150 single strokes the back pressure in the low pressure steam cylinder was 20 lbs. At this time the cross compound pump was compressing 130 cu. ft. of free air per minute, and under the conditions just mentioned the 11-in. pump was compressing 58 cu. ft. of free air per minute.

This back pressure is the result of pipe friction, and is approximately the figure that would be encountered when the locomotive is at rest if the exhaust is piped into the engine cylinder's exhaust cavity in the cylinder saddle, or it is about the amount of back pressure encountered if the pump exhaust is piped into atmospheric pressure in the engine stack.

The reason for questioning the amount of back pressure effective on the exhaust side of the steam piston is that excessive back pressure will affect the speed of the pump, reduce its capacity and very materially increase the steam consumption.

The back pressure not only results in a *more expansive use of steam,* but in combination with scant lubrication and well-worn or slightly defective valve mechanism, it is frequently responsible for the pump stopping in service. It is also responsible at times for the pump stopping in service for no apparent reason, or when no particular cause can be assigned.

The back pressure also plays an important part in the trouble with brakes creeping on or sticking when there is a fall in steam pressure in the locomotive boiler, which usually occurs when the engine is being worked hard and at such time the pump exhaust is obstructed by the engine cylinder's exhaust, when the exhaust is piped into the cylinder saddle. The figures (indicated as Figs. 1 and 2) are self explanatory, and the indicator card, Fig. 3 was taken from the exhaust pipe 6 ins. from the 9½-in. pump.

The back pressure thus encountered is due to pipe friction, and is not excessive if correct installation and proper size of piping is adhered to. The excessive back pressure that results in the undesirable effects mentioned is due to the method of disposing of the exhaust steam. This matter has been given considerable attention. Some roads' practice is to pipe it directly into the front end of the locomotive and turn the pipe upward into the stack where the exhaust becomes to a certain extent a blower on the fire. This practice results in there being a heavy draft on the fire when the air pump operates rapidly when descending grades.

Another disposition of the air pump exhaust steam is to pipe it into the engine cylinder's exhaust passage in the cylinder saddles, and while this creates no additional draft on the fire, it results in an excessive back pressure when the engine is being worked hard.

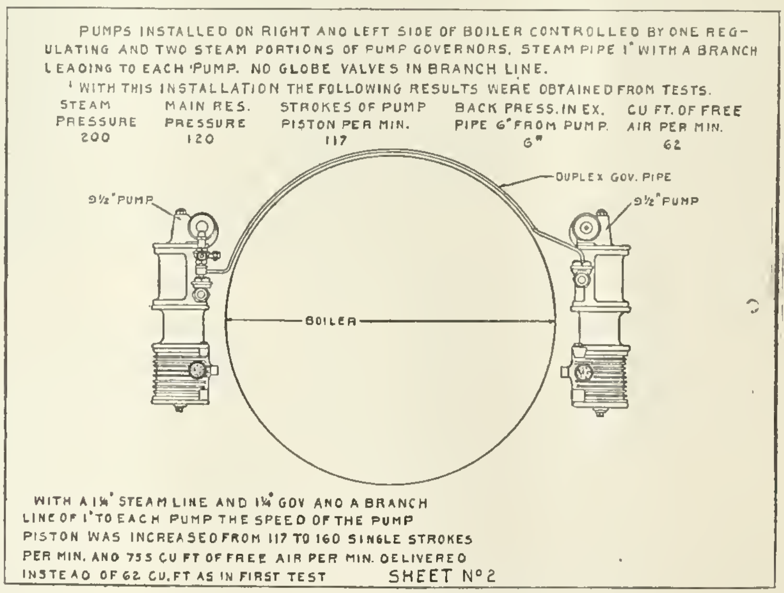


FIG. 2. PUMP INSTALLATION, BOTH SIDES.

Some roads have disposed of the exhaust steam by turning the exhaust into the water tank for the purpose of raising the temperature of the feedwater before it enters the boiler. Another method which has been used to a great extent consists of utilizing the exhaust steam for car heating in passenger service, and one of the latest methods is to pipe the pump exhaust to the front end of the locomotive, along the outside of the extension and stack, allowing it to exhaust into atmospheric pressure just outside of the engine stack. There are some serious objections to all of the methods mentioned, and the most prevalent practice is to pipe the exhaust into the cylinder saddle of the locomotive.

In an endeavor to determine to just what extent the air pump is affected by back pressure in road service a gauge was attached to the exhaust pipe 6 inches from the pump on an engine using the high-speed brake in heavy passenger service. This gauge showed a back pressure of 10 lbs., while the locomotive was at rest and as high a back pressure as 30 lbs. when the locomotive was being worked hard.

In freight service an engine hauling a heavy train was selected and a gauge attached to the exhaust pipe 12 ins. from the pump and one 24 ins. from the cylinder saddle. The exhaust pipe of this 9½-in. pump used was 21 ft. in length, made of 1¼-in. pipe, and with the pump working against 100 lbs. air pressure with 200 lbs. steam pressure the gauge 24 ins. from the cylinder saddle registered a constant pressure of 23 lbs., and the gauge near the pump vibrated from 30 to 100 lbs., while the engine was hauling a heavy train at a speed of 18 miles an hour.

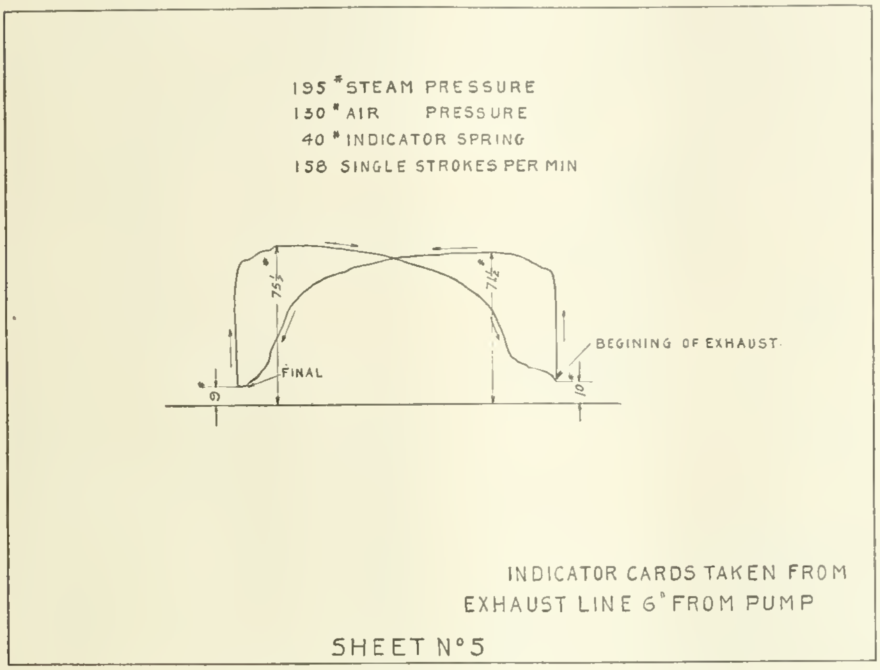


FIG. 3. INDICATOR CARD, EXHAUST LINE, 6-IN. PUMP.

While the engine was being worked to its full capacity at a speed of 20 miles an hour the gauge near the cylinder saddle registered 40 lbs., and at a time the engine slipped on the rail, a pressure of 50 lbs. was observed, while the vibration of the hand on the gauge near the pump was from 10 to 120 lbs. At a speed of 8 miles an hour the gauge at the saddle registered 20 lbs., and when the speed was increased to 18 miles an hour the pressure increased to 37 lbs.

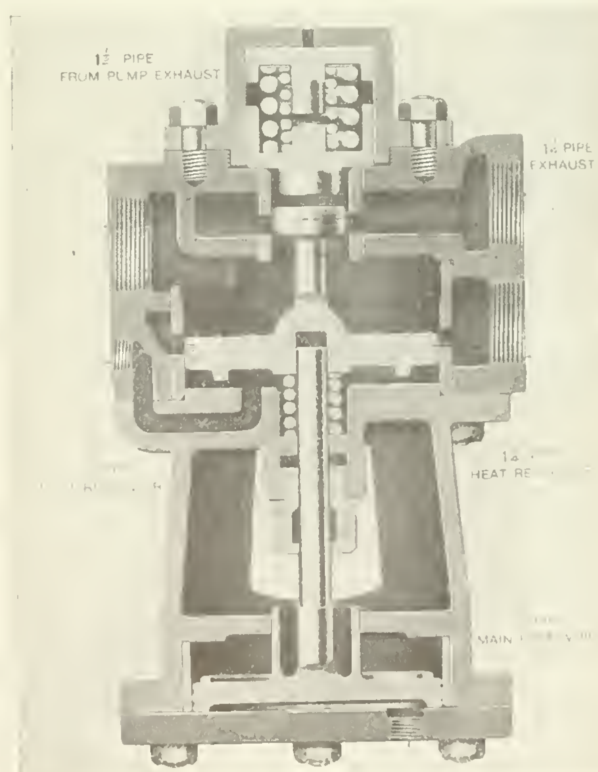
With a view of entirely eliminating the back pressure on the air pump piston, Mr. J. S. Barner, of the N. Y. C. & H. R. R. R., has designed and perfected an air pump exhaust nozzle which, with the proper sized exhaust pipe, will accomplish what is intended.

This nozzle is in the form of a casting which encircles the engine exhaust nozzle and has a 1½-in. pipe connection and a 2-in. exhaust pipe outside of the front end. With this arrangement the exhaust from the engine cylinders tends to create a vacuum in the pump exhaust pipe, and while the locomotive is at rest the exhaust creates no noticeable draft on the fire. The use of the nozzle has no detrimental effect upon the steaming qualities of the locomotive, and it also eliminates the thumping sound of the pump exhaust.

This nozzle was tested in freight service under the same conditions as the first mentioned freight test, to determine the amount of back pressure and under the conditions where the gauge at the cylinder saddle showed from 20 to 23 lbs., the use of the nozzle prevented the accumulation of sufficient pressure to register on the gauge.

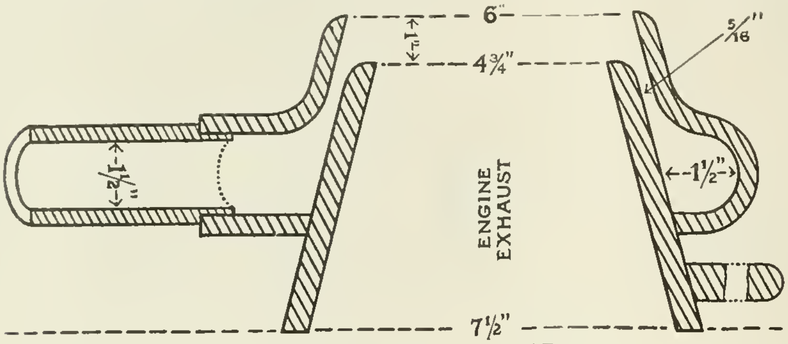
In another demonstration the engine was pulling a train of cars and the gauge at the cylinder saddle registered no pressure, while the nozzle was being used. After connecting the exhaust pipe to the cylinder saddle and proceeding at the same rate of speed a back pressure of 16 lbs. was observed.

Realizing that train heating by means of air pump exhaust steam is economical if steam can be obtained without creating an excessive back pressure at the end of the pump piston stroke, Mr. F. F. Coggin, of the Economy Car Heating Company, has introduced the by-pass valve illustrated here. This valve, located in the exhaust pipe, near the pump, accomplishes its purpose by allowing the first part of each exhaust to be diverted into the heating system of the train, and when the piston of the air pump has partially completed each stroke, and before much air pressure has been built up in the air cylinder, the valve opens an exit for the remainder of the exhaust in the steam cylinder to escape to the stack or to the front end, thus allowing the pump to operate under practically the same conditions as though all the exhaust were



BY-PASS VALVE.

allowed free escape. Tests of this device in service show no appreciable difference in the speed of the pump, whether the exhaust is used for heating purposes or not. Indicator cards taken from pumps with this valve attached, show no material difference in the final back pressure on the exhaust side of the piston, and separation tests to determine the division of exhaust steam under road conditions show from 70 to 85 per cent. of the total exhaust steam as being diverted into the heating



AIR PUMP EXHAUST NOZZLE.

system. The only movable feature of this valve consists of two small differential pistons connected to the same rod, these pistons being respectively 5 ins. and 1-½ in. in diameter, and provided with suitable packing rings.

The car heating pressure is constantly maintained under the large piston. The exhaust passes into the chamber between the two pistons, and being higher than the true heating pressure the pistons are moved downward, thus opening a series of ports leading to the heating system, allowing the high exhaust pressure to equalize down to or near the heating pressure when the differential areas of the pistons cause them to move upward, closing the ports leading to the heat system and opening the ports leading to the stack, or front end, thereby permitting the remainder of the exhaust steam in the pump to pass out to the atmosphere.

Air Brake Tools.

In contemplating the interesting subject of repairs to air brake apparatus it becomes evident that a great deal of stress is placed upon the requirements of tools and facilities for making repairs, and admitting that they are of importance they are, nevertheless, frequently given more consideration than is absolutely necessary.

In many instances where the subject of tools is given extraordinary consideration it may be observed that the knowledge and ability of the man who is to handle them is not always given such serious consideration, but in order to institute a successful and economical system of repair work the man to do the work must be considered before the tools which are to be used.

In selecting a man, after the requisites of honesty and sobriety, comes his knowledge of air brakes and his ability to handle tools or his ability as a mechanic; the tools to be used are of minor importance.

The best-trained machinist or the most skilled mechanic is next to useless on modern air brake repair work unless he has a good general knowledge of air brakes; but a man with a knowledge of the brake, whether a skilled workman or not, will quickly recognize the source of air brake disorders and find some means of applying the remedy regardless of tools or facilities.

This statement is borne out by the fact that in going from shop to shop or from one repair plant to another few places will be found where repairs are made in the same identical manner, even in shops on the same railroad.

Evidently, then, while one repair man finds it convenient to do a particular piece of work in a certain manner, another repair man finds a different method more convenient. Tools are, of course, necessary; but it is possible to have too many of them for the welfare of the employer as well as the employed, and it is often amusing to watch newly employed machinists when they start on their first day's work. One may open a suit case and take out an immense quantity of highly polished and nickel-plated tools, while another may reach down in his pocket and produce a jack knife and broken rule, and while it has no particular significance or any bearing upon the subject, the one with the broken rule often remains while the other is seeking employment elsewhere.

A fact that is sometimes temporarily lost sight of is that when a man is handling his tools he is doing no work for his employer, during the time the man is measuring, calipering or wiping off his tools he is accomplishing nothing in the way of work actually done and the time consumed is the same whether done in loafing or handling tools.

In the following it is not desired to submit any list of tools that might be found convenient for use or to suggest any addition to, or improvements in, tools, but rather to discourage the use of some tools now used in repair work. On air pump repair work there are many different tools that are necessary as well as convenient to use, such as the cap-screw, packing nut, valve cage, valve seat and open-end wrenches, but a special tool for every different operation in overhauling the pump is uncalled for.

We often hear the expression "calipering the cylinders" of a pump in order to determine whether or not they should be rebored, while the use of a pair of packing rings a trifle larger than the bore of the cylinder will very quickly show the wear of the cylinder. If the rings are placed in the middle of the cylinder and marked where they overlap and then placed in the end of the cylinder with the openings at the discharge valve side of the pump, the difference between the marks on the rings will show the amount of wear. As it would be termed, the cylinder would be worn approximately 1-3 of the distance the marks would be apart; thus the wear of six different cylinders could be determined in about the same time that one could be calipered, and this also applies to main valve bushings and main valve cylinder heads.

A depth gauge is a convenient tool for measuring the lift of air valves, and it should be used oftener than it really is or possibly with better effect; however, the average repair man needs nothing for this purpose but a rule or scale or a broken hacksaw blade.

A combination square is the proper tool to be used in straightening a reversing valve rod if it becomes bent or to determine whether or not the rod is bent.

Some quicker methods with less handling of tools can be put into effect on all classes of air brake work in many railroad shops, particularly on triple valve repair work, as nearly every shop has its own assortment of tools and facilities. Without wishing to criticise any particular method of triple valve repair work, it is a fact, nevertheless, that the day of the surface strip and the face plate for repairing a leaky slide valve is past. Instead of wearing out a good surface strip by rubbing it over a slide valve seat or ruining a good face plate by rubbing a slide valve over it, the repair man can find a shorter cut to the desired end by rubbing the valve on its seat when necessary and thereby cut out all the time consumed in wearing out shop tools. It is very plain that if a certain amount of rubbing must be done on the wearing surface of the valve and seat it must be a saving in time to do the rubbing on both the valve and seat at the same time.

While tools are in nearly all cases of secondary importance and while it requires time to handle them, there are many that are really time-savers, such as the gimlet or auger type of holder for grinding check valves, and valve seat reamers and socket wrenches, which are not expensive and require very little care.

Electrical Department

D. C. Series and Shunt Motors.

Before taking up the difference between these two types of motors, the characteristics and application of each, it would be well to outline in general

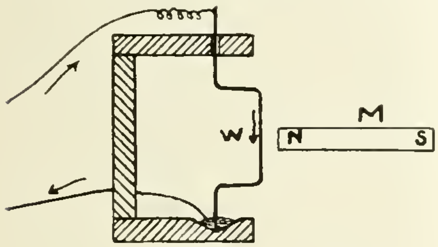


FIG. 1. ROTATION OF WIRE.

by what principle a direct current motor works and also its important parts.

A very simple but interesting fact is illustrated in Fig. 1. If an electric current is allowed to flow through the wire W from some source of power, say a battery, and this wire is suspended so that it can move, and the north pole of the magnet M is brought up close to it, the wire will move across the face of the magnet. If the other pole of the magnet is placed near the wire the movement will be in the opposite direction. Or if the same pole of the magnet is left in position, but the direction of flow of the current in the wire is changed, then the direction of movement of the wire will be in the opposite direction. Changing either the direction of the flow of current or changing the pole of the magnet gives reverse motion. If both are changed, however, the direction remains the same.

The same condition will hold if the magnet is replaced by a soft iron or steel rod, on which is wound a number of turns of insulated wire carrying an electric current, as this rod will then become a magnet, one end being a north pole and the other a south pole. The more turns of wire wound around the bar and the greater the power of current in the coils the stronger the magnet and the greater the force acting on the wire W.

The direct current motor, as it is today, is based on this fundamental principle. The armature, composed of many wires or coils connected to the commutator, the purpose of which is to get the electric current from the source of power to the armature coils, is the same as the wire W, and the field, made up of several turns of wire mounted on iron or steel blocks symmetrically placed around the outside of the armature, is practically the magnet M. The armature having many coils and the field being divided into four or more parts there are, at any instant, many wires which are being attracted by different amounts, according to the distance away from the field poles, and many repelled, so that the torque or turning power of the motor is constant. To obtain reverse rotation the direction of flow of current must be changed in either the armature or field, not in both.

The next point to consider in order to appreciate the characteristics of the series and of shunt-wound motors, is, what is the back electromotive force which is present in direct current motors?

Referring again to Fig. 1, if we disconnect the source of power from the wire W and then move this wire rapidly across in front of the magnet, or the rod on which is wound the turns of wire carrying current, there will be generated in this wire a voltage, which will vary in value directly as the speed

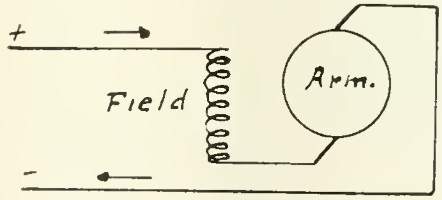


FIG. 2. OUTLINE OF SERIES.

at which the wire passes by the magnet, and as the strength of the magnet, and if the ends of this wire are connected by some material which is a conductor of electricity we will have a flow of current in this wire. This is the principle of a dynamo or generator. While the motor is running the many armature coils are passing quickly by the fields, poles or magnets and a voltage or pressure is generated in this armature in opposition to the voltage applied at the terminals of the motor, thus choking back the flow of current more and more as the speed increases. This counter voltage which is generated in the motor is called the "back or counter electromotive force."

It is this counter electromotive force (e.m.f.) that permits the resistances, which are connected in the circuit, to be cut out as the motor speeds up. The only choking effect in the motor when standing still is the resistance, which is very small, and if full voltage was applied to the motor there would be such a rush of current that the motor would probably burn up. By inserting resistance, however, of such value that the current will not exceed a certain predetermined pressure, the motor will start slowly and begin at once to generate this counter e.m.f., choking down the current. The resistance can be cut out step by step until no more is in circuit, at which speed the counter e.m.f. is of such value that the current flowing through the motor does not exceed the safe amount. The motor will still continue to speed up, the current gradually falling, and will reach a balance speed when the difference between the impressed voltage and the counter e.m.f. generated is a voltage sufficient to give a current through the armature, such that the product of this current and the field gives the pull or turning power necessary to do the work required. It follows that if the field is strengthened, the armature will not have to rotate as rapidly in order to give the same back e.m.f. and vice versa. Increasing the field strength, therefore, gives slower speed and decreasing the field strength gives higher speed.

The above principles apply equally well to the direct current series and shunt wound motors, as the two types are essentially the same. In practice, however, they differ greatly, as each has been developed to perform the service for which it is best adapted.

The series motor gets its name from the arrangement of connections between the armature and field, which are in series, i. e., the same current which flows through the armature flows through the field coils. Fig. 2 shows the diagrammatic connections of a series motor and Fig. 3 connections for a shunt-wound motor. Fig. 4 shows connections for a four-pole machine.

Since the armature and field are in series and the same current passes through both, the strength of the field

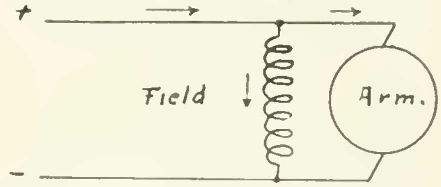


FIG. 3. OUTLINE OF SHUNT

varies with the load, which affects both the torque of the motor and, as mentioned above, the speed. The torque or turning power of a motor is the pull it can give at one foot radius from the center of the armature shaft, and depends on the product of the field strength and current flowing through the armature, so that the pull of a series motor increases rapidly with a large drop in speed.

Suppose a certain job will require a pull of 100 lbs. on a belt running over a pulley of 1 foot radius, the motor will take 25 amperes from the source of power and will run at 950 revolutions per minute. If, however, the job requires a torque of 1,000 lbs., which is ten times the case just taken, only 135 amperes are required, which is only a little over five times the former, and the motor will run at a speed of 400 r.p.m. The pull goes up much more rapidly than the power taken into the motor, and in that the series motor economizes on the use of power by a drop in speed. It is therefore used where necessary to start up against a heavy load, which means that a large torque is required, and also when desirable to have the speed drop off with the load. The series motor will always give the same torque for the same value of armature current (which also passes through the field) independent of the voltage impressed at the terminals of the motor, as torque is equal to the armature current times the field strength. With lower voltage the motor will, of course, run slower, because there is less back e.m.f. to generate. Thus series motors are used for electric locomotives on railway work, as they are required in these cases to start up against a heavy load and in railroad practice saving of power consumption is a very important item. Moreover, the automatic variable speed characteristic of the motor is an advantage. By regulating the voltage to the motor as slow speed as desirable can be obtained. Series motors are also used for cranes, hoists and for steel rolling mills where, in each case, the load varies greatly. One important thing must be considered, when using a series motor, and that is, the condition which exists when the load is taken away, with voltage still applied. The motor will speed up as the load comes off, with a drop in current, as less and less difference between the impressed voltage and counter e.m.f. is required to produce the necessary torque; also the field is weakening, which increases the speed. The motor will, if the load is removed, race and be destroyed. Thus series motors should not be fitted with a belt, but with a positive drive, unless some automatic feature is installed to cut off the power, in case the belt should slip off or break.

The shunt motor is so called because the field takes, or shunts its current, from the line independent of the current in the armature. In other words, the current passing through the armature does not pass through the fields. A diagrammatic sketch is shown in Fig. 3, and referring to Fig. 4 connections are shown, so that the motor will operate as a shunt instead of a series motor. From these diagrams it is readily seen that the current flowing through the field is constant for constant voltage impressed, and that there is no automatic change of the field strength, in the motor itself, as the load comes on. As the field remains constant it follows that the torque depends on the armature current and that the speed should be constant. However, with increase of current in the armature the latter does not have to rotate quite as fast to give the back e.m.f., and the speed drops slightly.

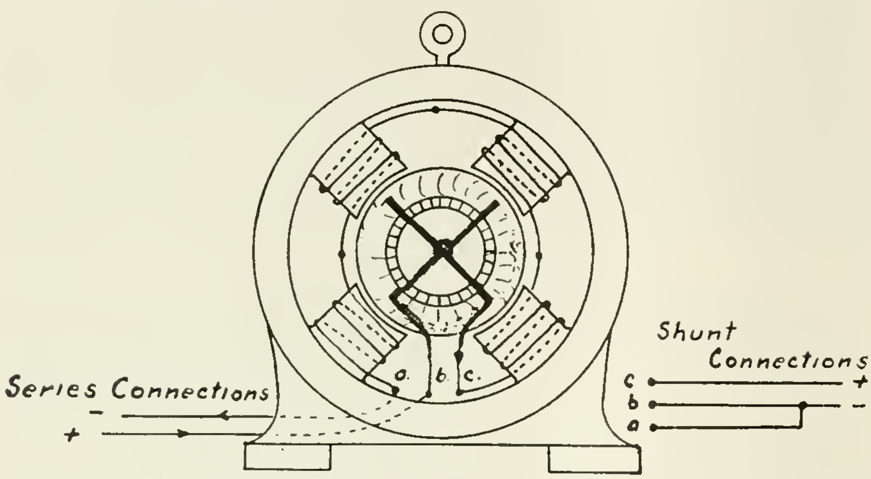


FIG. 4. THE STAR SHOWING SERIES AND SHUNT WINDING.

Under the same conditions assumed with the series motor, at 100 lbs. torque the current required is 25 amperes and the speed is 990 rev. per min. For the 1,000 lbs. torque the current required is 210 amperes and the speed is 900 r.p.m. Thus it shows that the power taken will be as the pull and that greater peaks of load or fluctuation of power will occur when using a shunt motor for loads requiring a large variation of torque. The shunt motor is used where it is necessary to obtain nearly constant speed. As the field current does not vary with the armature current the motor cannot run away or race when the load is taken off as the counter e.m.f. will soon nearly reach the value of impressed voltage.

The speed and torque of a shunt motor can, however, be changed to adapt it to industrial work by two methods: first by armature control and second by field control.

In the case of the armature control a resistance is placed in series with the armature, which cuts down the voltage to the armature, and of course the speed is less and any speed can be obtained. The torque, however, will remain the same, as this depends on current in the armature and not on speed. In running on a lower speed the same conditions apply, i. e., decrease of torque gives increase of speed and vice versa. It is not possible by this method to obtain a constant reduced speed with a change in torque. This method is used for controlling the speed of fans, blowers and centrifugal pumps. With this method the change in speed is always less than normal speed.

In the case of field control a resistance is placed in series with the field which will weaken the field and the speeds with this method of control will always be greater than normal speed. For a new speed, the value will remain practically constant throughout varying torque. This type of motor is used where continuous service is required, for instance, for driving shafting and machine tools.

Before specifying the type of motor to be used for a certain work a careful study should be made to determine what will be the speed and torque requirements.

The Boy He Wanted.

A Chicago stationer has a new office boy who is "different." The lad entered the store early in the morning when the stationer was opening his mail. The latter glanced up and went on reading without speaking. After three minutes the boy said:

"Excuse me—but I'm in a hurry!"

"What do you want?" he was asked.

"A job."

"You do? Well," snorted the man of business, "why are you in such a hurry?"

"Got to hurry," replied the boy. "Left school yesterday to go to work, and haven't struck anything yet. I can't waste time. If you've got nothing for me say so, and I'll look elsewhere. The only place where I can stop long is where they pay me for it."

"When can you come?" asked the surprised stationer.

"Don't have to come," was the reply. "I'm here now."

General Foremen's Department

General Foremen's Ass'n Endorsed.

Editor:

The following letter was written to the Executive Committee of the International Railway General Foremen's Association, Indianapolis, Ind.:

"Executive Committee.

"I have your letter of Dec. 15, asking for an expression with reference to the International Railway General Foremen's Association.

"I am satisfied, in fact, I know an association of this kind, composed of practical men, is capable of doing a great deal of good and there are a great many live subjects which they can take up and dispose of, which should be of benefit not only to the members, but to the railroads they represent.

"I am strongly in favor of the organization and have been since its inception. You have some subjects for the year 1911 that are worthy of careful thought. I trust that the year 1911 will be one of the most fruitful years since your organization. Yours truly,

"(Signed) W. L. Kellogg,
"Supt. M. P., C., H. & D. Ry.
"Cincinnati, Ohio."

At the recent meeting of the General Foremen's Executive Committee in Chicago on Dec. 12, we decided that if we could get a number of endorsements from the various heads of the Motive Power Departments, throughout the United States, and have them published in the various journals, that it would point out to the subordinates the interest that is manifested by the head of this department, in such an organization, and we would thank you to publish such endorsements in the General Foremen's Department of your valuable paper.

F. C. Pickard,
Mem. Executive Committee.

Setting Eccentrics Before Wheels are Under Engine.

By Chas. Markel.

In regard to the setting of eccentrics on locomotive drivers, we have found that it is very inconvenient in the Clinton, Ia., shops of the Chicago & North-Western Railway, or rather we have found it to be very difficult to key eccentrics on and properly fasten them under an engine, especially the large engines mostly used now, where things are so compact underneath as to give very little room to work. If one has to take the eccentrics off to cut key-ways after the valves are set it usually means a delay of a day or more in finishing the engine, therefore it is important to get the valves set as quickly as possible, and if the eccentrics are set and keyed on beforehand it is a small matter to set the valves, simply to adjust the blades in full gear, see the valves work square in the hooked-up working position and fill out the valve-report. It is important that the eccentrics be put on as securely as possible and it is almost impossible to do this properly under the engine, and eccentrics frequently work loose on the keys, which cripples an engine's valve motion, and this is a trouble that is not very often located by the engineer, nor even by the inspector, as it appears all right until the engine is working.

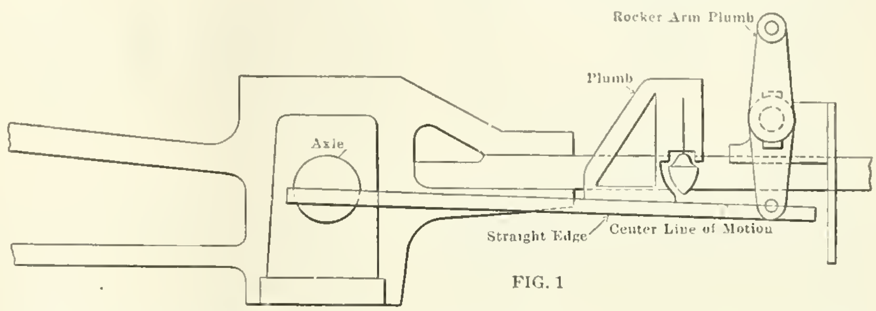


FIG. 1

We find that it is a more convenient and satisfactory method to set the eccentrics, cut the key-ways (if on a new axle), key them on and finish them on the floor while the wheels are out. We have set all eccentrics in our shop on the floor for the last fifteen years and we seldom have one to alter when we come to set the valves. If, as sometimes happens, they do not appear to be the same in both motions or the same on both sides we usually find the trouble somewhere else, such as reach-rod not being the right length or the quadrant, reverse-shaft or link-lifters not being right.

Our method of setting the eccentrics is simple: We have a board 1½ ins. x 10 ins. x about 3 ft. long, a half circle the size of the largest shaft, say 9 ins., cut out in the middle, a V-clamp on the side of the board to fasten it on the axle. As shown in the illustration, this clamp can be raised or lowered so as to bring the top of the board to the center of any size axle. A small level is inserted at one end so that if the line from the center of the drivers to the center of link block is level, we level the board. If the center line of motion is not level then we use a plumb-bob and set the board to the right incline. The plumb-bob frame can be marked for the proper incline for different classes of engines. We clamp the board on the axle up against the eccentric, put the crank-pin on dead center (forward or back) by plumbing the pin on the opposite side, put the eccentric plumb on the shaft (up or down), according to forward or back motion. This brings the valve on the middle of the seat, then we give it the proper angular advance towards the crank-pin measured on top of the board which is the center of the axle, and mark the key-way. The proper amount of advance depends of course on the outside lap of the valve and the lead we wish to give it. If the lap is 1 in. and we wish to set it ⅛ in. negative lead, we advance it ⅞ in., provided both inside and outside rocker arms are the same. If outside rocker arms are not the same we make the proper allowance.

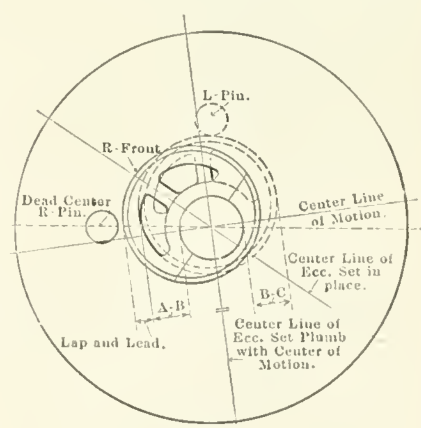


FIG. 2

We would offer a suggestion in the making of eccentrics. An eccentric that is bored out a little large for the axle (say 1/32 in.) in all probability will never stay tight, as the only contact of the large half with the axle is the point of the set-screws. With the engine working hard or with the straps a little loose it pounds the points of the set-screws into the axle and the eccentric becomes loose. The proper

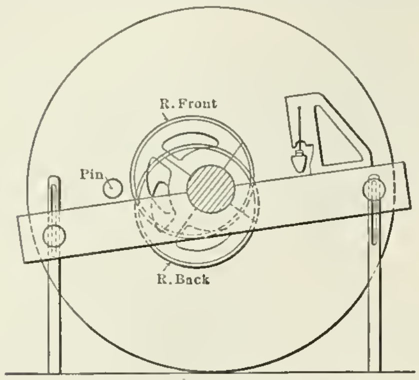


FIG. 3

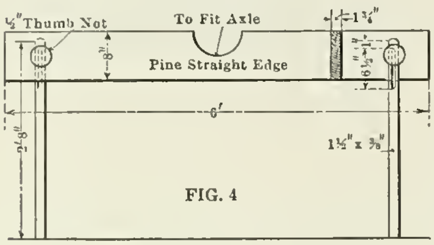
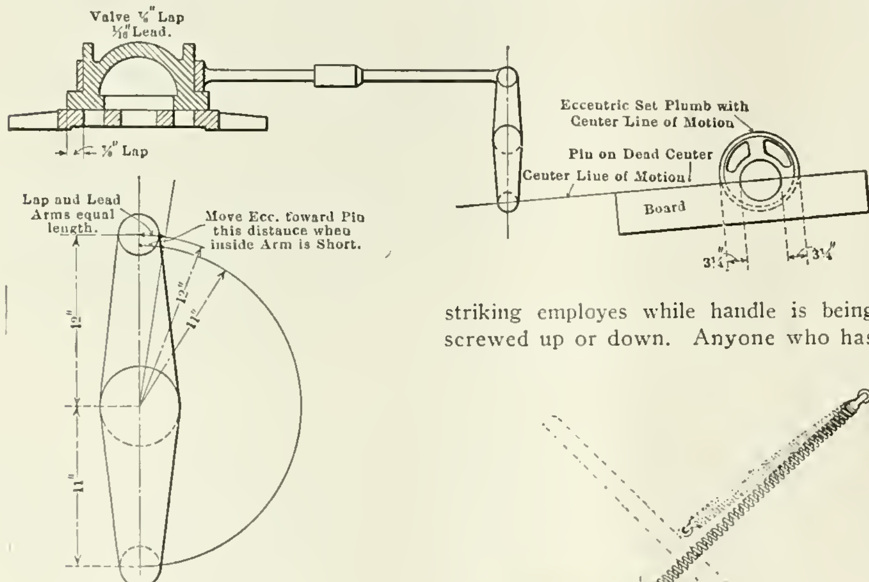


FIG. 4



way to fit an eccentric to the axle is to bore it a trifle small or bore it with a Russia iron liner between the two halves. When this is taken out it will hug the axle tight and perhaps be a trifle open and the probabilities are that it will always stay tight on the axle.

Calipering a Magnetized Shaft.

In these days, when electricity has an established place in most of our modern railroad repair shops, it may become necessary to caliper a shaft of an armature or other piece which has become magnetized. Dealing with this matter, the *Electric Traction Weekly* says:

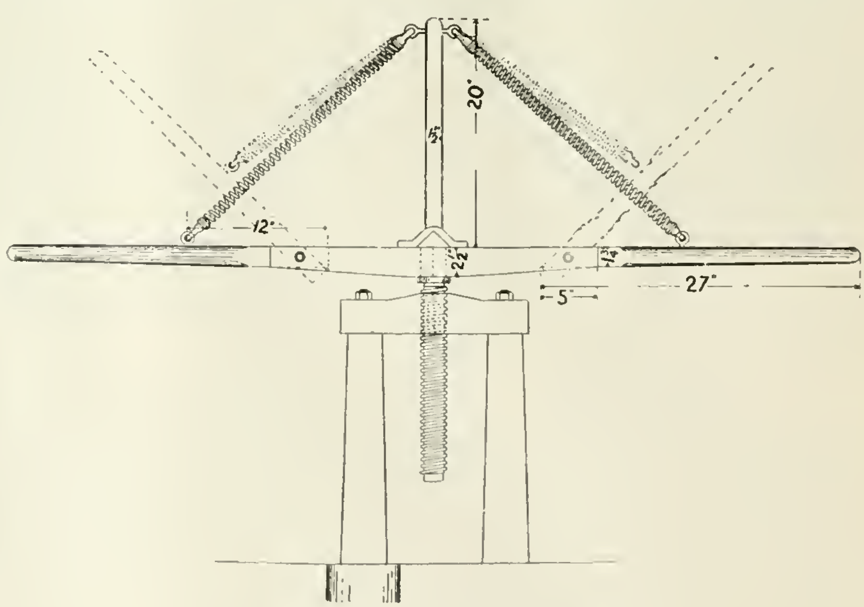
"When the steel of an armature shaft is unusually hard, the shaft oftentimes becomes magnetized. If a thread has to be calipered or a box bored to fit accurately, the calipers stick to the shaft, so that it is impossible to get a perfect fit. To overcome this, take a pair of outside calipers and solder a piece of brass wire about ⅜ ins. long on each leg, then shape ends the same as an ordinary pair of calipers. The magnetism will have no effect on the brass ends and a perfect fit can be easily made."

The illustration shown by our contemporary is that of a neat little L. S. Starrett (Athol, Mass.) spring calipers with thumb-nut adjustment with the ends formed of brass soldered on as described.

Safety in Shop.

The Chicago & Northwestern Railway are putting forth every effort to prevent accidents to shop employes and the blue print I send you shows how the chairman of our shop committee, Mr .Walter Shaw, has overcome the danger of the screw-press handle from striking employes while handle is being screwed up or down. Anyone who has used a shop screw-press knows the danger of being struck by a rapidly revolving handle. This blue print is very plain and is simply this: When not in use the handles are held in verticle position, as shown by coil springs which remain in that position while running the screw up, and when leverage is wanted the handles are pulled down, which gives full leverage.

CHAS. MARKEL,
Clinton, Ia. Shop Foreman.



SAFETY HANDLE FOR SHOP SCREW PRESS.

Reducing Cost of Train Moving.

The claims of agitators that railroad companies might effect immense savings in operating expenses by adopting improved methods of performing work take no account of the fact that by the introduction of the most perfected motive power and rolling stock railroad companies have reduced the cost of moving freight and passengers far below the cost of doing the work on the railways of all other countries. That, too, in spite of the fact that the wages paid to American railroad employees is about double the wages paid in other countries. The great mistake made by our railroad companies was in the lowering of rate charges to accord with the cost of moving trains. It may turn out that the introduction of powerful consolidation locomotives and of Mallett double end compounds with their enormous train-hauling capacity has been a mistaken move on the part of our railroad companies. But there is no turning back to less expensive machinery.

Electrical Resistance.

To find the resistance of a cable whose size is given in circular mils, drop one cypher from the number of circular mils and the result will be the number of feet per ohm.—*Electric Traction Weekly.*

Items of Personal Interest

The title of Angus Sinclair, instructor of technical education of the Erie Railroad, has been changed to "special instructor of education."

Mr. A. Morrison has been appointed locomotive foreman of the Canadian Pacific at Wynyard, Sask.

Mr. E. A. Spingler has been made assistant road foreman of engineers of the Pennsylvania at Huntington, Pa.

Mr. Rudolph Ellzey has been appointed master mechanic of the Kentwood & Eastern, with office at Kentwood, La.

Mr. L. S. Carroll, purchasing agent of the Chicago & Northwestern, has been appointed general purchasing agent at Omaha.

Mr. M. Jungling has been appointed master mechanic of the New Orleans Great Northern, with office at Bogalusa, La.

Mr. F. F. Scott, member of division 190, B. of L. E., has been appointed road foreman of engines of the Chesapeake & Ohio Railroad.

Mr. J. H. Grant, member of division 247, B. of L. E., has been appointed road master of division No. 1, of the Halifax & South Western Railway.

Mr. J. F. Schwaiger has been appointed road foreman of engines on the Eastern district of the Wyoming division of the Union Pacific Railroad.

Mr. R. L. Gebhardt has been appointed division engineer of the Lehigh Valley, with office at Auburn, N. Y., vice Mr. M. H. Elkin, transferred.

Mr. R. Collett has been appointed superintendent of locomotives and fuel service of the St. Louis & San Francisco, with office at St. Louis, Mo.

Mr. John Ball has been appointed assistant purchasing agent of the North Western and of the Chicago, St. Paul, Minneapolis & Omaha, at Chicago.

Mr. Isaac Seddon, purchasing agent of the Chicago, St. Paul, Minneapolis & Omaha, at Chicago, retains his office and title and will report to Mr. Carroll.

Mr. James McDonough has been appointed master mechanic on the Atchison, Topeka & Santa Fe at Newton, Kan., succeeding Mr. E. E. Machovec.

Mr. E. F. Hewitt, engine house foreman of the Pennsylvania Railroad, at Meadows, N. J., has been appointed general foreman of the Meadow shops.

Mr. W. C. Walz has been appointed division master mechanic of the Chicago, Burlington & Quincy, at Hannibal, Mo., vice Mr. J. W. Cyr, promoted.

Mr. William J. Harahan, who has been assistant to Mr. F. D. Underwood, president of the Erie, has been elected a vice-president of the company.

Mr. F. A. Lammerding has been appointed engine house foreman of the Pennsylvania Railroad, at Meadows, N. J., vice Mr. E. F. Hewitt, promoted.

Mr. M. H. Strauss, of division 424, B. of L. E., has been appointed general roundhouse foreman of the New York Central & Hudson River Railroad at Avis, Pa.

Mr. W. Davis, heretofore chargeman of the Grand Trunk Railway, has been appointed erecting shop foreman at Stratford, Ont., vice Mr. W. C. Sealey, promoted.

Mr. W. C. Radke has been appointed master mechanic of the Minnesota division of the Northern Pacific at Staples, Minn., vice Mr. C. T. Hessmer, transferred.

Mr. J. McQuarrie has been appointed locomotive foreman of the Canadian Pacific Railway, with office at Sutherland, Sask., vice Mr. M. W. Boucher, transferred.

Mr. F. H. Fechtig, purchasing agent of the Atlantic Coast Line Railway, has had his authority extended over the Winston-Salem Southbound, with office at Wilmington, N. C.

Mr. C. H. Norton, general foreman of the Bergen roundhouse of the Erie, has been appointed general foreman of the Jersey City shops, vice Mr. F. H. Murphy, promoted.

Mr. J. L. Butler, master mechanic of the White River division of the St. Louis, Iron Mountain & Southern at Cotter, Ark., has been transferred as master mechanic to Crane, Mo.

Mr. E. B. Paterson has been appointed locomotive foreman of the Canadian Pacific Railway, with office at Wilkie, Sask., vice Mr. G. Andrews, assigned to other duties.

Mr. C. A. Kothe, assistant general foreman of the south side Jersey City shops of the Erie Railroad, has been appointed general foreman of the Bergen shops of the same road.

Mr. H. M. Barr has been appointed master mechanic of the Sterling division of the Chicago, Burlington & Quincy at Sterling, Col., vice Mr. T. J. Raycroft, transferred.

Mr. M. H. Elkin has been appointed division engineer of the Lehigh Valley Railroad, with office at Hazleton, Pa., vice Mr. F. W. Gilcreast, resigned to accept service elsewhere.

Mr. E. J. Hufford, district foreman at Green River, Wyoming, has been promoted to general mechanical inspector of Union Pacific, with headquarters at Omaha, Neb.

Mr. A. J. Davis has been appointed acting foreman painter of the Vancouver car shops of the Canadian Pacific during the absence of Mr. A. Parker on six months' leave.

Mr. August F. Blaess has been appointed assistant engineer maintenance of way of the Illinois Central Railroad, with office at Chicago, vice Mr. Lawrence A. Downs, transferred.

Mr. F. E. Patton, formerly road foreman of engines on the Mobile & Ohio, has been appointed master mechanic on the Southern Railroad in Mississippi, with headquarters at Columbus, Miss.

Mr. Fred Von Bergen has been appointed air-brake inspector of the Nashville, Chattanooga & St. Louis Railway, with office at Nashville, Tenn., vice Mr. Otto Best, resigned.

Mr. R. E. Smith, general superintendent of motive power of the Atlantic Coast Line, has had his authority extended over the Winston-Salem Southbound, with office at Wilmington, N. C.

Mr. Walter S. Williams has been appointed superintendent of the Springfield division of the Illinois Central Railroad, with headquarters at Clinton, Ill., vice Mr. Charles R. Wescott, resigned.

Mr. W. C. Sealey, heretofore erecting shop foreman at Stratford, Ont., on the Grand Trunk Railway, has been appointed general foreman of the Toronto shops, vice Mr. J. Dugid, promoted.

Mr. George H. Bussing has been appointed superintendent of motive power of the New Orleans Great Northern, with office at Bogalusa, La., vice Mr. H. W. Burkheimer, master mechanic, resigned.

Mr. W. A. Hammel has been appointed purchasing agent of the Atlanta, Birmingham Atlantic, with office at Atlanta, Ga., vice Mr. W. D. Knott, granted leave of absence on account of ill health.

Mr. A. E. Girard, of division 660, B. of L. E., has been appointed road foreman of engines on the Los Angeles division of the San Pedro, Los Angeles & Salt Lake Railroad, with headquarters at Los Angeles, Cal.

Mr. George H. Eck has been appointed master mechanic of the Hudson River division of the New York Central & Hudson River Railroad, with office at New Durham, N. J., vice Mr. C. E. Keenan, resigned.

Mr. J. W. Cyr, division master mechanic of the Chicago, Burlington & Quincy, at Hannibal, Mo., has been appointed superintendent of motive power on that road, at Chicago, vice Mr. F. A. Torrey, promoted.

Mr. J. C. Garden, master mechanic of the Eastern division of the Grand Trunk Railway, at Montreal, Que., has been appointed master mechanic of the Battle Creek, Mich., shops, vice Mr. J. T. McGrath, resigned.

Mr. F. P. Gutelius, formerly general superintendent of the Lake Superior division of the Canadian Pacific at North Bay, has been transferred to Montreal as general superintendent of the Eastern division of the C. P. R.

Professor C. I. de Muralt, of the engineering department of the University of Michigan, has been engaged as editor of the *Railway Electrical Engineer*, the official journal of the Association of Railway Electrical Engineers.

Mr. J. Dugid, heretofore general foreman of the Toronto shops of the Grand Trunk Railway, has been appointed master mechanic of the eastern division, vice Mr. J. C. Garden, transferred to Battle Creek, Mich.

Mr. C. J. Stewart, formerly master mechanic on the Central New England Railway, has accepted the position of master mechanic on the New York Central & Hudson River Railroad, with headquarters at Waterbury, Conn.

Mr. W. G. Tawse has resigned as road foreman of engines for the Chicago & Eastern Illinois to accept a position with the Locomotive Superheater Company. His headquarters will be People's Gas Building, Chicago, Ill.

Mr. J. B. Randall, who has been for many years a most successful locomotive engineer on the Louisville, Henderson & St. Louis Railroad, has been appointed master mechanic on that road, with headquarters at Louisville, Ky.

Mr. L. S. Carroll, purchasing agent of the Chicago & North Western, has been appointed general purchasing agent of the North Western and of the Chicago, St. Paul, Minneapolis & Omaha, at Chicago, and his former title has been abolished.

Mr. G. C. Bonefeld has been appointed master mechanic of the United Railways of Havana, with office at Havana, Cuba, vice Mr. William M. Stokes, resigned to go to the Galena Oil Co., at Buenos Ayres, South America.

Mr. George L. Bourne, formerly of the Railway Materials Company, of Chicago, has been elected second vice-president of the Locomotive Superheater Company, of New York. Mr. Bourne's office is in the People's Gas Building, Chicago.

Mr. C. T. Hessmer, master mechanic of the Minnesota division of the Northern Pacific at Staples, Minn., has been appointed master mechanic of the Seattle division, with office at Seattle, Wash., vice Mr. W. B. Norton, assigned to other duties.

Mr. T. J. Raycroft, master mechanic of the Sterling division of the Chicago, Burlington & Quincy at Sterling, Col., has been appointed master mechanic of the Alliance division, with office at Alliance, Neb., vice Mr. F. C. Stuby, assigned to other duties.

Mr. John I. Rogers, formerly connected with the Midvale Steel Company, has opened an office at 165 Broadway, New York, where he will practice as a consulting engineer, making a specialty of the design and operation of modern plants, furnaces and machinery.

Mr. J. T. McGrath, heretofore master mechanic of the Battle Creek shops of the Grand Trunk Railway at Battle Creek, Mich., has been appointed superintendent of rolling stock, in charge of the Chicago & Alton Railroad locomotive and car shops and terminals at Bloomington, Ill.

Mr. F. A. Torrey, superintendent of motive power of the Chicago, Burlington & Quincy lines east of the Missouri River, at Chicago, has been appointed general superintendent of motive power of the entire Burlington system, with office at Chicago, vice Mr. F. H. Clark, resigned to go to the Baltimore & Ohio.

Mr. W. F. Paton, who has just been promoted from assistant general passenger agent to general passenger agent of the National Lines of Mexico, has been connected with that system since 1877, at which time he entered its service as a stenographer, and has since steadily won his way up. He has been in charge of the department for about a year.

Mr. H. B. Brown, for several years master mechanic of the Mahoning division of the Erie at Cleveland, Ohio, has resigned to enter the service of the Illinois Central Railroad at Memphis, Tenn., in a similar capacity. Before accepting employment with the Erie, Mr. Brown's experience had been altogether with the Baltimore & Ohio as machinist, engineer, road foreman of engines and master mechanic.

There was a very notable gathering and banquet on Thanksgiving night at the Broezel Hotel, Buffalo, N. Y., held in honor of Mr. Willard Kells, retiring master mechanic of the Buffalo division of the Lehigh Valley Railroad. Aside from employees, both shop and road men, who had been immediately under the authority of Mr. Kells, there were many transportation department men present, besides, local officials and officers of other roads, clubs and societies. In all, about 125 persons were in attendance at this farewell banquet to wish Mr. Kells prosperity and good fortune in every way.

Mr. Frank H. Clark, general superintendent of motive power of the Chicago, Burlington & Quincy at Chicago, has been appointed general superintendent of motive power of the Baltimore & Ohio, and the Baltimore & Ohio Southwestern, with office at Baltimore, Md., vice Mr. J. D. Harris, resigned. Mr. Clark was born at Pecatonica, Ill., July 23, 1865. He graduated from the University of Illinois in 1890, and began railway work with the Chicago, Burlington & Quincy as chief draftsman in 1894. Five years later he was promoted to the position of mechanical engineer, and in 1902 he was made superintendent of motive power of the lines east of the Missouri River. He has been general superintendent of motive power of the entire Burlington system since April, 1905, which office he now resigns to go to the Baltimore & Ohio. From the time he graduated until the time he went to the C. B. & Q. he was engaged in consulting engineering work. He has done much work for the Master Car Builders' Association and the American Railway Master Mechanics' Association, and during the year 1909-1910 was president of the former.

Among what are known as the New Years honors, in Canada, we find the name of Thomas Tait, late chief commissioner of the Victorian railways in Australia. Mr. Tait has been knighted by King George in recognition of his services in the field of railway development. Sir Thomas Tait recently resigned the chairmanship of the Victoria Railway Commission, Australia, where he was eulogized in press and parliament for his services in that office. Sir Thomas was born at Melbourne, Que., July 24, 1864. He is the son of Sir Melbourne Tait, Chief Justice of the superior court for the Province of Quebec. He received his education at the high school, Montreal, and in 1880 he entered the audit department of the Grand Trunk Railway at Montreal. Two years later he became private secretary to Sir William Van Horne, then vice-president and general manager of the Canadian Pacific. Afterwards Sir Thomas Tait became assistant superintendent of the Canadian Pacific at

Moose Jaw. He also filled the offices of assistant superintendent of the Ontario division of the Canadian Pacific at Toronto; general superintendent of the Ontario & Quebec division, and assistant general manager of the entire system. Later he was manager of the lines east of Port Arthur, and then manager of transportation over the entire system. In the spring of 1903 he went to Australia to assume the chairmanship of the Victorian Railway Commission. He converted the railway system of Victoria from a non-paying to a paying basis, the surplus in 1909 being £200,000, or a profit of £550 a day, as compared with a deficit of over £1,000 a day before he assumed the chairmanship of the commission.

Persistence the Scots' Inheritance.

No people on earth are more successful in pushing their way to high places in the world than the Scots. This characteristic is reported to be due to the long centuries of training in fighting men and conditions on their sterile hills of Highland Scotland. We consider a good example of the effects of inheritance of determination is to be found in the way Mr. John C. Stuart, vice-president and general manager of the Erie has raised himself from the bottom almost to the top of the ladder of railroad life in thirty years of getting-there effort.

Mr. Stuart's ancestors were Highlanders of the wilds of Athol in Perthshire, their ancestral home having been under the shadow of Birnam Hill, made famous in Shakespeare's tragedy of Macbeth. They toiled and fought in that region for many generations, although it is likely that they were blood relations of the royal house of Stuart. They had sided with Prince Charlie's rebellion in 1743, which closed in gory Culloden, then they came to America and found congenial habitation in the wilds of Pennsylvania where they met with activities for their valor in fighting Indians.

The story is told of one expedition made by the Stuarts against the Campbells which ended disastrously. When the fragment of the raiders returned amidst family lamentations, the sage of the clan remarked, "They've licked us, but we've enjoyed a hantle o' braw feichting." Feicht is the motto of a branch of the Sinclairs who use the word in the sense of endeavor.

John C. Stuart full of the persevering spirit left the mountains of Pennsylvania and went to work for the Chicago and North Western Railway and rose steadily, step by step from lower to higher positions, always true to the motto, "onwards and upwards." The energy that brought this result was the cultivated habit of grasping every detail of the business thoroughly.

Alexander Crombie Humphreys.

It is peculiarly fortunate that the science of engineeering has attracted so many of the brightest and best minds in America. The rapid development of the resources of the country is owing in a large measure to the ready skill with which great problems in engineering have been met and mastered. Among those who have risen into marked prominence in this sphere of intellectual activity President Humphreys, of the Stevens Institute, is among the foremost. Without any early advantages, excepting the fact that his father was an eminent teacher in Boston, Mass., and the young lad had the benefit of a good general education under his father's eye, he was soon at work bookkeeping with the New York Guaranty and Indemnity Co. Advancement came rapidly. At twenty-one he was superintendent of the Bayonne and Greenville Gas Light Co. While engaged with this company he recognized the need of a technical education and began the full course of the Stevens Institute in mechanical engineering. For the full term of four years he kept up with his classes and attended to his duties in the office of the gas light company. Graduating with much honor, he accepted the presidency of the Pintsch Lighting Co., for which he built many oil-gas works and conducted many successful scientific experiments, that attracted so much attention that offers of important positions came to him from all over the world.

In 1885 he became superintendent and chief engineer of the United Gas Improvement Co., of Philadelphia. He established the London firm of Humphreys & Glasgow, and is now the head of the firm with an extensive engineering practice that has risen to much prominence in America as well as in Great Britain.

In 1902 he accepted the presidency of the Stevens Institute, and his work there has been distinguished by a thoroughness that commands general admiration. The honors that have come to him from universities and colleges are almost without a parallel among living engineers. As president of engineering and other societies he is much in demand, and one would marvel how the busy engineer finds time to take an active hand in so many societies, all requiring rare tact and high ability. In spite of all the multifarious duties devolving on him, he finds time to keep abreast of the literature of the time. As president of the American Society of Arts Collectors his opinion in matters of art is unerring. Socially he is one of the most delightful of men, modest and unassuming and genial. It is not until some subtle question is raised that the wide and clear mental vision of the gifted and accomplished scholar and engineer comes into view. He is still in the prime of life, and with an industry equal to any emergency and with his keen and trained intellect sharpened by constant activity and polished by experience, it is not unreasonable to look for still higher accomplishments from so resourceful and energetic an engineer and so thoroughly earnest and variously gifted man of the world as Dr. Humphreys.

Obituary.

It is with much regret that we have to record the death of our friend, Albert H. Lowry, who died on January 5, at the age of 55. Mr. Lowry entered the service of the Pittsburgh, Cincinnati, Chicago & St. Louis as fireman, August 5, 1888, and was promoted to engineer October 31, 1890. For the last four or five years he was inspector and instructor of engineers and firemen in the use of fuel and stores generally, but particularly in the elimination of the smoke nuisance, in which he was very successful.

George Parsons Sweeley, late master mechanic of the Alleghany shops of the Pennsylvania Lines (Northwest system), who died at his home in Alleghany on Jan. 10, 1911, was very well known in mechanical circles, and has been in continuous service with the Pennsylvania for more than 35 years. Mr. Sweeley was born in Montoursville, Pa., on July 13, 1856, and after being educated in the common schools, entered Renovo shops as apprentice in 1857. He was made machine shop foreman soon after completing his apprenticeship, and thereafter was appointed successively, general foreman Indianapolis shops, 1883 to 1888; general foreman Columbus shops, 1888 to 1893; master mechanic Crestline shops, 1893 to 1896; master mechanic Wellsville shops, 1896 to 1900; master mechanic Alleghany shops from 1900 until his death. He was a member of the M. M. and M. C. B. associations, the Pittsburgh railway club, the Bellevue club and the masonic fraternity. He is survived by a widow, one daughter and twin sons, also by a brother, Mr. E. H. Sweeley, general foreman on the Long Island Railroad.

John E. Switzer, chief engineer of the Canadian Pacific Railway, died of pneumonia in the Royal Victoria Hospital in January. Mr. Switzer, who was as recently as January 1 appointed chief engineer of the Canadian Pacific, first entered railway service as a rodman in 1888, during the building of the Lake Temiskaming Railway, now a part of the Canadian Pacific. Since then he has held similar positions and acted as assistant engineer on a number of other lines.

Simple 4-6-2 for the Chicago & North Western Railway

In July of last year, the Chicago & North Western Railway Company received twenty Pacific type locomotives from the American Locomotive Company. In design, these engines were practically duplicates of a previous order of twenty-five of the same type, a description of which appeared in our February, 1910 issue, page 76. These engines were alike except that five of the present order are equipped with the Locomotive Superheater Company's top-header, double loop design of superheater, known as type A. One of the superheater engines is shown in our illustration.

Outside of the changes in the boiler construction, practically the only other modification made in the design because of the application of the superheater, was an increase of 2 ins. in the diameter of the cylinder. The locomotives using saturated steam are equipped with cylinders 23 x 28 ins., while the cylinders of the superheater engines are 25 x 28 ins. Both classes of engines are designed for a working pressure of 190 lbs.; but it is understood that the superheater engines are actually being run with a working pressure of 175 lbs. The boilers are designed to carry a working pressure of 200 lbs. per square inch.

The officials of the C. & N. W. report that, since they have been in service the performance of the superheater engines has been very satisfactory, showing considerable saving in coal and water as compared with locomotives of the same class using saturated steam. They make through runs from Chicago to Elroy, a distance of 217 miles, with trains of from 8 to 12 cars.

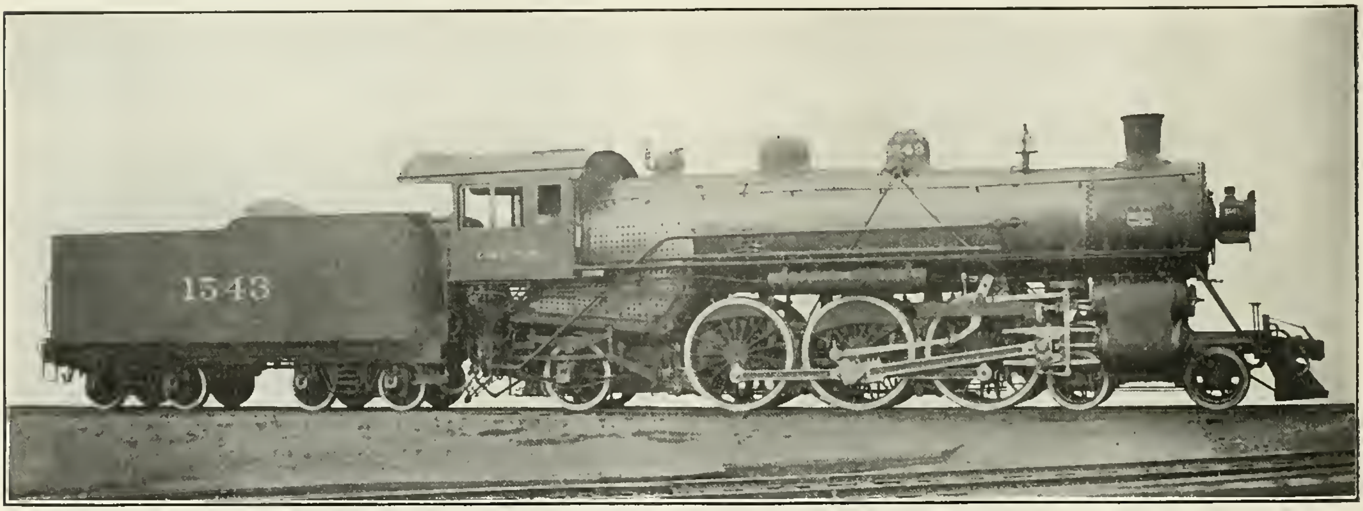
Though the schedules are not very severe, they are such that the saturated steam locomotives can barely make them, or at least are not able to make up more than 10 or 12 minutes on the run. The records show that the superheater engines burn about one ton less coal per 100 miles than the saturated steam engines, saving about four tons of coal on a round trip.

Going south over this division, the locomotives without the superheater always take coal at Evansville, while the engines here illustrated very seldom find it necessary to do so. Because of the saving of water consumption effected by the use of superheated steam, it is necessary for these engines to take water only where the trains make regular stops. As a regular thing, they run 113 miles for water, which is quite an important feature on this division as it cuts out one regular stop.

It is stated that in two months one of the engineers running these engines never pulled into Elroy late. In one instance, his train was 35 minutes late at Madison and arrived at Elroy on time, making up the 35 minutes in 76 miles. This performance is the more interesting in view of the fact that on this particular section the saturated steam engines are never able to make up any time. On the line from Chicago to Milwaukee, 85 miles, the records show that superheater engines save a ton of coal each way.

The design of the superheater is, as stated, of the double loop type designed to give an average temperature of 600 degs. Fahr. The rear return bend is only 24 ins. from the back flue sheet which is somewhat nearer than has heretofore been customary in American locomotive practice, but which tends to give a higher degree of superheat. A superheating surface of 691 sq. ft. is provided which is 21 per cent. of the total evaporating heating surface and about 23 per cent. of the evaporating tube heating surface.

Extended piston and valve rods are employed, thereby reducing the friction on these parts and making their proper lubrication easier. In both the saturated and superheater steam engines, steam is distributed to the cylinders by 14-in. piston valves, actuated by a simple design of the Walschaerts valve gear. For other details of the construction, reference may be had to the description of the previous order of twenty-five saturated steam engines of the same class. As a result of the satisfactory service of the engines here illustrated, superheaters of the same type were specified by the C. & N. W. for 30 out of an order of 50 consolidation engines now being delivered by this company.



4-6-2 ENGINE FOR THE CHICAGO & NORTH WESTERN RAILWAY.
Robert Quayle, Superintendent of Motive Power and Machinery. American Locomotive Company, Builders.

Some of the principal dimensions are appended for reference:

Cylinder.—Type, simple piston, diameter 25 ins.; stroke, 28 ins.; tractive power, 37,620 lbs.
Weight.—In working order, 250,500 lbs.; on drivers, 154,500 lbs.; engine and tender, 408,400 lbs.
Heating surface.—Tubes, 860, 2,232 sq. ft.; firebox, 209 sq. ft.; arch tubes, 27 sq. ft.; total, 3,328 sq. ft.; superheating surface, 691 sq. ft.; grate area, 53 sq. ft.
Boiler.—Type, ext. wagon top; O. D. first ring, 70 5-16 ins.; working pressure, 190 lbs.; fuel, bitum. coal.
Firebox.—Type, wide; length, 108⅛ ins., width, 70¼ ins.; thickness of crown, ⅜ ins., tube, ½ in., sides ⅜ in., back, ⅜ in.; water space, front, 4½ ins., sides, 4½ ins., back, 4½ ins.
Tubes.—Number, 212; diameter, 2 ins.; length, 20 ft.; gauge, No. 11, B. W. G.; superheater—Number, 30; diameter, 5½ ins.; gauge, 3-16 in.
Tank.—Style, U-shape; capacity, 8,275 gallons; capacity fuel, 12 tons.
Valves.—Type, piston, 14 ins.; travel, 6 ins.; steam lap, 1 1-16 ins.; ex. lap, 3-16 in.
Setting.—¼ in. lead constant.
Wheels.—Driving diameter, outside tire, 75 ins.; material, cast steel; engine truck, diameter, 37¼ ins.; trailing truck, diameter, 49 ins.; tender truck, diameter, 37¼ ins.

Wilson Flare Light.

The United States Marine Signal Company, of New York, naturally have a good deal to do with the lighting of harbors, rivers, etc., and in perfecting this branch of work they were naturally lead to the production of a very effective flare light for railway work. It is for use in clearing up railway wrecks, or other emergencies. It can be used in construction and repair work which have to be done outside at night.

The light itself is from acetylene gas. The flame, we are told by the manufacturers, is not extinguished by the wind, and the light can be easily moved about. No one who has worked clearing away a railway wreck but will admit the almost priceless value of a good, powerful and steady light. It has been the means of directing life-saving efforts to the victims of the disaster, and in any case it is a great time saver for the company as well as a comfort to the workers.

CAMP NEAR LAC ST. JEAN, BOSTON & MAINE RAILROAD.

Congratulations from F. D. Underwood.

The Erie Railroad Company enjoyed a very prosperous year in 1910, and President Underwood congratulated all officers and employees of every grade in the following circular: "It is for me to wish for you all a Happy New Year. The past year adds one more to the remarkable record previously held, and speaks more than any words of mine for loyalty, ability and personal interest shown in your work."

"The president and executive staff join in thanks and congratulations for the results obtained."

Joint offices have been opened in the McCormick Building, Chicago, by the Detroit Seamless Steel Tubes Co., Michigan Malleable Iron Co. and the Monarch Steel Castings Co., all of Detroit, for the sale in the West and Southwest of Detroit locomotive flues, Detroit journal boxes and Monarch couplers. Mr. Walter E. Marvel, formerly manager of the St. Louis office of The Buda Company, has been appointed western sales manager in charge of the Chicago offices.

Leaving Well Enough Alone.

The advantage of leaving well enough alone was very well illustrated in a case mentioned by one of the Westinghouse Air Brake Company's inspectors. The company had equipped a small road in Canada with an entire outfit of brakes, and nine years afterward the superintendent of the road sent word to the brake company that the brakes were not working well. An inspector went to inquire into the cause of the trouble, and naturally asked what attention the triple valves and brake cylinders had received.

"Attention?" said the superintendent; "they were never touched. I gave orders when the brakes were put on that no one should ever touch the brakes, and my orders are obeyed on this road."

"You never cleaned them or oiled them?" asked the inspector.

"Never a clean or an oil," was the reply. "I was afraid that if any one of my men took the thing apart he would never get it together again. You put all those things in good working order again and let us see if they can go nine years more without attention."

Dispatching by Telephone.

The Baltimore & Ohio Railroad have just installed a telephone train dispatching equipment between Grafton, W. Va., and Salem. The apparatus was made by the United States Electric Company, of New York. The circuit is 35.8 miles long and there are twelve stations on the line, the dispatcher being at Grafton. The Gill selector is installed at each of these stations and the signal bell is rung by the main line current, the source of power being at the dispatcher's office. This circuit covers a busy section of single-track road and telephone dispatching is expected to expedite train movement over the division. An illustrated description of this system was given in our January issue, page 25.

Fire-Door Opener.

A very effective fire-door opener for use on locomotives has been brought out by the National Railway Devices Company, which we illustrate below. By reference to the line engraving showing Shoemaker fire door open, it will be seen that the door-ring is attached to the boiler by stnds Q, and that the door guides are attached to the four projecting lugs of the door-ring by bolts D. An upright plate is also bolted to the door guides to the right of the door, to which the Shoemaker door operator is attached by four stud bolts. Thus it will be noted that the entire fire-door apparatus, excepting foot valve, is attached to the boiler by the door-ring studs, rendering it unnecessary to make additional holes aside from the two for attaching the foot valve as shown. By casting the door-ring in blank, holes can be drilled to suit old studs, making it an easy matter to apply this device to a locomotive formerly equipped with old-style swinging door.

The opening of valve A from main air reservoir blocks the air within chamber Z and also within G of foot valve, the pressure against larger area of upper piston head, thus holding the doors shut.

Foot pressure on pedal P lifts foot-valve stem off its seat, closes port H and forms a close passage of air through foot-valve and through admission valve V to the top side of large piston head. By reason of the pressure on the under side as described, equalized pressure on both sides of large head now results in driving the piston down by the pressure against the upper side of small head. When foot pressure on pedal P is withdrawn, valve stem X seats itself, again blocking the receiving air within G; port H is opened, thus allowing a free escape of air from upper side of large head through exhause valve W, and the piston is driven upward by pressure against the greater area of upper piston head.

When large piston head blinds port M an air cushion is formed between same and cylinder head until the air gradually escapes through a very small hole in stem of feed check valve V, which prevents slamming of doors in closing movement. When the lower head blinds port

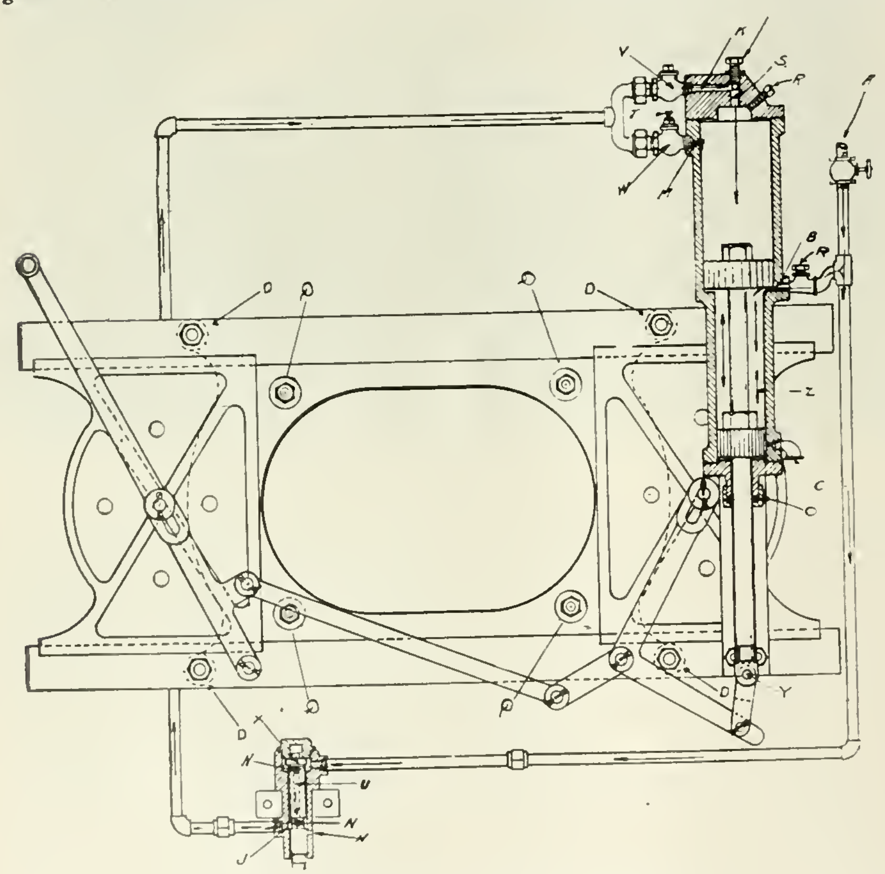


DIAGRAM OF SHOEMAKER FIRE-DOOR OPENED.

C an air cushion is formed between same and bottom cylinder head until the air escapes gradually through stuffing box O, which prevents heavy jarring of doors in the opening movement.

Some of the advantages which the makers claim are that no cast gears or cast levers are used which might become worn or broken. There is practically no friction-bearing machinery to maintain under the doubly trying condition of intense fire-door heat, the Shoemaker being a simple plan of transmitting air so as to cause the up and down movement of a differential piston operating in a cylinder under nearly normal temperature.

There is always the possibility of instantly changing from air to hand operation by the removal of pin Y, thus insuring against delay from breakdown of fire-door on the road.

The railroads are given the right to make and carry as unpatented storehouse stock all of the apparatus excepting Shoemaker door operator (proper), foot valve and pedal.

A Boring Experience.

One of the old railroad machine shop traditions that held up a fallacy for many years was that in boring a cylinder the boring mill must be kept going or the cylinder would be spoiled. Al Ramsdell was one of the Tom Sawyer type of boys, and his most alluring attraction was the Erie machine shop in Jersey City. One evening he happened into the shop when Sam Woods, assisted by Tony Fellers, was boring one of the cylinders of 621. Al fancied the job of turning the crank of the boring mill and boned Sam for a trial of the job until he was permitted to man the crank. Then he was told that he must keep on turning until the cut was finished or the cylinder would be spoiled. He soon tired of the labor of turning the crank and pleaded to be relieved, but Sam insisted that he should finish the job or he need never put his face into that shop again. Al fumed and fretted and begged and ground out all the protesting words at his command without exciting the least pity, until it suddenly dawned upon him that he was the victim of a boring joke. Then he relinquished the wheel and his exit from the shop was greeted with jeers and laughter.

Crosby Valve Catalogue.

We have recently received a copy of the latest catalogue issued by the Crosby Steam Gage and Valve Company, of Boston. The catalogue illustrates the Crosby spring seat globe and angle valves made with brass, iron and steel bodies. These valves are especially adapted for high pressure service and are extensively used on locomotives. The point about these valves is that the upper disc of the valve has a face cut with a conical depression, terminating in an annular groove of considerable depth. The seat of the valve is made to fit the conical depression of the face and also has an annular groove of considerable depth. The conical depression on the valve face and the similar conical eminence on the valve seat present a large contact surface and the annular grooves permit of sufficient resilient action between face and seat

SHOEMAKER FIRE-DOOR CLOSED.

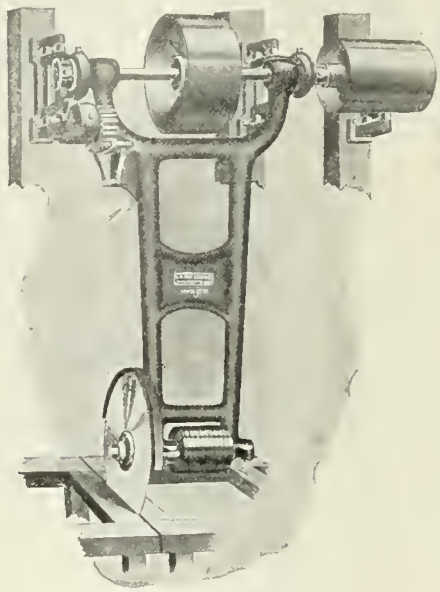
so that when the valve is shut tight it remains tight. This characteristic prevents them jambing when the valve is closed and leaves them free to accommodate themselves to any variation of temperature. The conical surfaces are said to be less abraded by the passage of steam or other fluid than is the case with ordinary valves. This valve was originally invented in Leeds, England, and the patent was shortly after acquired by the Crosby Company. The catalogue shows a great variety of valves—globe, angle, blow-off, check, valves, flanges, etc., etc. The sizes and prices are given and altogether the catalogue is a handy book of reference on the subject on which it deals. Write to the company, at 93-5 Oliver street, Boston, or to 44 Dey street, New York, if you wish to secure a copy.

New Plant Opened.

The Commercial Acetylene Company of New York have just sent out invitations to their many friends to visit their new plant, which is now in operation at Moberly, Mo. This plant is for the purpose of re-charging commercial acetylene cylinders used for engine headlight, car lighting, signal lighting, oxy-acetylene welding, etc. This company, it will be remembered, uses the safety storage system, in which the cylinders are filled with porous asbestos and acetone, which latter absorbs the acetylene, and while in storage there is no free acetylene to explode and cause damage.

A Car Shop Swing Saw.

Knowing that our readers are always interested in machines that are distinctly new, we take pleasure in illustrating a brand new large car swing cut-off saw, manufactured by the well known firm, J. A. Fay & Egan Co., Cincinnati, Ohio. This swing saw is especially designed for heavy cut-off in car shops. In its construction, the manufacturers have given

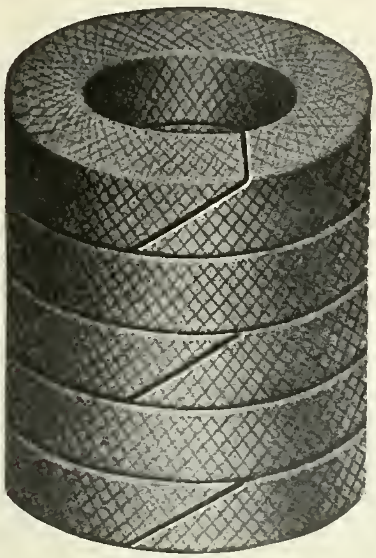


SWINGING CUT-OFF SAW.

special attention to the frame—making it very heavy and substantial. One can see from the illustration that the main driving pulley is very large, essential in the manufacture of heavy material.

The manufacturer's automatic adjustable counterweight makes it easy to operate this machine and insures a quick return of the saw when released. The saw mandrel is fitted with the Fay & Egan patent expansion bush saw flange, which permits the use of a saw having a slightly larger hole than usual. The journal bearings are self-oiling from chambers underneath. A guard is furnished with each machine to which is attached a handle for operating.

Capacity, with the largest saw practicable, 56 ins. diameter, it will cut-off 19 ins. square, or 48 ins. wide by 2 ins. thick. For further particulars concerning this machine, you are invited by the manufacturers to write for large illustrated circular.



Baldwin Record No. 68.

Record of Recent Construction No. 68, of the Baldwin Locomotive Works, has just been published, and affords a very complete and interesting record of the progress and the forms of the Mallet articulated compound locomotive which has been gaining in favor in America during the last five or six years. That the Baldwin Locomotive Works has introduced a number of features which have proved of value, especially in the heavier classes, is gathered from the lucid description and fine illustrations presented. A compendium of these features is presented and is well worthy of the attention of all who are interested in the heaviest and most powerful of modern locomotives. There are over thirty illustrations in the Record with accompanying letterpress descriptions, and copies of this fine pamphlet may be had on application at their offices in Philadelphia. One of the peculiarities which have been developed by this firm is the easy way of making compound Mallets out of simple engines. This is done by using a road engine the rear unit and attaching a front unit which contains the L. P. cylinders, a smoke box and an extension piece for reheater or feed water heater, as may be desired.

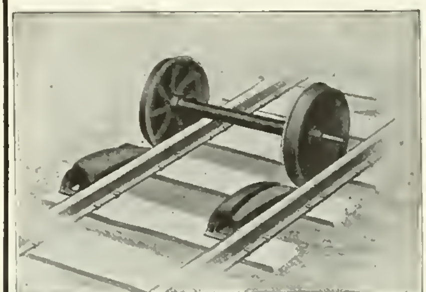
A Weighty Difficulty.

It was on a suburban train. The young man in the rear car was suddenly addressed by the woman in the seat behind him.

"Pardon me, sir," she said, "but would you mind assisting me off at the next station? You see, I am very large, and when I get off I have to go backward, so the conductor thinks I am trying to get aboard and helps me on again. He has done this at three stations."—*Collier's.*

Office in Manila.

The Dearborn Drug & Chemical Works, who have distributed their Feed Water Treatment and Lubricants through an agency in the Philippines for the past two years, have decided to open their own branch office and warehouse in Manila, and Mr. F. O. Smolt, who has been connected with mining developments since his graduation in chemistry from the University of Illinois in the class of '91, has become connected with the Dearborn Company, and sailed Jan. 7 for Manila, to take charge of this work, under the supervision of Mr. E. C. Brown, manager of the foreign department of the Dearborn Company. Mr. Brown has spent most of the past two years in Japan, China and the Philippines, investigating steam plant and railroad conditions in the interests of the



Dearborn Company, and is still there, having made selling connections at Tokyo, Tientsin, Hongkong and Shanghai.

McKeen Motor Cars.

We are informed that a new 55 ft. 200-h.p. steel gasoline motor car for the Charles City Western Railway Company left Omaha, propelled by its own power, Dec. 28, en route to Charles City, Ia. The Charles City Western is an interurban line, using a McKeen gasoline switching locomotive for its construction work, and is to be operated with gasoline motor cars. This is the ninety-fourth car turned out by the McKeen Motor Car Company, of Omaha, Neb. The 70-ft. motor car just completed for the Arizona Eastern Railroad was shipped to Globe, Ariz., under its own power Dec. 31. This makes the ninety-fifth McKeen motor car now in service on railroad and interurban lines. This company has just received an order from the North Coast Railroad for a 70 ft. gasoline motor car, which is to be delivered in March. That company is already operating two 55 ft. motor cars in the vicinity of Kennewick, Wash.

Route Too Long.

A negro was under a Civil Service examination to prove if he knew enough to act as letter carrier on a Southern route.

"Now, Mr. Washington," said the examiner, "tell this board how many miles it is from the earth to the moon."

"Huh, boss, I can't tell dat, and I'se goin' to quit dis yere right now. You cain't put me on no such run as dat."

1909 Proceedings of M. M. Association.

The Report of the Proceedings of the Forty-third Annual Convention of the American Railway Master Mechanics' Association, held at Atlantic City in June last, appears in a substantially bound volume of 600 pages. In point of interest it may be noted that the papers submitted and the debates thereon not only amply sustain the high position which the association holds in the mechanical world, but as the mechanical appliances used on railways become more complex it is but justice to state that the master minds engaged in the work of constructing and repairing these involved contrivances meet the new problems with a spirit of ingenuity that only comes by experience. The concrete presentation of the record of the work of these meetings in a handy volume is an enduring tribute to the high intelligence of the founders of the association. The collected volumes form one of the best indexes of the progress of the development of the mechanical, and more especially the

motive power department of railways of our time. The book may be had from Mr. Joseph W. Taylor, secretary of the association, 390 Old Colony Building, Chicago, Ill.

Mallett Compounds.

We do not know of any subject familiar to motive power men, or one on which there exists a stronger demand for information than on the "Mallett Compound for Road Service." That subject is under investigation by the Traveling Engineers' Association. The chairman of the committee is Mr. B. B. Craig, 209 South Broadway, Seymour, Ind., to whom answers to the following questions ought to be sent:

No. 1.—How does the Mallet engine compare with other engines in the consumption of coal and water handling the same tonnage?

No. 2.—Will the Mallett engine make the same mileage handling the same tonnage as other engines between classified repairs?

No. 3.—How does the Mallett engine compare with other engines in the cost of running repairs, making same mileage and handling same tonnage?

No. 4.—How do the boiler repairs, such as flues and staybolts, compare with other engines handling the same tonnage?

No. 5.—Is there any difference in the wear and cost of repairs between the high and low pressure engines on the Mallett compound?

No. 6.—Do you experience any trouble keeping the valves square, and do you have any trouble with valves and cylinder packing? If any give the difference between high and low pressure engines?

The eighteenth annual convention of the Air Brake Association will be held in Chicago, May 23 to 26, 1911. The Auditorium Hotel has been selected as headquarters during the session. Information concerning hotel accommodation and how a member may secure transportation are set forth in circulars which may be had on application to the secretary, Mr. F. M. Nellis, 53 State street, Boston, Mass.

A British railway builder, Mr. J. Norton Griffiths, has secured from the Chilean Government a contract to build a railway valued at about $20,000,000. American engineers or workmen wishing to obtain employment on this job should apply to Mr. Griffiths at Wednesbury, England.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, March, 1911. No. 3

The Eastern Express.

The simple words at the head of this article refer to a very important train which, officially known as No. 6 on the Southern Pacific, leaves San Francisco daily for Chicago at 8:40 p. m., and travels over the Southern Pacific to Ogden, Utah, then over the Union Pacific to Kansas City, Kan., and then by the Chicago & North-Western Railway to Chicago. Our frontispiece this month represents No. 6, which is composed of a reclining chair car, Pullmans, dining car and Pullman tourist sleepers. At the moment the photograph was taken, 12:15 p. m., this train was 224 miles from San Francisco and was passing the station named Floriston, in the canyon of the Truckee river. This station is in the State of California, but is so close to the State line of Nevada that on a small map it looks as if it was exactly on it. The canyon of the Truckee river is a picturesque spot, with foaming stream and hills and mountains of enduring granite, dotted over with the hardy pine. The railway train —one might almost refer to it as the evidence of a luxurious civilization—nevertheless reflects the highest type of mechanical skill in its construction and the most careful and painstaking management for its successful and regular operation day after day.

SOUTHERN PACIFIC NO. 6 EASTERN EXPRESS PASSING FLORISTON, CAL.
(Courtesy of *Comercio Extranjero.*)

The Southern and the Union Pacific are sometimes spoken of as the Associated Lines and often as the Harriman

Lines. Extensive betterments are being planned on this magnificent system, which when carried out will not only greatly facilitate the carrying on of the companies' increasing traffic, but will put bread in the mouths of a host of workmen for several years to come. This kind of expenditure runs into high figures, makes improvement permanent and finds employment for the bone and sinew of the country.

SOUTHERN PACIFIC WAITING ROOM, SANTA BARBARA.

To double-track the Associated Lines from the Missouri river to the Pacific coast the sum of $75,000,000 will have to be expended, according to a vote taken by the directors of the Union Pacific and the Southern Pacific at a recent meeting and announced by Mr. Robert S. Lovett, president of both the lines.

This enormous expenditure will mark the first departure, upon a large scale, from the policy of curtailment entered upon by the railroads following the panic of 1907. The executive committees, Mr. Lovett said, had also decided to complete the double-tracking of the Oregon Short Line from the junction with the Union Pacific main line at Granger, Wyo., to Huntington, Ore., and the line along the Columbia river in Oregon to Portland, being a total of 1,673 miles. The work will be distributed over a period of five years.

For several years the Union Pacific has been double-tracking its main line westward from Omaha, and by July 1 will have about 630 miles of the 1,000 miles between Omaha and Ogden double-tracked

The entire country served by the Union Pacific and Southern Pacific systems is developing rapidly. Its growth in population and its agricultural and commercial development will no doubt continue.

Continuing the official announcement from which these facts are drawn, Mr. Lovett said, "With an increase in wages all along the line, with the right to increase rates suspended by law, and further regulation and hostile legislation threatened, and with investors still timid and asking high rates for money required by railroad companies, it may seem a time for curtailment rather than increased expenditure by railroad managers. But we believe these unfavorable conditions are temporary. The growth and development of the country, at least that portion of it served by our lines, is bound to continue. Nothing can stop it long."

Plans for the construction of a number of extensions and new lines tributary to the Union Pacific and Southern Pacific in the West and Northwest, which for some time have been under consideration, were also approved, the expenditures therefor to extend over a period of six years. On many of these tributary lines McKeen motor cars are used, and we are informed that two Southern Pacific 70-ft. all-steel gasoline motor cars left Omaha Jan. 21, coupled together, moving under their own power, traveling over the Union Pacific and Southern Pacific to Sacramento, Cal.

Old Time Railroad Reminiscences.

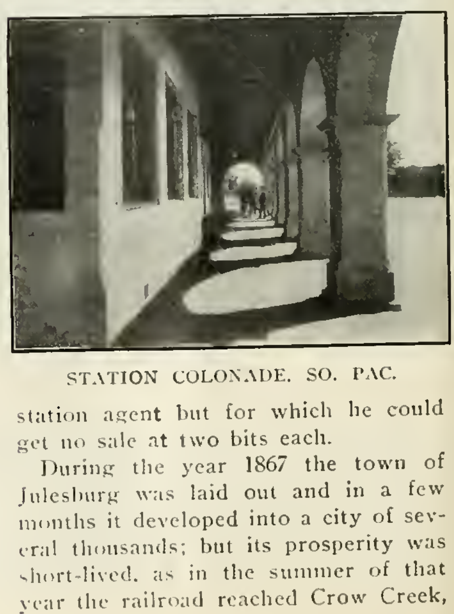
By S. J. Kidder.

Among the unique practices of railroading on the Union Pacific was the use of a "half-way post," painted white, located midway between stations and which under certain circumstances answered the purpose of a train dispatcher. In the event of two trains moving in opposite directions happening to get between the same stations the one first reaching the post had the right of way and, according to time-card rules, the other must back up to the station and take the siding.

The country along the road abounded with wild animals, mostly antelope, which usually went in herds and who would leisurely gallop off as a train approached, also wolves, coyotes and prairie dogs. Before the building of the railroad, buffalo were very numerous, it being estimated that three millions of them grazed upon the plains; but with the advance of track building they fell back from the road and during the time I spent in Nebraska none were to be seen along the line. Antelope meat was a common article of food on restaurant tables and frequently no meat other than this was obtainable. In 1868 there was yet a considerable immigration movement along the California trail, bound for the Pacific slope. Bull trains were frequently to be seen plodding along up the Platte valley, at almost snail's pace, the trains usually being made up of a considerable number of outfits.

Each outfit was composed of yokes of cattle drawing large canvas-covered wagons, known as prairie schooners, in which were the household goods, women, children, etc., with a cow or two following each wagon and a complement of dogs. The object of these immigrants traveling in trains was both for companionship and to afford a sufficient number of men to protect them in case of Indian attacks.

The finest kind of wolf skins, or pelts, as they were called, were a drug on the market. At Big Springs the entire water tank was enveloped with pelts that had been tacked up to dry by the station agent but for which he could get no sale at two bits each.



STATION COLONADE. SO. PAC.

During the year 1867 the town of Julesburg was laid out and in a few months it developed into a city of several thousands; but its prosperity was short-lived, as in the summer of that year the railroad reached Crow Creek, 139 miles west. The town of Cheyenne started on its career near the creek, and shortly after Julesburg pulled up stakes and most of it moved to Cheyenne. That such had been anticipated is evidenced by the fact that most of the buildings in Julesburg were of portable construction and so sectioned as to make them quite convenient for removal by rail. Cheyenne, too, had a mushroom growth, and in a few months after its founding had a population of ten thousand, though the following year this was greatly reduced by many moving on westward, following the track construction. Cheyenne in its very early days was a decidedly tough place, with little or no local government, overrun with gamblers, thieves and all manner of undesirable characters, the consequence of which was the organization of what was known as a vigilance committee, the paramount duty of the organization being to preserve order. Between "Judge Lynch" and the committee an improvised graveyard soon began to receive subjects for disposition, the subjects having suddenly been removed from the activities of this life with their boots on. Once in a while the committee got hold of the wrong man and before the mistake was discovered the victim had "passed in his checks."

An affair of this kind occurred during my only visit to Cheyenne. The morning after my arrival, while walking up the railroad track from the engine house to the depot, I noticed a few hundred feet north of the track a rough tripod made of three sticks of timber, inside of which hung a man, whose body swayed gracefully back and forth in the breeze. As it later proved that this was a case of mistaken identity, I was forcibly impressed that Cheyenne was a good place to keep away from and have never been there since.

The food at the railway eating-house was usually very good, though at Sidney, at times, some of the table viands had outlived their real usefulness. One noon several of the tables were occupied by the passengers of a train which had stopped there for dinner, while a table in the corner was occupied by railroad men. The scent floating upward from the butter on the latter table could have been compared only to that of real old Dutch sour kraut, and to register his displeasure a fireman shouted as the landlord entered the dining-room, "Say, Mr. Landlord, I'll bet ten dollars one pound of that butter will haul more cars from here to Cheyenne than any engine on the road."

For several years following the beginning of the work of construction of the Union Pacific the Indians were a constant menace to the road and the white man, though the United States soldiers located at various points, exerted a strong and restraining influence over them. One of the largest tribes was the Sioux, whose camp was immediately south of the town of North Platte. The tepees made a large village, and here could always be found the squaws and papooses as well as the bucks when not away committing mischief or depredations. Spotted Tail, a very old man, was the big chief, and living with him was his daughter Dove-eye, whom Ned Buntline, a famous frontier story writer of the day, designated as the "beautiful Indian princess," but who, in fact, was about as homely and uncouth a damsel, both in face and form, as one could well imagine. "The noble red man," too, "tall and straight as an arrow," that I had so often seen pictured and read about in books, was not in evidence, most of them being of ordinary height and somewhat inclined to be stoop-shouldered. The squaws as a very general rule were quite short and inclined to plumpness. Nearly all of these Indians were scantily clothed, the men in many instances wearing only a blanket and moccasins, the women a short calico skirt and sack and red flannel leggings, while the children were frequently seen clothed in Nature's garb only, conditions hardly suitable, it seemed, for winter weather.

The ambition of these redskins ran to ornaments rather than clothing. Beads, trinkets made of stone or bone and any piece of metal that could be secured and which was susceptible of being brightly polished was sure to fall into their hands by fair means or foul. Nearly all of the bucks wore a long leather strap hanging down the back, one end being attached to a whisk of hair on top of the head, the other end reaching to or trailing on the ground. The outside of the strap was embellished with pieces of tin and brass, the former taken from the scrap pile back of the tin shop and the brass begged or stolen from the round house, these pieces being constantly kept highly polished with the aid of oil and lampblack obtained from the firemen.

During the winter of 1867-8 the Indians had been quite inactive, other than an occasional raid to the Black Hills, at which time every able-bodied warrier would be absent from the village, and upon their return a pow-wow would be held. One of these I attended, accompanied by a Frenchman who understood the Sioux language. The gathering took place at the freight house, the chiefs being on the platform while the audience sat on the ground in a semicircle. Little Thunder was the orator of the occasion, and as he described their wanderings while away, the number of horses and cattle stolen, the number of scalps taken, etc., his listeners silently smoked the pipe of peace, one taking a whiff or two, then passing it to the next, the pipe being continually passed along from one to another.

During the early spring a "Treaty of Peace" was held in the new shop, there being present a number of army officers and commissioners representing the Government and several Indian chiefs, while a lot of railroad men stood about and observed the proceedings. The result of the conference was that the Indians agreed to refrain from marauding and be good, while in turn the

OPERATOR'S DESK, SANTA BARBARA, CAL.

Government was to provide them with arms, ammunition, clothing and food. Shortly after the work of distribution began at the freight house, the supplies being piled high on the platform. As the Indians marched up in single file each was handed a shirt, pair of pants and a blouse, the clothing being surplus uniforms left over after the termination of the Civil War; then as they moved on in line to the viand department the Indian tied a knot in each sleeve of his shirt and when receiving his supplies the coffee was turned into one sleeve, the sugar in the other, while in the body of the shirt was stored the flour, and in this manner the rations were carried to the camp. No pretense was made when issuing the clothing to fit the recipient, neither would one Indian exchange with another. As a consequence, when they appeared in their new garments a short Indian would frequently be seen with his pants and blouse sleeves turned up a number of reefs while his taller fellow would be strutting about with the blouse sleeves half way from the elbows and the bottom of his pants occupying a similar position between the ankles and knees. At stated periods cattle were furnished and at such times the Indians, mounted on their ponies, drove the cattle to the level plain north of the railroad, where they would be stampeded, then in the wild chase arrows would be shot into the frenzied animals until they fell from loss of blood.

About this time the squaws appeared and as the noble redmen nonchalantly rode back to camp the squaws dressed and dissected the carcasses and the meat was then toted to camp, from a half mile to two miles, on their backs.

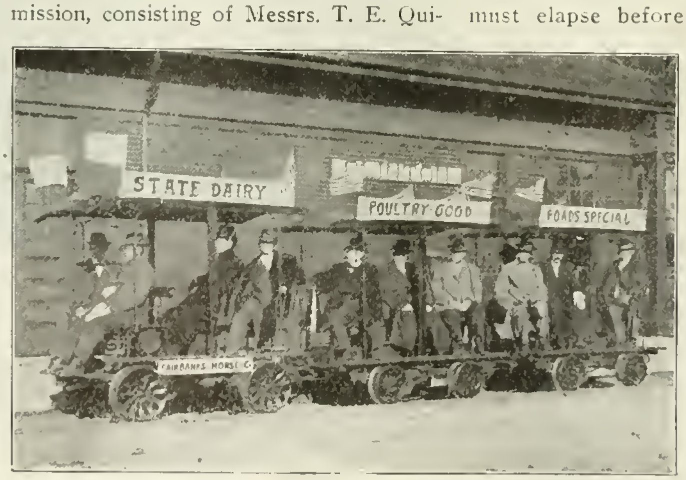
Shortly following the issuing of arms and ammunition rumors began floating about that the Indians were again assuming a hostile attitude and precautionary measures were taken.

All the shop, engine and trainmen were provided with arms, each locomotive carrying two guns mounted on brackets in the cab above the boiler head, and orders were issued that no train be run at night but to lay up wherever darkness overtook them until daylight. The section men had seven-shooter carbines, which were always kept within convenient reach, both when about their work or at home. Among the depredations committed was an attack on Tom Calhoon and Wilkes Edmonson at Sidney. I had hardly reached the engine house from breakfast when a cry of Indians was heard, and everybody rushed out, to see a half-dozen mounted redskins crossing the track quite a distance to the east. The two conductors were seated in the high weeds which flanked Lodge Pole creek and about a half-mile away, fishing. As the shop men saw the Indians they began shouting, which caused the fishermen to jump up, and being observed by the Indians a dash was made for them, the shop hands at the same time rushing back to their benches to grasp their weapons and start in pursuit. The conductors were attacked, both being pierced by several arrows, and Calhoon lost his scalp, after which the Indians rode rapidly away as the shop force charged down upon them. For a number of years attacks to persons or property occasionally occurred, but in time the radical measures taken by the Government drove the Indians to their reservations, where they could no longer hamper the railroad or jeopardize the safety of those who might settle the territory along its line. Perhaps the reader may wonder why this article is not continued and something said about the Union Pacific and its operation after the Indian question had been settled, in reply to which the writer would say that he did not admire the indications for the immediate future.

It required but a few months to quite satisfy him that life on the plains was conducive neither to comfort or safety and instead of waiting for civilization to expand over the "Great American Desert" he was only too glad to return to that portion of the country where such already existed.

Gasoline Motor Train.

A unique and unusual train was run over the Kansas City, Clinton & Springfield line last October, having on board the Kansas State Food and Dairy Commission, consisting of Messrs. T. E. Quisenberry, secretary State Poultry Board; W. P. Cutler, State Food and Dairy Commissioner; S. M. Jordan, State Farmers' Institute; Prof. F. M. Mumford, Dean of the Missouri University Agricultural College; Curtis Hill, State Highway Engineer. This train stopped at all points en route between Springfield and Kansas City, and short addresses were given to farmers and business men on farming, poultry raising, good roads and various other departments of the farmer's life.



GASOLINE TRAIN ON THE K. C., C. & S. RY.

This is the first trip of the kind, and nearly 5,000 farmers listened to the lectures by these specialists. The trip was made on gasoline motor cars furnished by Fairbanks, Morse & Co., and not only proved a very interesting occasion, so far as the farmers along the line were concerned, but made it possible for the lecturers to time their visits to the needs of the communities, and avoided the necessity of either moving on regular trains, which would have limited the time, or the expense which a special train, with engine and cars, would have entailed.

In view of the necessity, which is becoming more acute every day, for intensified farming, this method furnishes an economic and novel way for the quick and thorough distribution of information by State food and dairy commissions, and for bringing the information which agricultural colleges possess quickly and often to the personal attention of the farmer.

The Expected Does Not Happen.

A curious case of what usually would have been followed by an accident, but which was not, occurred not long ago on the Manitoba division of the Canadian Pacific Railway. A track-walker one Sunday morning found a piece of car-wheel flange about 18 ins. long lying beside the rail. The piece appeared to have been newly broken off, and the man realized that there must be a car in service not far away with a most seriously defective wheel.

The track-walker was some distance from a station and as considerable time must elapse before he could reach a telegraph office he hit upon the happy expedient of exhibiting the fragment of the wheel flange to the locomotive engineer of the first freight that came along.

The knight of the throttle at once comprehended the situation, stopped his train and took the fragment to the first telegraph station, from whence enquiry was made as to the whereabouts of the train containing the car with the broken wheel.

The final location of the wheel with 18 ins. of tread gone showed it to have traveled fifty miles from where the fragment was picked up. The car had not given any trouble and was on the track when discovered. It was then safely put into a siding.

ft. 10 ins. length and 2 ins. diameter. The heating surface of the furnace is 32.5 sq. ft., which with 535 sq. ft. for the tubes, gives about 568 sq. ft. total. The boilers are tested at 14 atmospheres and have a capacity of 45.5 cu. ft. water and 17.5 cu. ft. steam or 63 cu. ft. total. For the boiler feed there are used two Friedmann injectors, one for each side.

The engine has two horizontal cylinders of 10 x 17 ins. The maximum tractive effort is 2.7 (long) tons, and the net weight available for adherence, 13 tons. Seeing that the tractive effort per ton of the ensemble of the car is as high as 100 lbs., this is found largely sufficient for quick starting. The engineer's cab occupies the whole width of the truck, and is built of sheet steel and angle iron, containing the locomotive levers, boiler feed apparatus and air-brake valves. As there are two separate posts for the engineer for forward or backward drive, so that he always faces in the running direction, some of the apparatus has double maneuver, such as the speed changing, working of the governor, whistle and sand box and air-brake valves. On each side of the cab is a water tank and coal box. The capacity of the water tanks is 94.5 cu. ft., while the coal bins hold 1.2 tons. On the right-hand side of the locomotive boiler is mounted a passageway which connects on one side with the cab and in front with the car platform. As the cab also opens on to the rear car platform, the conductor can pass all along the cars and locomotive by going through the cab. The cars are heated by metal foot warmers, using hot water, which is heated by the steam from the boiler. On the entire car there is a capacity of 86 persons, seated and standing. W. S. Blackstone.

Eccentric Setting on the Shop Floor.

Editor:

I was very much interested in the Chicago & Northwestern Railway method of setting eccentrics on axles before the wheels were put under the engine. This method was very fully described by Mr. Charles Markel, the shop foreman at Clinton, Ia., and appears on page 83 of your valuable magazine for February, 1911.

It is possible to set the eccentrics in another way before they are put under the engine. Suppose that the ends of the rockers are equal to each other in length. Roll the wheels to a convenient point within the shop, where there is a good wooden floor between the rails or if over a pit, place a pair of good clean pit-planks under the axle, and drive a couple of nails through planks into the stringer, so that the planks cannot be moved. The next operation is to place the driving wheels, so that they will be correctly quartered with reference to the floor. Put, say, the right crank pin approximately on the top quarter, and drop a line with a plumb-bob on each end, over the pin. If the two lines are equidistant from the center of the axle then the wheel is so placed that the right crank pin is exactly on the top quarter, and the left pin is on the back quarter. The wheels should then be secured in this position by being wedged on both sides; or four small nuts should be put on the rail and pushed up until they touch the wheels. In this position the wheels will not roll.

Next drop the line over the axle, near one wheel, and let the plumb-bobs hang down with points close to the planks. Mark those points. Do the same thing in the center of the axle and close to the other wheel. Lay off from these the center line of the axle. Now, mark it on the floor or planks. Put the left hand eccentrics on and with plumb line, arrange it with bulge downward, the points of the plumb-bobs on the floor when equidistant from the center line of the axle will show this.

You know the lap and lead the valve is going to have. Say it is ⅛ in. lead and ⅞ in. lap. In such a position the valve will be exactly 1 in. off its center, and as there is a rocker arm to deal with in this motion, we know that the left forward eccentric must follow its crank in the Stephenson valve motion. The left crank pin is on the back quarter, corresponding to the position of the piston on the left side, being at the back end of the cylinder.

The eccentric is now to be moved with center line of bulge toward the left crank and as soon as the plumb-bobs show that their points have traveled 1 in. from the points found when the bulge was exactly downward. Secure the eccentric in that position and it will be found that the correct angular advance of the eccentric for that setting of the valve has been gained. Similar operations will bring the other eccentrics to their proper positions. This is really not a perfectly accurate method of doing the work as several attachments of the link motion may modify the result.

North Smyrna. Jympat.

English 4-6-2 Tank Locomotive.

Editor:

A somewhat novel type of engine (for English railways) has recently been built at the works of the London Brighton & South Coast Railway. It is of large dimensions and is intended to haul the heavy 60-minute expresses between London and Brighton, a distance of nearly 51 miles.

ENGLISH TANK EXPRESS LOCOMOTIVE.

The cylinders are 21 ins. diameter by 26 ins. stroke, with drivers 6 ft. 7½ ins. diameter. The total weight, with 2,300 gallons of water in the tanks and 3 tons of coal in the bunker, is 86 tons, of which 56 tons are on the coupled wheels. The boiler is 15 ft. 9½ ins. long and has a diameter of 5 ft. 3 ins. There is a total heating surface of 1,865 sq. ft., of which the firebox contributes 125 sq. ft., the tubes 1,398 sq. ft., and the Schmidt superheater 342 sq. ft. B. R. A. L.

London, Eng.

"Shakopee" or "Dummy."

Editor:

I was much interested in the picture of the old car and engine "Shakopee" shown in the February number. I came to the Minnesota Valley Road May 7, 1867. They had at that time forty-seven miles of track. This engine and car was then running between Minneapolis and West St. Paul, the latter place at that time consisting of two houses, a small depot and a saw mill.

There was a joint arrangement between the C. M. & St. P. and the Minneapolis Valley road for four trips a day. Later on as the latter road was built westward, that run was discontinued and the engine and car was stored at the small shops at Shakopee, and used as a business and pay car until some time in the seventies, and was run by any engineer who was at hand. I ran the engine a great many trips, including a number between St. Paul and Duluth, with Northern Pacific construction officials who hired her from the Minneapolis Valley, and later the St. Paul and Sioux City Co., as the road was then called. It is now a part of the C. St. P. M. & O. R. R. I always understood this engine was built at the shops of what was then the Columbus & Indianapolis Central Railroad. I am not positive as to this name, but Mr. W. Romans built her, as his name on a brass plate was on the engine. Her tank was under the boiler. I think her cylinders were 9 or 10 x 18 ins.; drivers, 4 ft. 9 ins. outside of tire. Her motion was peculiar. The links were raised and lowered by a connection with lower end of reverse lever. No rockers, the lever was at back end of quadrant when engine was working in forward motion, it had had a fine boiler, carried 160 lbs. of steam, and was slow at starting, but could "go some," and was never known to leave the rails.

I belive the engine was scrapped in the late seventies and I heard the car was afterward put to the ignoble use of a pea-nut stand in Minneapolis. I am pleased to see this picture, as it brings back to me incidents of more than forty years ago, one of which was cutting a hole through the ice and washing out the boiler of this little engine, standing on a bridge in the month of March, on a Sunday, making the hand hole plates with hemp and they beginning to freeze before I got them in place, then filling the boiler with a small hand pump, this being one of the propositions we were up against in a new country.

I have ridden twenty-five miles in twenty-nine minutes many times on this little engine without any great effort. I never heard her spoken of as the "Shakopee." She was known by every one as the "Dummy." I value the picture highly.

CHAS. C. ROWELL.

Div. 82, Onawa, Iowa.

C. P. R. TRAIN ENTERING LOWER PORTAL OF SPIRAL TUNNEL IN THE ROCKIES.

More Facts About the "Shakopee."

Editor:

Since writing this letter I have been thinking hard, and some things have come to my mind that are not included in the letter, which I will give you in this. In 1864 and 1865 I was running an engine between Dayton and Sandusky, Ohio, on what is now a part of the Big Four System. We crossed the C. & S. C. road at Urbana, and I can distinctly remember seeing an exact duplicate of this engine and car go west on that road. Further. I can recollect being told that Mr. Romans was the master mechanic of that road. This, I think should settle the question of where these little engines were built and that Mr. Romans was the builder.

C. C. R.

Cause of Leaky Flues.

Editor:

I have the misfortune to be a foreman boilermaker at the principal repair shops of a trunk railroad, which goes through a great deal of country infested with limestone. The water of some divisions is heavily charged with lime and causes much grief from leaky flues and firebox sheets, more especially flues. When an engine receives a new set of flues and has them leaking before more than three thousand miles have been run, which is a common circumstance, there is nearly always reflections cast upon the flue setter who did the work, and the fault finding is nearly always unjust.

I have read your article in the February issue headed "Material From Which Flues are Made," and I think it is like striking the rivet head straight. The time was when flues would bead as clearly as if the material was gold with no tendency to crack. With material of that kind an apprentice would set a set of flues without losing one, now the most experienced boilermaker must exert the greatest care and skill to set flues without losing considerable from cracking. When complaints are made, you hear the growl that boilermakers are not what they were in the good old days. I deny that and say that the material put into flues is not what it used to be. Our officials say that nothing except iron flues are bought, but I knew better. There may be iron flues among them, but the greater part are steel and poor steel at that. A good steel flue can be beaded as easily as the best iron and a strip can be turned over on itself without any sign of fracture, but it is different with Bessemer and other inferior grades of steel. Some people talk very fluently at railroad club meetings about the cause and discomfort about leaky flues, but the real cause is rarely touched. When a brick arch tube may be depended to fail in three months, there is no use saying that such tubes used to last as many year- They don't last properly today because the chasing after cheapness has led to the purchase of material hardly fit for stove pipes. That is where the trouble is and the truth ought to be told.

FOREMAN.

Chicago, Ill.

[As this is a particularly important subject we should be pleased to publish letters thereon from other practical men. —EDITOR.]

A Squealer.

Editor:

I was much interested in Dr. Sinclair's description of his first experience in a blizzard. Many of us in the Northwest have had similar experiences and we are not sorry to see some appearances of spring approaching. The last blizzard I came through, a curious thing happened to the whistle, or rather to the sound of the whistle. It seemed to go at least an octave higher than usual during the storm. My early education in music was very sadly neglected, so I cannot tell whether it was high C or D flat above the staff, but it fairly screamed, and finished up with a wild crescendo covering quite a number of notes like a Piute Indian showing off at the State fair. We tried it several times for the fun of the thing, and I noticed when we were passing through a deep cut its natural voice seemed to come back to it again. One would almost be led to believe that there was life in the frozen thing, and that it was crying out on account of the cold, but I have seen it colder and no variation in the note of the same whistle.

I spoke of it to the roundhouse foreman, but he was too busy with actual conditions to permit his mind to assume the necessary degree of tranquillity to contemplate abstract theories, so I let it go at that. I cannot get the echo of the thing out of my head. If there be any such thing as the Call of the Wild, that was it. Perhaps you or some of your clever correspondents may put me in to clear in regard to this, so that I may cease wondering at the unusual phenomena. I shall feel grateful for any information leading to a solution of the musical mystery. Of one thing I am positive, that I will know that wild wail again if I hear it, for mixing as it did with the war of the elements, it was something not easily forgotten.

J. R. T.

La Junta, Col.

[Two causes might have led to the change of note of the whistle, so interestingly described by our correspondent. Either the drum of the whistle had loosened or the velocity of the wind was such as to interfere with the jet of steam striking exactly on the edges of the drum. The latter wast most likely the case.—Editor.]

Railway Shop Management.

Editor:

I have recently read, with considerable interest and benefit to myself, in all railway mechanical papers and convention proceedings of mechanical departments, as to shop management. These articles and discussions have brought about considerable good, especially to the shop that has not kept up with the times and made some effort to meet the conditions, even if the shop and tools are old.

A decided improvement can be made in any shop by a little thought and effort on the part of the foreman in charge. As a great deal has been said as to the best management of shops, I would like to give my views as to how the railway companies can make a decided improvement and saving in cost of running and general repairs to locomotives by adopting the jig system of building and repairing locomotives.

In order to have this system successful, a separate organization must be established and managed by a practical mechanic, he in turn to be assisted by inspectors, office force, etc., depending on the size of the railroad. The head of the organization could be known as superintendent of locomotive standards.

All jigs should be made at one shop under direction of a competent foreman and force of good mechanics. This organization should be furnished the best of tools and be entirely independent of the general shop and under orders of the superintendent of motive power or his assistant only.

After the design of locomotive has been decided upon, one complete locomotive should be built from blue prints and all changes and alterations from blue prints should be noted, and if this locomotive is then satisfactory, jigs should be made to drill, ream, plane, slot, shape and turn every piece of the complete locomotive. After one complete set of jigs is made they should be sent to the locomotive works in charge of practical employees from the department of standards, to personally see that all jigs are properly used, and given the best care and promptly returned to home shop after the order of locomotives had been delivered. No less than four inspectors should be at the locomotive works on an order of fifty engines, and if they work night shift there should be four inspectors to watch the work. On arrival of the new locomotives at headquarters they are distributed to various divisions on the system, and when any repair parts are required they should be furnished from headquarters, finished complete by original jigs.

Headquarters should keep all terminal storehouses supplied with jig-finished material of parts that frequently require renewal, such as cylinder heads, crossheads, pistons complete, rod brasses, straps, bolts, driving boxes, shoes, wedges, etc. In order to maintain this standard and keep the least number of repair parts in stock, there should be a standard scrapping limit to all wearing parts, such as axle bearings, crank pins, piston rods, valve stems, cylinder and valve bushings, bolt holes, etc. To illustrate, if cylinders are 21 ins. bore and scrapping limit of bushings is 21¾ ins., there should be carried in stock three sizes of T-rings and spring rings, which should be 21¼, 21½ and 21¾ ins., which would cause the bushings to be bored out when worn to the sizes mentioned, in place of boring them any size, as now practiced, and carrying a number of sizes in stock. This system should apply to all wearing parts, including all bolt holes, which should be reamed to hardened bushing sizes and all finished bolts be furnished from main shop. When limit to all bolt holes has been reached the holes should be bushed and redrilled to original size. All boiler fittings should be located for the convenience of enginemen and at the same time located so that repairs could easily be made. Seating tools should be provided to reseat all valves connected to boiler without removing any of the valves. To facilitate the quick repairs to engines in engine houses at important terminals one class of power should be used, and in order to keep them going they should be provided with one extra tender, one cab, one engine truck, one set of main and side rods, one ash pan and one pair of drivers of each location, fitted up complete, with eccentrics and driving boxes. With the above-named duplicate parts on hand quick and cheap repairs can be made and as soon as one of these parts is used the one removed should be immediately repaired or new one procured in order to always have one on hand.

For example, suppose engine came in with broken spokes in wheel center, or broken axle, all that would be required to get engine in service would be to drop the wheel, take off tires, replace the new wheel and apply the tires taken from the condensed wheel. This could be done in fifteen hours, which would save three or four days' time if done in usual manner. To still further help in the quick turning of power at terminals, the inside flanges on driving boxes at wedge side should be removed so that wedges could be readily taken out and lined down in one hour apiece. Driving-box brasses should be removed without dropping wheels, which could be done in three to five hours apiece. Side motion plates can be applied to driving boxes so that side motion can be renewed in three hours, on one box. A simple driving-wheel tire retainer can be applied which will prevent engine failures from loose tires working in and out. A solid-end main rod can

C. P. R. TRAIN EMERGING FROM UPPER PORTAL OF SPIRAL TUNNEL.

be used without straps, bolts, flanged brasses, etc., which will prevent the destructive breakage of straps, which breakage usually damages the cylinder, cylinder-heads, guides, etc. To prevent the overlooking of some defect in the machinery by the inside engine-house inspector, there should be an outside inspector during daylight hours who could look the engine over while fire was being knocked. He could also note the firebox conditions as to flues, stay-bolts, etc., and make report to foreman.

The roundhouse organization is very important, and the best results can be obtained by assigning machinists to certain classes of work, thereby making specialists of them. They should be furnished a first-class portable bench, with vise attached, and room in drawers to carry all tools in connection with their special work. When the regular machinist is absent the foreman should turn the bench and tools over to the man best fitted to handle this class of work. By having specialists, the man doing the work will soon devise tools and ways to do the work, such as tools and jigs, to help himself along. A specialist on steam pipes, dry pipe, stand pipe and niggerhead will save the company $15 an engine on the job alone, and this amount will average well for all classes of work done by the specialist and the man who is only called on to do this work occasionally.

A first-class tool room should be maintained in engine house and all necessary tools kept clean and sharp. The tool room should be in charge of a machinst, who should be provided with power machines to keep the engine-house tools in good condition. In conclusion, I wish to state that to get the best results the foreman in charge, who should be a practical man, and should have competent assistants, should allow him to plan and supervise with men under him, visit other shops occasionally, read all mechanical publications pertaining to his work and still have time to listen and talk to the individual workman, who is the fellow who really has the ideas and is one of the causes that has pushed the railway shops to the front in recent years.

Chas. Markel,
Shop Foreman, C. & N. W. Ry.
Clinton, Ia.

Demand for Machinists.

Editor:

As a result of improved conditions in business generally and on railroads particularly, there is a growing demand for skilled machinists familiar with the construction and repair of locomotives and other machinery used on railways. The machine shops are crowded with work, especially in the rebuilding of locomotives that have, to say the least, run long enough. Besides rebuilding, there is an increase in general repair and roundhouse work. The increased transportation business calls for an increase in the number of locomotives. Some of the leading railroads are placing large orders for new locomotives, the Harriman lines particularly, placed the largest order ever given at one time to the Baldwin Locomotive Works last month. Capable and experienced roundhouse machinists are particularly in demand, the necessity for keeping every locomotive wheel moving being very great.

In the roundhouse work, or whatever may be called locomotive running repairs, it is very gratifying to observe that there is a universal tendency towards a marked improvement in facilities and better conditions, with the result that the necessary operations are more speedily performed under a greater degree of comfort than formerly. While the improvement in expedition is a cause of satisfaction to the railway officials, the advance in physical comfort cannot fail to attract a better class of men to the roundhouse. As is well known, many skilled machinists had a reluctance to engage in such work on account of the severe physical conditions, often involving dangerous exposure. Higher wages are being obtained in some quarters, and it is high time. Indeed, it has been often remarked that while men engaged in the building trades, doing the simplest kind of work, are being paid liberally, skilled machinists, whose work is of the most exacting kind, are still working at last century's wages.

In the matter of work that requires the most accomplished skill we are prepared to maintain that there is no class of mechanics whose work requires more skill, greater rapidity of dispatch, and often under severe conditions, than that of railroad machinists. Higher compensation, shorter hours of labor and improved environment should be cheerfully accorded to them. Appearances at present are full of hope for the future, and we are confident that railroad machinists will shortly assume their former position among the skilled trades, not only as that of second to none, which they really are, but as the leaders in handicrafts where constant grappling with engineering problems keeps their minds luminous with the fires of intelligence and distinctly makes them as near akin to those of the learned professions.

R. B. A.

A Fair Day's Work Fair.

Editor:

One of the quack mechanics, who has been striving to convince the Interstate Commerce Commission that it is practical to greatly reduce the expenses of railroad operations, went into the office of the general manager of a prominent railroad and made the statement that he could save the company two million dollars a year were he given permission to supervise the repair shops. On being questioned about what he knew of the shops and of the rolling stock, he admitted that he knew nothing. He had never been in any of the shops and never had the opportunity to inspect the rolling stock. His idea was to make the workmen increase their output by the general introduction of piecework and the putting on of inspectors who would see that the mechanics worked to the best of their ability.

It is much easier to propose such a scheme than to carry it into practice. The American workman already works harder than the workmen in any other machine shop in the world, and any attempt to increase his burdens would be certain to end in disaster. Delegations from workmen's unions of various foreign countries have repeatedly visited American workshops, to report on our labor conditions, and they have invariably reported that American mechanics performed too much work. Yet our self-appointed reformers would like to make uncomfortable conditions worse. Fellows who never performed a day's hard work in their lives are anxious to compel industrious workmen to labor constantly with the whole of their mental and physical strength. Sham workmen are the worst tyrants that infest the earth.

Sam Signal.

Struck by Lightning.

In a book recently published in London on "Lightning and the Churches," by Mr. A. Hands, he presents some striking diagrams and photographs showing how lightning will jump, as it were, from one piece of metal to another in its passage down an unprotected church tower and how, in a tower "protected" in an unscientific way, the discharges may prefer some other path to the conductor—if, for instance, the conductor has a bad earth connection. On the other hand, he gives instances of churches, such as Week St. Mary, in Cornwall, and St. Botolph's, Boston, Lincolnshire, better known, perhaps, as "Boston Stump," which were struck time after time till a conductor was fixed, and which have not been struck since. Then again, as he points out, we do not know how many times churches which are protected by conductors have been struck without being injured, for the only way in which you can tell whether a conductor "has been put to the supreme test and has saved the building from damage" is by a slight mark of fusion at the tip. It is a common occurrence, we learn, to find these marks when inspecting conductors. It would be rather exhilarating to discover the traces of fusion on one's own lightning conductor.—*London Spectator.*

Catechism of Railroad Operation

By Angus Sinclair

60. In descending a long gradient where it is necessary to inject water into the boiler, how should the fire be regulated?

A.—In such cases the fire ought to be maintained sufficiently active to keep the incoming water up to the temperature of the steam. When that is not done the comparatively cool water inside the boiler may have disastrous effect upon flues and fire-box sheets.

61. Is it possible for the water inside of the boiler to have a lower temperature than the steam?

A.—That is possible and it happens frequently. There is so little circulation inside the boiler when an engine is drifting that the incoming water may not be affected by the steam heat. When this condition exists the stream pressure will drop suddenly when the throttle is opened when the end of the grade is reached. Keeping the fire active while the engine is drifting has the effect of converting the incoming water into steam, thereby maintaining the water and steam at the same temperature.

62. What is the force most active in stimulating the fire for generating steam in a locomotive boiler?

A.—The exhaust steam passing through the smoke stack.

63. Explain the draft-creating action of the exhaust steam.

A.—The exhaust steam rushing through the smoke stack at great velocity induces a movement of the gases in the smoke box toward the atmosphere so that steam acts to some extent as a piston pumping out the gases, the combined action producing a partial vacuum in the smoke box. This partial vacuum draws the gases through the flues and fire-box, while the pressure of the atmosphere forces air through the grates thereby stimulating the fire.

64. What is a spark arrester?

A.—A spark arrester consists of an obstruction placed in the smoke stack or in the smoke box on which the sparks strike before they get outside There is also a wire netting to arrest the sparks that otherwise would escape into the atmosphere.

The spark arrester formerly consisted of a cone and netting placed in the smoke stack. The modern practice is to use a plate of iron sloping in front of the flues which projects the sparks into an extended smoke box. A wire netting for stopping the emission of sparks is spread between the flues and the smoke stack opening.

65. What are locomotive draft appliances?

A.—These consist of an exhaust nozzle and the plate already mentioned as extending from above the upper row of flues. This plate, called a diaphragm, is also employed to make the gases pass uniformily through the different rows of flues. It is also used to make the fire burn evenly, which results from the flues drawing the gases evenly from the fire-box.

Some engines have a petticoat pipe or lift pipe interposed between the exhaust nozzle and the smoke stack. That pipe is sometimes used to regulate the draft through the flues.

The diamond-stack form of engine has a petticoat or lift pipe in the smoke box set above the exhaust nozzle and extending within a few inches of the base of the smoke stack. Some lift pipes have a moveable sleeve which is used to regulate the draft through the flues.

66. What is a boiler flue?

A.—It is a plain iron or steel pipe about 2 ins. diameter extending the length of the boiler secured to tube plates. The flues are surrounded by the water in the boiler and transmit the greater part of the heat generated in the fire-box.

The invention of the multi-tubular boiler—that was putting a multitude of flues in a boiler—first made a high speed locomotive possible.

67. What is the most common causes of leaky flues?

A.—Abrupt changes of temperature, such as injecting much water when the fire is low; permitting cold air to strike the flues and using the blower after the fire is drawn.

68. How would you fire a boiler that had leaky flues?

A.—Fire so that the fire would be kept uniform and avoid opening the door more than was positively necessary.

69. When there are indications that steam would begin to blow off, how would you check the heat?

A.—By closing the dampers and putting the fire door upon the latch.

70. As a fireman would you be interested in watching the water level and why?

A.—Certainly. It is only by watching the water level that I could co-operate with the engineer.

71. What is the purpose of a brick arch in the fire-box.

A.—A brick arch lengthens the journey of the gases from the fire to the entrance of the flues promoting the admixture that produces the maximum possible heat; it maintains an intensely hot body where the gases have to pass, with the result that gases are frequently ignited that without the arch would pass into the flues without heating vitality. The brick arch is an excellent spark arrester, and it also prevents cold air from passing directly into the flues, thereby preventing leakage of the flues and fire-box sheets.

72. When and for what purpose is the use of the rake upon the fire desirable?

A.—When the surface of the fire is caking and obstructing the passage of air through the mass.

73. What would you consider to be abuse of a boiler?

A.—Heaping a heavy load of coal into the fire-box at one firing, cooling the boiler by running with the fire door open, irregular use of the injector and operating the injector when steam is shut off.

74. Are there any advantages for a boiler to have large grate area?

A.—Under certain limitations a large grate area permits of slow combustion and promotes economy of fuel. The grate surface may, however, be so large that the intensity of heat necessary to consume all the fuel gases will not be reached. Some railroad companies find it economical to put dead grates in some classes of engines having very large grate areas.

75. Why is it necessary to provide for a liberal supply of air to promote combustion in a locomotive fire-box?

A.—Because the oxygen in the air is essential in the act of combustion, which is a chemical combination of oxygen and carbon, the latter being the principal element in the fuel.

76. Is it possible to use too much air in promoting combustion, and what is the result?

A.—Using more than the necessary quantity of air is wasteful for the superfluous air has to be heated to the same temperature as the vital gases, thereby wasting heat.

77. What results from the fire receiving a supply of air inadequate to effect complete combination?

A.—A form of gas is generated from the fuel which is of inferior heating quality.

78. Are you familiar with any simple experiment that will illustrate the effect of too little and of too much air in promoting combustion?

A.—That can be shown by a common kerosene lamp. The admission of too much air will make the flame smoke and the same result will come from restricting the air supply.

79. In what condition must a fire be kept in order to prevent smoke.

A.—As bright as possible.

80. In what way would you act to maintain a fire bright?

A.—Fire frequently and in small quantities.

81. What effects upon the working of the fire has a small nozzle?

A.—With a small nozzle the exhaust steam escapes with such violent shocks that it tends to tear up the fire. A small nozzle also causes back pressure in the cylinders.

82. How would you prevent the fierce exhaust due to small nozzle from tearing holes in the fire?

A.—By firing heavily.

83. Is the pressure inside the boiler uniform over the whole surface?

A.—The steam pressure is uniform all over but the weight of the water adds pressure on the lower part in proportion to the height.

84. Do you recognize any rule concerning the dumping of ashes?

A.—I do understand that ashes should not be dumped close to stations or among switches, road crossings or places where they might start fires.

85. Is there any rule covering the filling of the water tank?

A.—See that it is filled at the usual water stations. Avoid permitting the water to overflow as that is a dangerous practice, especially in frosty weather.

86. What are the duties of a fireman on arrival at a terminus?

A.—The answer to this question will be based upon the rules of the particular company.

87. Do you admit that the engineer is responsible for the fireman's conduct while on duty and the manner in which the fireman's duties have been performed?

A.—I do.

Some railroad officials in charge of engineers and firemen finish the first year examination with personal questions which must be answered according to the judgment of the candidate.

Air Brake Questions and Answers—First Series.

1. What is an air brake?

A. It is a brake operated by compressed air, and requires special mechanism for the application of the power.

2. How is the air compressed for use in the brake system?

A. By means of an air pump, or compressor, located at some convenient place on the side of the locomotive boiler.

3. What are the essential parts of the air brake as applied to a locomotive?

A. They are an air pump or compressor, an air pump governor, a main reservoir, an engineer's brake and equalizing discharge valve; a duplex air pressure gauge, a plain triple valve, an auxiliary reservoir, a brake cylinder, with a piston in it, and the necessary piping, stop cocks and angle cocks.

4. How many kinds of triple valves are there in use?

A. Two; the plain and the quick-action triples.

5. What is the main reservoir used for, and where is it located?

A. Primarily for the storage of a large quantity of air, to be used in releasing the brakes and quickly recharging the auxiliaries; and secondarily, to catch the moisture, dirt and oil which are pumped in along with the air. It may be located in any convenient place about the engine or tender, but it is usually placed under the boiler, just back of the cylinder saddles, or under the running board.

6. What is the usual standard train pipe pressure?

A. With the plain quick-action brake 70 lbs., and with the high-speed quick-action brake 110 lbs.

7. What pressure is usually carried in the main reservoirs?

A. With the plain brake, 90 lbs.; with the high-speed brake, from 120 to 130 lbs.

8. Why is it important that all air-brake apparatus should be kept tight and free from leaks?

A. In order that the air-brake mechanism may operate properly and that there may be no waste of air, with its attendant evils, or any unnnecessary work required of the pump.

9. Where does the air come from that operates the sand-blower, bell-ringer, air-whistle signal, water-scoop or other devices?

A. From the main reservoir.

10. How should an air pump be started?

A. Very slowly, with all drain cocks wide open. After the water has drained away, close all drain cocks, and when a pressure of 35 or 40 lbs. has accumulated in the main reservoir, open the pump throttle sufficiently to run the pump at a speed that will maintain the required pressure and perform the brake work satisfactorily. The steam end of the pump should be lubricated freely during the starting, just after the drain cocks are closed.

Position Is Important.

Ordinary blocks and tackle consist of a rope and a single and a double block, or it may be simply a fixed and a movable pulley. The question sometimes arises as to where shall these blocks or pulleys be placed. Which goes with weight?

In the case of what we have referred to as the fixed and movable pulley arrangement, both pulleys are alike in so far as they carry one rope each. We will now imagine one of these hanging from the ceiling; it becomes the fixed pulley for the time being and the "fall rope," or the one you pull by, hangs down from it to the ground; the rope, however, runs over the upper half of this pulley and comes down to the lower or movable pulley, passes round the lower half of this pulley and runs up to a hook on the lower end of the upper pulley box or block. The lower or movable pulley is attached to the weight and we have three divisions of the rope, viz.: the fall rope; the upper to lower rope section; and the lower to upper rope section. Now, as these blocks are all alike in each having one grooved pulley, we will use the name "fall pulley" for the one from which the fall comes, and the question is, do you get more power when the fall pulley is hanging from the ceiling or attached to the weight?

In the first place, when the fall pulley is hanging from the ceiling and you have 100 lbs. to raise, you pull down on the fall rope, and that shortens the length of the other two rope sections. If it was not for this fact, the down pull on the fall rope does little more than tend to tear down the fall pulley. This leaves only two rope sections, the ones between the pulleys, and these sustain the weight and do the lifting. As there are two effective rope sections, it follows, each will be strained 50 lbs, and a pull of 50 lbs. will have to be applied to the rope in order to hold up the weight of 100 lbs.

In examining the other arrangement, suppose the fall pulley is attached to the weight and the fall rope is run up through the ceiling, and when you attempted to raise the weight you had to be on the floor above and pulling up on the fall rope. As in the previous case, the strain of the fall rope on the fall pulley tends to carry the fall pulley in the direction of the strain, or, in this case, upward, and that happens to be the direction you want, the fall pulley (attached to the weight) to move. You therefore have three effective rope sections—the up-moving fall rope, and the other two, as in the previous case. Raising a weight of 100 lbs. means a pull of 33 1/3 in each rope section, as against 50 lbs. in the former case. Placing the fall pulley or the double block in connection with the weight shows an economy of power over the other way, but the other way may be at times the mor convenient of the two.

Flexible Boiler on Mallet Articulated Compound on A., T. & S. F.

The Baldwin Locomotive Works have supplied the Atchison, Topeka & Santa Fe Railroad with a pair of engines, each having flexible boilers. The engine which we illustrate is No. 1171. It has what might be called an accordion connection, so that as the engine progresses round a curve, not only does the frame which is jointed in the center, swing about a pivot point, but the boiler having the accordion plaited connection is able to bend together on one side and expand on the other as the curvature of the track demands.

The flexible boiler connections used on these two engines are entirely different in construction, one having a double ball-jointed connection, while engine No. 1171 has a bellows form of connection. On the other engine the connection consists of two cast iron sleeves, fitted one within the other and provided with snap rings to keep the joint tight. Each sleeve forms a ball joint with a cast iron ring, which is bolted to the shell of the corresponding boiler section.

On engine No. 1171 the joint is composed of sixty rings of high carbon steel, having a thickness of No. 14 wire-gage. These rings are 10 ins. wide and have an outside diameter of 75½ ins. They are made with a set, so that, when placed adjacent to each other, they form a series of V-shaped joints. The adjacent rings are riveted together at the inside and bolted at the outside and the connection is bolted in place between the front and rear boiler sections. The products of combustion traverse the flexible connection through a cylindrical flue 44 ins. in diameter. This flue is riveted to the rear boiler section, and prevents cinders from lodging in the crevices between the connecting rings. The design of this joint is illustrated in Fig. 1 on next page.

The arrangement of the superheater and reheater is practically the same on both engines. An open chamber is located in each boiler section, adjacent to the flexible connection, and these chambers contain the heaters. The superheater is located in the rear boiler section, and the reheater in the front section. These heaters are of the Jacobs type, and each consists of a steel drum traversed by horizontal fire tubes. The superheater is exposed to a higher temperature and steam pressure than the reheater, and its tubes are welded at each end, while in the reheater the tubes are rolled and beaded. The heaters are fitted with internal baffle plates, so that the steam is compelled to follow a circuitous course among the tubes.

The throttle valve is connected with the superheater by an internal dry pipe and the steam enters the superheater at the top. There are two outlets, placed right and left in a steel casting on which the superheater drum is seated, and these outlets communicate directly with suitable passages which are cored in the high-pressure cylinder saddle. The connections between the saddle and steam chests are effected by short elbow pipes.

The high-pressure exhaust on the locomotive now under notice, is conveyed forward through a pair of horizontal pipes fitted with ball and slip joints. These pipes terminate in a cast steel waist bearer, which spans the front frames and supports the rear end of the forward boiler section. The reheater is located immediately above this waist bearer, and is seated on a steel casting similar to that which supports the superheater. The two currents of steam, after being reheated, unite in the center of the drum and enter a single pipe connection in the front of the latter near the top. This pipe connection is carried forward through a large flue which traverses the waterheater. On reaching the smokebox the steam enters an elbow pipe, and is conveyed to a passage cored in the low-pressure saddle. It then flows through short pipe connections to the low-pressure steam chests.

The low-pressure cylinder saddle, to which reference has previously been made, is of cast steel, and is supported on a second casting of the same material.

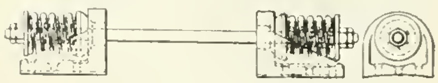


FIG. 2. CENTERING DEVICE.

This casting constitutes part of the front frame system, and to it the low-pressure cylinders are keyed and bolted. The vertical center line of the cylinders coincides with the stack center line, and the smoke-box is supported on the saddle as in a locomotive of the ordinary type.

To assist in holding the boiler sections in alignment, a centering device is placed on each side, on the horizontal center line of the boiler. This arrangement consists of a pair of helical springs, which are seated in cast steel brackets rivited to the shells of the front and rear boiler sections. The springs are held in place between washers, carried by a horizontal thrust bar, (Fig. 2). When the engine enters a curve, the two boiler sections assume an angular position with reference to each other, and by reason of the compression of the springs on the outer side, the corresponding thrust bar is thrown into tension, thereby tending to bring the boiler sections back into alignment. It is of course necessary, in these locomotives, to place flexible joints in all pipes which pass the articulated connections in the frames and boiler. This, however, introduces no objectionable complication. Some of the principal dimentions are as follows:

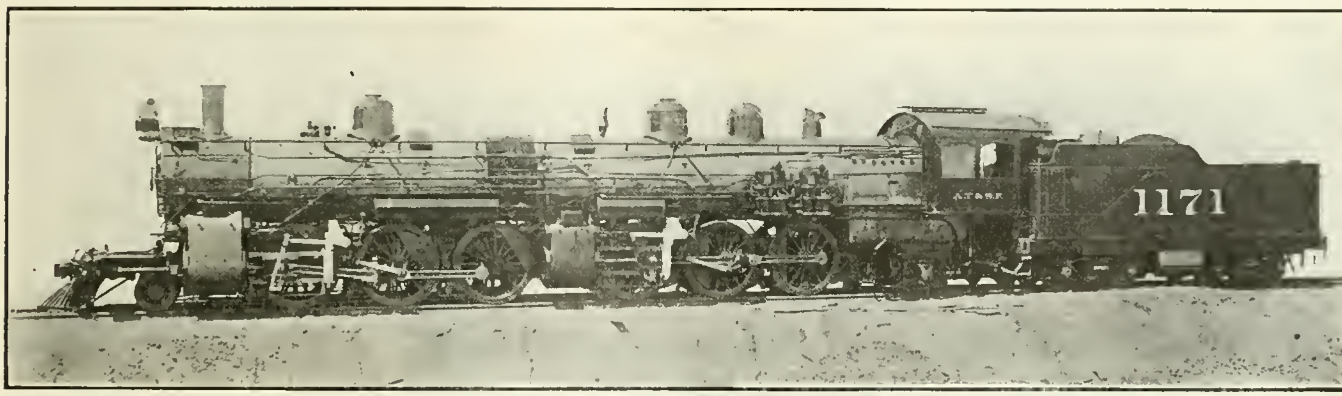
Cylinders, 24 and 38 x 28 ins.

Valves, balanced piston.

Boiler—Type, straight; material, steel; diameter, 70 ins.; thickness of sheets, 21/32 and 11/16 in.; working pressure, 220 lbs.; fuel, soft coal; staying, Jacobs-Shupert.

Firebox—Material, steel; length, 119⅝ ins., width, 63¼ ins.; depth, 74⅛ ins.; thickness of sheets, sides, 5/16 in.; back, ⅜ in.; crown, 5/16 in.; tube, 9/16 in.

Water Space—Front, 5 ins.; sides, 5½ ins.; back, 5 ins.



ARTICULATED COMPOUND WITH FLEXIBLE BOILER FOR THE A., T. & S. F.

W. F. Buck, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Fire Tubes—Material, iron; thickness, No. 11 W. G.; number, 294; diameter, 2¼ ins.; length, 19 ft. 7 ins.
Feed-water Heater Tubes—Number, 322; diameter, 2¼ ins.; length, 9 ft. 10 ins.
Heating Surface—Firebox, 200 sq. ft.; fire tubes, 3,376 sq. ft.; feed-water heater tubes, 1,893 sq. ft.; firebrick tubes, 34 sq. ft.; total, 5,503 sq. ft.; grate area, 52.5 sq. ft.
Engine equipped with Santa Fe type superheater and reheater. Superheating surface, 390 sq. ft.; reheating surface, 564 sq. ft.
Driving Wheels—Diameter, outside, 69 ins.; journals, main, 10 x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels—Diameter, front, 31¼ ins.; journals, 6½ x 12 ins.; diameter, back, 40 ins.; journals, 8 x 14 ins.
Wheel Base—Driving, 37 ft. 10 ins.; rigid, 13 ft. 8 ins.; total engine, 56 ft. 5 ins.; total engine and tender, 89 ft. 3 ins.
Weight—On driving wheels, 317,300 lbs.; on truck, front, 29,000 lbs.; back, 46,000 lbs.; total engine, 392,300 lbs.; total engine and tender, about 562,000 lbs.
Tender—Wheels, diameter, 34¼ ins.; journals, 5½ x 10 ins.; tank capacity, 9,000 gals.; fuel capacity, 12 tons; service, passenger.

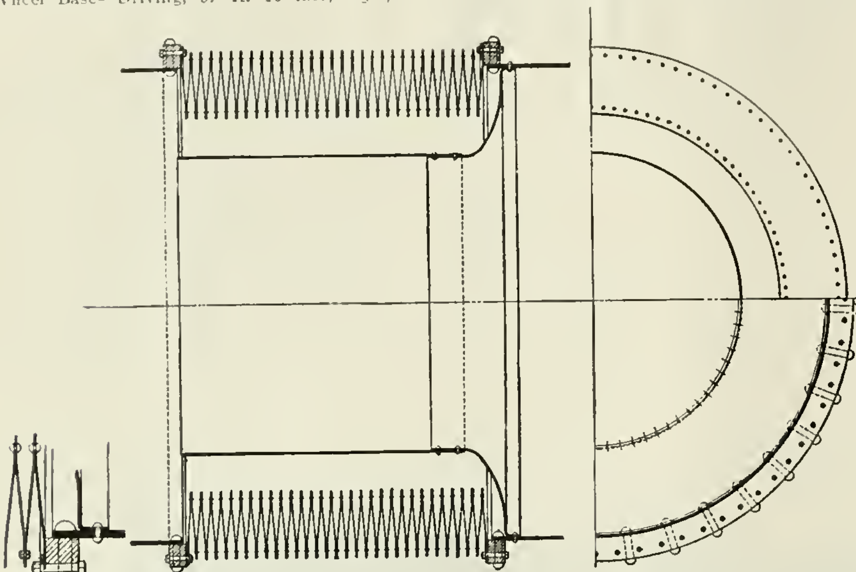


FIG. 1. SECTIONS OF ACCORDION BOILER CONNECTION.

Duties of the S. M. P.

In his paper on "Alabysis—Chemical and Otherwise," presented to the Central Railroad Club, Mr. E. M. Tewksbury gives an interesting analysis of what he considers to be the duty of a superintendent of motive power. That part of the paper reads:

"The superintendent of motive power not only analyzes his master mechanics, master car builders, and the whole force, but when his assistant places before him a design, say, for a new locomotive, he at once proceeds to analyze it. He must know before placing his approval to the drawings that it is in every particular a properly balanced engine; that it has the required heating surface to generate steam for the size cylinders specified; that the weight is properly distributed between each pair of driving wheels and truck; that the driving wheels are accurately counter-balanced, a most important matter in the design and construction of locomotives.

COUNTER-BALANCING.

"The counter-balancing is not only necessary, but of vital importance, as it has been acknowledged that an improperly counter-balanced engine is the cause of many broken rails, which may result in great destruction to property and persons. To emphasize this, you will please bear with me while I point out that from 1885 to 1907 the axle load has increased from 24,000 pounds to 53,500 pounds, an increase of 123 per cent. The average weight on drivers has increased from about 60,000 pounds in 1885 to over 180,000 pounds in 1907. In connection with these great increases, and in looking for the cause of broken rails, one writer has said:

CAUSE OF BROKEN RAILS.

"I have investigated a number of cases and find same due to an impact blow from a badly counter-balanced engine—I have had occasion recently to compute the impact blow delivered by an off counter-balanced engine running at a speed of ninety miles an hour, although it was one of the latest types of engines, yet at one point in the revolution the minimum pressure on the rail was 4,000 pounds, and at another point the maximum pressure was 57,000 pounds. This enormous pressure is distributed over an area of only about ½ square inch, hence, you can see what a tremendous blow can be delivered in high speed traffic. This is assuming that the roadbed is in perfect condition. When you take into account the irregularities of the track, such as are due to the freezing of the ballast and the rolling of the engine due to this irregularity in the track, the maximum pressure delivered by an off counter-balanced engine must be far higher than that which I have computed."

Another speaker on the same subject said: "Upon the rail there is all the increased effect of suddeness of application, and also other stresses due to vertical oscillations of the load. We need only to recall the beautiful experiment made by Professor Goss, in which a wire was run underneath a driving wheel, a portion of the wire being crushed, and another portion not, indicating that the entire wheel had been elevated by an improper counter-balance.

"That the builders are liable to give you an off counter-balanced engine I know from experience. I purchased several switch engines that were wanted in a hurry, accepting a design and pattern which was said to have received a great deal of thought not only by the builders, but by a superintendent of motive power of one of our largest trunk lines, but when these engines were received they were so badly off counter-balanced that you could not keep a chimney on the rear headlight."

Brick Arches.

The Traveling Engineers' Association indicate that they intend to collect all the information available concerning the brick arch for a report to be submitted to the next convention. We urge those having information on the subject to send it to the chairman of the committee, Mr. W. G. Tawse, Box 425, Momence, Mich. The questions asked are:

No. 1.—Economy derived from the use of the brick arch when water conditions are considered unfavorable?

No. 2.—What results have been obtained where the brick arch has been placed against the flue sheet?

No. 3.—What results have been obtained by the brick arch having space between flue sheet and the arch brick?

No. 4.—Have boiler troubles been decreased by the application of the brick arch?

No. 5.—What results have been obtained from the use of the brick arch in the elimination of black smoke?

No. 6.—What changes are necessary on the draft appliances of locomotives when brick arches are applied to obtain the best results.

No. 7.—Can the nozzle tip be opened up by the use of the brick arch, and does this reduce the fuel consumption?

No. 8.—Have you had any more trouble with flues stopping up when the brick arch is used?

No. 9.—What adjustments are made on the different designs of arches to arrange for flues to be bored out?

No. 10.—Can a poorer grade of coal be burned on engines with a brick arch than with engines without brick arch and obtain desired results?

Chicago & Northwestern New Line.

The Chicago Northwestern's new line of 42 miles, which effects a saving of 26 miles between Sioux City and Hawarden, has been opened for traffic. It will be used for all through travel into South Dakota which has heretofore gone by a 68-mile route via Alton.

Low Pressure Turbine for Lighting.

By P Bendixen, Master Mechanic.

About two years ago a leading railway supply manufacturing company, were considering an addition to their electrical equipment due to the growth of the plant, and made a thorough investigation of the various prime movers suitable for the purpose. Taking into consideration the heating of the shops in winter and the fact that the old power plant was running non-condensing, all factors pointed to the low pressure or exhaust turbine as the most suitable power unit to install, from the standpoint of reliability, simplicity, economy and maintenance.

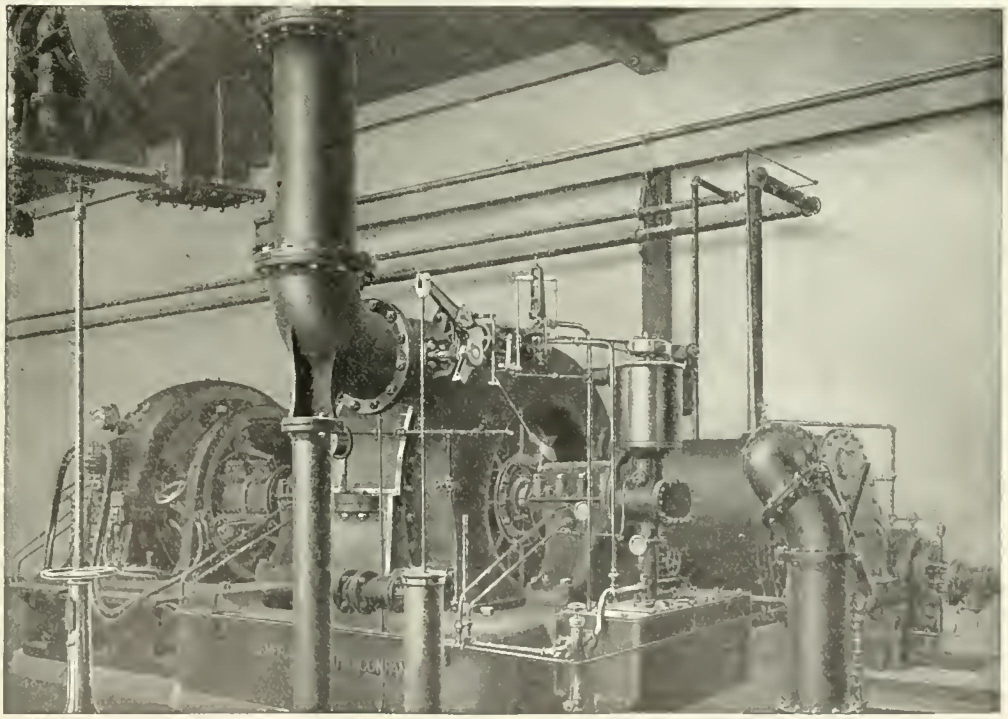
The power equipment at that time consisted of two 100 kw. direct conected high speed tandem compound engine-driven units, a number of hydraulic pumps, and an air compressor exhausting into one header, making an ideal arrangement for connection to an exhaust turbine. Having made a study of various turbine plants, the company decided to install a 500 kw. horizontal Curtis turbine. This turbine was put in operation in September, 1909, and has been in service for about fourteen hours a day since. It supplies all electrical power required by the plant, which at present amounts to 250 kw. average load; this power being used mostly for the operation of cranes, the lighting of shops, and for lifting magnates. When machinery now under construction is completed and installed, the load will be increased to about double.

The main steam supply is derived from the exhaust of the hydraulic pumps, but owing to the fact that these pumps are subject to interrupted service, due to breakdowns on the system, other means of supplying steam had to be provided, and a connection was therefore made from the exhaust header to the high pressure steam pipe through a 4 x 8-in. Foster pressure-reducing valve. By means of this connection the required amount of steam to keep the turbine in operation is secured. This arrangement works very satisfactorily, as the valve operates within a range of one-half pound drop in pressure. The average back pressure is about 3 lbs., and to take care of an excessive back pressure, the exhaust header is provided with a 12-in. relief valve set to operate at 5 lbs. pressure. All steam to the turbine passes through an 18-in. two stage separator, which separates all oil and moisture from the steam. A 3150-ft. Worthington condenser is installed, the condensed steam being returned to the boiler feed water heater.

Before putting the turbine in service it was run for a few days under various loads, the generator being loaded on a water box. It was found that sufficient exhaust steam was available to furnish 425 kw. continuously, and as much as 575 kw. for short periods. Six boilers of about 120 h.p. each were in service at that time. The results of the test would indicate that 75 to 80 per cent. of the energy delivered to the engines and auxiliaries was recovered.

The governing of the turbine is very good, as with a load fluctuation of about 500 amperes the variation in potential does not exceed two or three volts. The lighting load consists of enclosed arc, flame arc, mercury vapor and incandescent lamps, all of which are more satisfactory when operated by the turbine than when the engine-driven units carry the load. This improved performance is owing to the better regulation of the turbine.

It is found that the attention required by a turbine generator of the size here installed is not as much as that demanded by one of the engine-driven units. Good results are obtained without the use of a receiver generator between the units and the turbine, as the reducing valve makes up for any deficiency in the steam supply, which might be due, as stated before, to the stoppage of one of the engines or pumps. With this arrangement a sufficient supply of steam (direct from the boilers if necessary), is always assured, thus making the installation fully as reliable as the high pressure engine or turbine, and much more economical than either of these when running non-condensing. The longest continuous run so far made with this turbine has been five days and nights. No shut-downs, due to trouble of any kind with the turbine, have occurred since the turbine was first put in operation, and this company, (Bettendorf), can conscientiously recommend the installation of a low pressure turbine in any place where a sufficient supply of exhaust steam is available for its operation.



LOW PRESSURE CURTIS TURBINE MADE BY THE GENERAL ELECTRIC CO.

Defective Flue Material.

At a recent railway club meeting Mr. H. T. Bentley, superintendent of motive power and machinery of the Chicago & North-Western, talking about the quality of flues, said: "At one time we put an arch tube in an engine and we expected it to last from nine to twelve months, and it did last that long. We put them in now, and if they last a month or two they do pretty well. There must be a radical change in the composition of the metal. It is a serious thing, this flue question, and whether we should use iron tubes that are not iron or steel tubes that are steel is a question in my mind."

It is curious to read of this kind of complaint which people hear repeated at every engine house where flue troubles prevail, and they are nearly universal. There is a standard specification for locomotive boiler tubes which the American Railway Master Mechanics' Association adopted many years ago. If that specification were adhered to, tubes made under it would last as well as they did twenty-five years ago. Why do those having trouble from apparently defective material in tubes fail to have the material analyzed?

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Industrial Accidents.

Industrial accidents in the United States take an annual toll of life and limb far exceeding the killed and wounded in several great military campaigns. The statistics given by the Bulletin for 1908 of the Bureau of Labor, which may be regarded as incomplete because of the failure to fully report these accidents, yet shows a yearly mortality of between 30,000 and 35,000 adult wage earners alone, and the non-fatal injuries inflicted amount to at least an additional 2,000,000. These and other remarkable statements were made by Mr. John Calder, manager of the Remington Typewriter Works, of Ilion, N. Y., when at a recent meeting of the American Society of Mechanical Engineers, he presented a paper on "The Mechanical Engineer and the Prevention of Accidents."

Mr. Calder believes that much can be accomplished by a movement on the part of the profession, which has to deal so largely with the planning and working of industrial machinery. Prevention, not cure, was the theme of his paper, in which he analyzed the causes of such accidents as are regarded as preventable. He described various devices for guarding operatives. Mr. Calder believes that one-third of the present rate of mortality can be eliminated by such devices. The National Civic Federation and the Industrial Safety Association, which have already done much to arouse public sentiment along this line, were represented at the meeting and engaged in the discussion which followed the presentation of the paper.

The causes of preventable accidents are, in Mr. Calder's opinion, chiefly ignorance; carelessness; unsuitable clothing; insufficient lighting; dirty and obstructed workplaces; defects of machinery and structure, and absence of safeguards. Each of these was dealt with in turn, and remedies were set forth. Engineers are largely responsible, for to them usually falls the control of industrial plants, and the matter of safeguarding employees should be made one of scientific study by them.

Under this head of safeguarding, the author exhibited many interesting views of equipment and machinery, showing the use of safety devices on gears, steam turbines, lathes, cotton carders, rolling mill engines, transmission tubes, belts, variable diameter converting saws, log saws, constant diameter overhung saws, calendaring machines, grinding wheels, etc. He also took up in detail the especially dangerous machines and processes which present difficult safeguarding problems for the engineer. Under the first head he enumerated only four, which may be regarded as typical. These are two woodworking saws and cutters; punches and presses; rolling machinery of all kinds where hand feeding is necessary; also emery and other grinding wheels. Dangerous processes are those where the risk to the workman is not purely mechanical, and safeguarding here involves the enforcing of rules, such as never to clean a machine while it is in motion; the placing of machines in locations that will not endanger a passerby; protection of open stairs and gangways, protection of open vats containing chemicals, and of vessels which are likely to burst. The author further recommended the continual inspection of these safeguards, which good and efficient when new, may easily get out of repair and be worse than useless by creating a feeling of false security. He advocated the education of the workmen rather than the prevalence of many "take warning" signs which go unread, and he believed in employers providing first aid in case of accident.

The paper was a thoughtful presentation of this most important subject. It has often been charged that human life is held very cheap in this country, and Mr. Calder's paper is intended to arouse those who have the care of such matters in hand to the full realization of their responsibilities in this year of grace in the twentieth century.

The Efficient Machinist.

An old legend concerning the value to the world of different mechanics says that King Solomon, going the rounds of workmen engaged in building the great temple, asked a mason, "do you make the tools you handle so skilfully?" "No," replied the mason, "the blacksmith makes my tools." The Jewish king then went to every workman about the building and asked the same question; "do you make your own tools?" and received the same answer, that his tools were made by the blacksmith. Then the king declared, since all tradesmen depend upon the work of the blacksmith, the blacksmith is king of all tradesmen.

In modern mechanical manipulations the molder has to a great extent superseded the blacksmith, and the machinist is the workman who does most to make modern machinery and to keep it going. An ancient saying tells that

By hammer and hand
All trades do stand.

But the machinist now comes first, and he should always be skilful in all manipulations connected with the trades. The modern tendency is for a machinist to become a slave to the machine tool to the neglect of the hand skill that ought to be his pride.

Chipping, filing, riffling, scraping, stoning, he should be able to do, because it is necessary sometimes for them to be done where no machine can be used, and if they cannot be done by hand they cannot be done at all. He should be able to plane, to drill, to mill, to turn, and to grind. It is not necessary that he should know anything about hydrodynamics, ærodynamics or electrodynamics; about water wheels, steam engines, air compressors or electric motors; all that he needs to know in order to make him a complete machinist, is how to reduce iron or steel, or any other metal to any shape, and to put the pieces so shaped, into any combination, which anyone requires. All that he knows more than this is of inestimable advantage to him, although it does not constitute him any more of a machinist; but all that he knows less than this, grades him lower in the ranks of his trade. He may be excellent in some one branch, having learned that branch only, but only one branch is but a small part of the trade.

Set a first-class driller, planer, lathesman or milling-machine runner out in the back woods without his machine and he would be powerless before the grim and gaunt wolf hunger for mechanical equipment which haunts new regions.

By-Pass Valves.

Some railway men seem to be under the impression that the by-pass valves, attached to locomotives equipped with piston valves, are more ornamental than useful. The purpose of the by-pass valve is that if, for any reason, the pressure of steam in the cylinder increases to a higher degree than that in the steam chest the by-pass valve acts as a relief valve and opens communication between the cylinder and the chamber inside the valve. Without the use of the by-pass valves, any usual pressure in the cylinder would be equally felt by the rings of the piston valve, and as they are confined in a circular chamber they have no opportunity to yield to extra pressure and before the introduction of the by-pass valve were frequently broken by unusual compression in the cylinder. With the slide valve the conditions are different. Any extra pressure in the cylinder will immediately have the effect of lifting the slide valve from its seat and an equalization of the pressure in the cylinder and steam chest is instantly accomplished without any danger of fracture to any of the parts.

There are practically two kinds of by-pass valves, one in which the relief valve and by-pass valves are all contained in one design. The other, such as are used on Mallet compound engines, has by-pass valves on the low-pressure cylinders and relief valves on high-pressure steam chests. The purpose of these low-pressure by-pass valves is to prevent the injurious effects which would otherwise result from the pumping action of the large low-pressure pistons when the locomotive is drifting. These valves are so designed that they automatically establish communication between the two ends of the cylinder when the engine is running with the throttle closed. They then permit the circulation of free air drawn into the cylinders through the vacuum relief valves on the high-pressure steam chests.

The by-pass valve, where the design is all one, is usually a double disc or two-faced valve, mounted in chambers and bolted to the steam chest or valve chamber. The larger face of the by-pass valve is in immediate communication with the interior of this steam chest or chamber. The smaller face of the by-pass valve is on the side opening towards the cylinder. When the steam pressure in the cylinder is less than that in the steam chamber, as is usually the case, or when the pressure is equal, as is sometimes the case when the steam port is wide open, the by-pass valve remains perfectly still in its place. The compression point occurring as it does near the end of the piston stroke it is not unusual that the amount of steam enclosed may be raised to a much higher degree of pressure in the cylinder than in the steam chamber, and, as we stated before, this is the condition that calls the by-pass valve into action. The extra pressure from the cylinder opens the valve and any danger of rupture of piston valve rings or other attachments is averted.

It is quite possible that under favorable conditions a locomotive may run a long distance without the relief feature of the by-pass valves ever coming into action, just as an emergency valve is seldom used on the air brake. It will frequently be noted that taking off the covers of the by-pass valves, the relief valves seem glued to their places and it is sometimes difficult to move them from their positions. With the covers removed and a pressure of steam in the boiler a slight opening of the throttle valve will start the by-pass valves from their seats with a degree of suddenness that will leave little to be desired. It need hardly be added that it is essential to good practice to keep the by-pass valves perfectly fitted to their seats. Their circular form lends itself readily to fine fitting, a few rubs of fine emery and oil at intervals will retain their adjustment unless the seats or faces receive injury from some causes other than their limited service. It may be added that an extra amount of compression in the cylinder usually arises from a distortion of the valve gearing, or from a defect in the organic construction of some of the parts.

Misery from Scarcity of Roads.

The scarcity of roads of any kind and the almost entire absence of good roads has paralyzed intercourse and stunted the growth of business in many parts of the American continent, but our means of intercommunication in very sparsely settled districts have never been so restricted as they used to be in India. When England became the dominant power in India, probably there never was a country with a people so rich and intelligent in which roads were so few and travel so difficult. For the rich the camel, the elephant, the horse and the palanquin, for the poor the pony and the pack-bullock were the only means of conveyance by land. Springless wheeled carriages called ekkas, drawn by horses and ponies, and bullock carts could generally be used on a few of the main roads that might be enumerated on the fingers of one hand or in the neighborhood of populous towns.

In the Southwest of India from November to June small bullock carts could travel in certain districts on what have been called the "natural roadways of the country," otherwise in ruts, formed in black cotton soil, which after two days rain became a morass, impassible for horses, difficult for bullocks and buffaloes. Such was the distress of these animals when trying to drag the only vehicles of transportation, that they sank under their burdens and their bleached bones whitening the route acted as landmarks to travelers. Over thousands of square miles wheeled carriages were unknown and had never been seen by the oldest inhabitant. Merchandise was mostly carried on buffaloes, camels and packed bullocks. Grain merchants and other dealers in agricultural products paid merely enough to keep the producers above starvation.

In some places grain would be almost valueless, while less than a hundred miles away the people would be starving owing to the scarcety of food.

After a time the English Government of India proceeded to make roads and their labors greatly mitigated the misery that previously existed through want of easy means of intercommunication. Until railways were built there were always famines in certain districts. but these causes of misery have now ceased.

Improvements in Signaling.

In a paper written for the *Electric Journal* by Mr. J. S. Hobson, assistant general manager of the Union Switch & Signal Company, he says: In general the progress in signaling has been along the line of developing designs already in use. This has been the case rather than in making any radical changes in existing devices or even the marketing of new apparatus.

As an example of this the interlocking and signal installation for the new terminal of the Pennsylvania Railroad in New York City, while it is the latest development in railway signaling, it differs little in general principles from similar plants installed during the past five years. The most noteworthy features of this installation are the means used for obtaining the positive control of interlocked signals by the actual position of the switch they govern; the automatic control of such signals by track conditions; the automatic locking of all switches in every route by the entrance of trains thereon, and their automatic release immediately the rear end of a train has passed clear of the fouling point of the track including each switch. The special features further comprise means for giving visual indications to the towerman of every act of a train in actually locking and releasing levers controlling switch and signal operation, and means for permitting the joint use of all tracks for traffic in either direction between adjacent towers, by the co-action of towermen and track conditions.

All these are developments of methods previously used. There is, nevertheless, one original improvement in the Pensylvania Terminal installation, and that is the control of electro-pneumatic valves through magnets actuated by alternating current. The use of alternating current for the operation of signal apparatus has been steadily growing for the past seven years, and the twelve-month just passed represents a more rapid growth of its use than any previous year. Alternating current was first used in signal apparatus for the operation of track circuits on electric railways, employing either alternating or direct current for propulsion purposes, but now its use has gradually been extended to the operation of signals, indicators, locks, etc.

The only other striking improvement in signal apparatus has been the development of the electro-mechanical interlocking system, in which the switches and their locks are operated manually and controlled electrically, the signals being electrically operated. This system possesses the combined safety features of manual and power operated interlockings at a cost about midway between the two.

Numerous minor developments in products have been made during the past year, as, for example, the improving of insulation in electrical material, the standardization of details to fit them for more universal application, and the modification of designs to cheapen the cost of production and expedite delivery of orders, among which may be mentioned the substitution of drop forgings for parts previously made of malleable iron. As an example of the improvement in the design of electrical apparatus, porcelain and insulating molded material has been substituted, in many instances, for parts previously made of metal and insulated from their electrical connections by bushings and washers.

The Radius of Gyration.

A correspondent has recently asked us to explain the meaning of the expression "radius of gyration," which is used in engineers' pocket books in connection with the strength of pillars and struts. Last month on page 70, we endeavored to give a brief, popular explanation of the expression "moment of inertia." The student having found the moment of inertia by any one of several means, may now find the radius of gyration by dividing the moment of inertia by the area of the section and extracting the square root of the quotient so found. This is one of the easiest ways of getting the radius of gyration for a particular shape, but it does not give a hint of what the radius of gyration is or what use it is when one has found it.

Last month we showed that the moment of inertia was a mathematical expression which indicated the relative strength of one section as compared with another when the disposition of the material composing the section was alone considered. The moment of inertia is used in connection with beams, and the radius of gyration is a somewhat similar mathematical expression used in connection with pillars and struts, in which the disposition of the material or the form of the section is alone considered.

In order to understand what the radius of gyration is, we may first define the center of gyration as being that point in a revolving body such that if the entire mass of the body was concentrated at that point, the moment of inertia would be the same as in the original body with regard to a given axis. If a bundle of feathers weighing 1 lb., revolving about a center were suddenly replaced by 1 lb. of platinum at the center of gyration, the angular velocity would be the same, or, in other words, the momentum of the body would be centered at that point. The radius of gyration is the distance from the center of revolution to the center of gyration. This is what the expression means, but the radius of gyration when used in connection with the resistance to bending of columns indicates the strength of the section, due to the arrangement of the particles in it, be they iron, steel, or other material.

A beam can only bend in one direction as the load is usually carried on top of it. A column may bend in two ways, either in what we may call a north or south direction, or in an east and west direction. The radii of gyration for these two directions differs if the shape is not symmetrical about two axes. For example, take a 7-in. Pencoyd channel, placed with the flanges pointing north and south, and the web east and west. Such a structural shape when used as a column, has an area of 2.86 sq. ins., and weighs 9¾ lbs. to the foot. It has a radius of gyration of 2.73 with reference to the north and south axis, which is in the center of the shape and parallel to the web. This same shape has a radius of gyration of 0.50 with reference to the east and west axis, which is parallel to the web. In other words, it is easier to bend the channels, when suporting a load, along the web than across the web. In this instance it is more than four times (to be exact, 4.84 times) easier to bend the channel along the web than across it, and this is indicated by the different radii of gyration for the two axes.

The lesser radius of gyration is the one always used in calculations for the strength of columns, because it shows the column at its weakest, and therefore gives the full margin of safety for that shape. A square column 2 x 2 ins. has a radius of gyration of about 1.73. The same amount of metal disposed in a hollow square column has a radius of gyration of about 2.64, so that the square hollow column of same weight per foot, is more than one and one-half times, or is 1.526 times stronger as far as shape goes, than the solid column. When it comes to determining the ultimate strength of the column the formula for the resisting moment of the column is made up of three factors; first, the fiber stress, by which one is compelled to determine the material to be used in the column, and the allowable tensile or compressive stress for the material so chosen. Second, this fiber stress is multiplied by the least radius of gyration, and the product then divided by the distance of the outermost fibers from the neutral axis. The allowable fiber stress determines the material, the radius of gyration gives the value of the form due to the disposition of the metal.

Views On the Rate Question.

It is not an easy matter to harmonize the views of shippers, railway officers and bondholders, employees and the general public on the question of railway rates. Indeed, these views will probably not be entirely harmonized by any amount of statement or argument, but a quiet and rational survey of some of the salient points in the discussion may not be amiss in a magazine devoted to the consideration of mechanical department practice and engineering and scientific problems.

The principal contention of the shippers appear to us to be that they object to increased rates because they do not think the railways have stated their position with sufficient accuracy, and that if the railways exercised more care in their expenditures, by instituting more scientific management and greater efficiency, they would not require the higher freight rate, or at least not as much of it as they ask for. The shippers say ineffect that the railway contention is that the rapid development of certain freight business has demanded a greater outlay in handling by the roads, and that the increased cost of operation due to increase of wages on the roads and increased cost of material used in construction by the roads has to be met by increased freight rates. The shippers reply to this by saying that the increase of operating cost, which applies alike to passenger and freight traffic, has to be borne by the freight traffic alone.

In other words, the shippers contend that a 100 per cent. burden is to be borne by a business that produces 15 per cent. revenue. The shippers also believe that class rates on through business, which the roads claim has heretofore been too low, is not too low, but is a case of bad classification. They point out that a pair of patent leather shoes which will retail for from $8 to $18 is carried at the same rate as a pair of woman's brogans which retail for $1, and that a suit of oiled clothing is carried at the same rate as a case of ribbons or laces or silk stockings.

On the other hand the railways claim that they are entitled to protection of property from hasty and ill-considered legislation which hampers them or reduces their earning power, and they ask for freedom from interference with their business methods so long as they are clean and honest.

The utterances of a railroad president in the West amounts to this: "The railroads," he says, "do not want to be above the law, and they accept reasonable regulation of rates as a settled policy of the government, but," he asks, "by what authority do State officials proclaim that the railroads are earning too much, and that rates must be reduced? What experience have they that justifies them in assuming without investigation and without knowledge, that rates are too high?"

The people, he believes, are giving more thought to the railroad question now than they ever did before. That is a favorable sign. When the people give attention to both sides of a problem, they become more liberal in their views. Heretofore, only one side of the railroad question has been exploited, and that is the anti-railroad side. The people, therefore, were prejudiced without any desire to be prejudiced.

The vast sums which might be expended in what are called betterments have been reduced and in some cases entirely withdrawn, and the betterment work abandoned by reason of the fear entertained by railroad managers and those from whom they must obtain the necessary loans would not be willing to lend, or that having made the improvements they would be prevented by hostile legislation from reaping the benefits to which they were entitled by the lavish outlays, which not only increased their capacity but put bread into the mouths of many workmen throughout the length and breadth of the land.

As far as the capitalization of the railroads is concerned, another railroad president has stated that in his belief a fair valuation of all the railways of the United States would exceed their capitalization. He further goes on to say: "If a valuation were made of all the railways in the United States it would include all the expensive railways built in the Rocky Mountains, in the Sierra Nevadas, and in the Alleghenies, etc.; all the expensive and valuable bridges across the large rivers, all the large terminals in San Francisco, on Puget Sound, in Kansas City, Chicago, Philadelphia, New York, etc.; and all the two-track and four-track lines in the territory east of Chicago and north of the Ohio River, in which no valuation has yet been made, except that in Michigan.

"Citation of these facts ought to be sufficient to show why railway managers have no fear of the results of any valuation of railways that may be fairly made. When they have opposed physical valuation it is because they do not believe it would be of value in fixing rates. They are confident that it would demonstrate that it would cost many hundreds of millions of dollars more to reproduce the railways of the United States than they are capitalized for."

Lastly we come to the opinion of the operatives as voiced by a well-known labor leader, though he is not a railroad man but one who has not kept his eyes shut to the railroad situation. Without expressing any opinion on the subject we quote from his, and from these other opinions as given in the public prints. He says: "I have seen enough of the American railroad man at his work to be thoroughly convinced in my own mind that he is a good, efficient, loyal workman. I am now speaking of men as they appear in general. I am not a bit impressed by a general charge that the union men accomplish less than railroad men used to accomplish in the good old times that are beyond careful comparisons. I am inclined to think, man for man, that the men of today are just as willing as they used to be, that they are like typical workmen have always been, ever even too inclined to take a hearty personal interest in the affairs of their employers and pride in their work when they are allowed to take a pride in it, regardless of the wages."

The whole question requires only the exercise of a little common sense. We all want the country to prosper. It can only do that by the steady maintenance or growth of adequate business. The railways are a most important factor in the problem, and the unnecessary hampering of our transportation facilities is like the withering touch of a hostile hand on the sensitive plant. It does not destroy the plant, but it causes a temporary shrinkage and fading of leaves and buds, which require a more or less protracted period for recovery, and a forced expenditure of energy to regain the normal condition where leaves and buds may again drink in the sun's rays and grow and thrive again.

General Miller on Mr. Brandeis.

General Charles Miller, chairman of the Board of Directors of the Galena-Signal Oil Co., Franklin, Pa., has written a most analytical reply to Mr. Louis D. Brandeis' widely circulated assertion that the railroads could save one million dollars a day by adopting scientific management. The ideas of scientific management conceived in ignorance would try to put heavier work upon the employees who already labor harder than other railway men in any part of the world.

General Miller recommends that Mr. Brandeis begin his work by reforming law practice, the profession in which he has been trained. "It seems to me," says General Miller, "that Mr. Brandeis could be of incalculable value to the people of the United States if he would undertake to bring about an economical management of litigation and I have no doubt could reduce the number of motions that are made from time to time to delay lawsuits and the unnecessary expenses connected therewith. Mr. Brandeis, being so well versed in law, could probably bring about a saving, not of a million, but perhaps of two millions a day for the people of this country. Then again, he would certainly be able to figure out from the knowledge he has acquired from books and by mathematical demonstrations the proper amounts to be paid to attorneys in fees, so that a person entering into a lawsuit will know, that it will be economically administered, based upon Mr. Brandeis' theory, and he can know in advance the amount to be paid per hour or per minute to the attorneys handling his case. People can then go into litigation intelligently and know just what the cost will be. This proposition could be so clearly demonstrated in theory that one could tell exactly the amount of money to be expended and what the cost would be in the operation and management of a lawsuit.

"Some years ago, a gentleman used to talk to the President of a railway about the mismanagement of the road by the General Manager. This man was in the auditing department and could make figures to show how much or what per cent. of the gross earnings should be net, and he demonstrated theoretically on paper that the operating expenses should not exceed 42 per cent., while they were actually costing about 60 per cent. The President of the railway gave the gentleman an opportunity to prove in practice what he had shown in theory, and appointed him general manager, but he was unable to come within 20 per cent. of the actual operating expenses, which he had so clearly demonstrated on paper.

"I believe that Mr. Brandeis could perform a great service to the American people by applying his theories to law practice, because he knows all about it, and I take it that a man who undertakes to instruct other people how to do a thing must himself be well informed and able to educate those under him. If Mr. Brandeis could demonstrate the economical management of a lawsuit, as above suggested, he would be more widely and better known and advertised than he has become by his method of instructing railway managers how to operate railways and save a million dollars a day."

The Twenty-second Annual Report on the Statistics of Railways in the United States for the year ending, June, 30, 1910.

This book has just been issued and appears in a substantial volume of nearly one thousand pages. As a classified analysis of the operating expenses for the period that the report covers, it is the most complete report hitherto published. The tables of traffic averages and balance sheets are also very complete. The work is a model of classification and contains much valuable matter. The reports of the scales of wages paid to railway employees in every part of the country contains a mass of information that cannot be found in any other publication.

General Foremen's Department

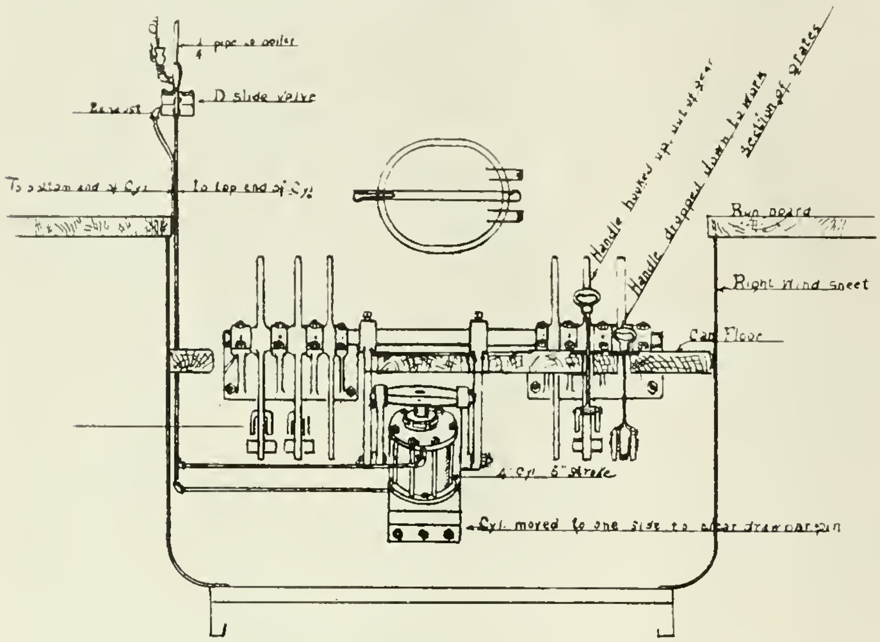
Steam Grate Shaker.

By Charles Markel.

Shop Foreman C. & N. W. Ry., Clinton, Ia.

The blue prints reproduced here show a steam grate shaker that was suggested by Mr. Chadle and designed by me. It was applied to a modern freight engine and did excellent work and was well liked by all the enginemen who used it. The engine was in the pool and was handled by all firemen, young and old.

It is made from old material and the original shaker castings were bolted to back boiler head. I simply made a 2-in. square shaft and turned it up to fit in the castings on back boiler head and squared the grate shaker levers to fit the 2-in. square shaft, and we fitted two levers on this shaft to connect with cross-head on the steam cylinder.



END VIEW OF STEAM-OPERATED GRATE SHAKER.

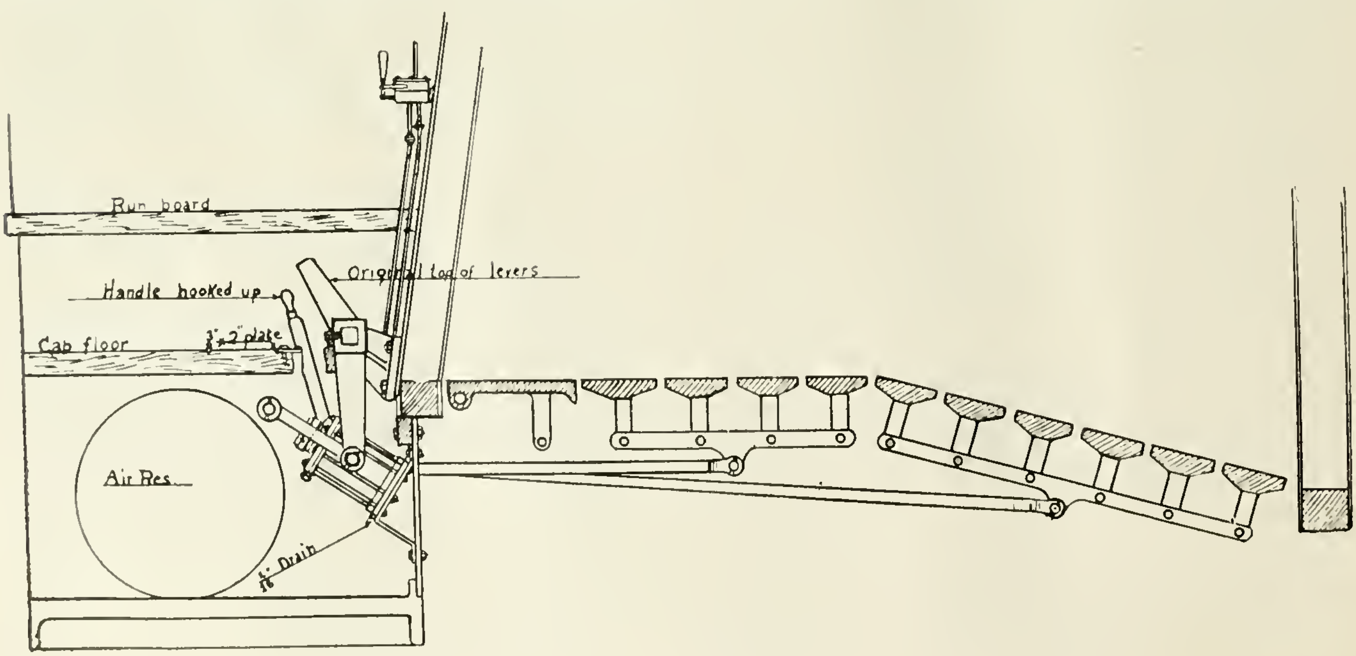
By operating the handle on the slide valve on the boiler head one can apply steam to either end of the cylinder, which would operate all four sections of the grate if the rods were all connected to the lever arms on the shaft. The grates were coupled up in four sections so as to shake at one time. If the operator wished to shake only one section he simply had to raise the rods by moving the handle shown attached to the three sections which he did not wish to shake.

The steam cylinder is located under the wooden deck of engine and is easy to get at when repairs are needed. The drawing gives details of the complete construction, also the slide valve which is used to operate the steam cylinder. This construction does not interfere with the handshaking of grates if the power shaker should become inoperative.

Speed Variator for Planers.

A very efficient adjunct which may be applied to belt or electrically driven planers in railroad repair shops has recently been put on the market by the American Tool Works Company of Cincinnati, Ohio. It has been called a speed variator and our illustration, Fig. 1, shows the machine fully equipped, while Fig. 2 shows the top view of the variator.

Four speeds are obtained by the use of a pair of opposed four-step cone pulleys operated by an endless belt between them, the whole being mounted upon a



STEAM-OPERATED CYLINDER FOR SHAKING GRATE. C. & N. W. RY.

substantial platform on top of the housings. The belt is shifted from step to step and provides a range of speeds intended to fully cover all requirements.

This form of drive has two advantages over the old geared drive, viz., simplicity of design and freedom from destructive vibration. It is also free from the noise and vibration of the gear-driven type. Vibration invariably causes inaccurate work to be done. The new speed variator is free from these defects and insures smooth work.

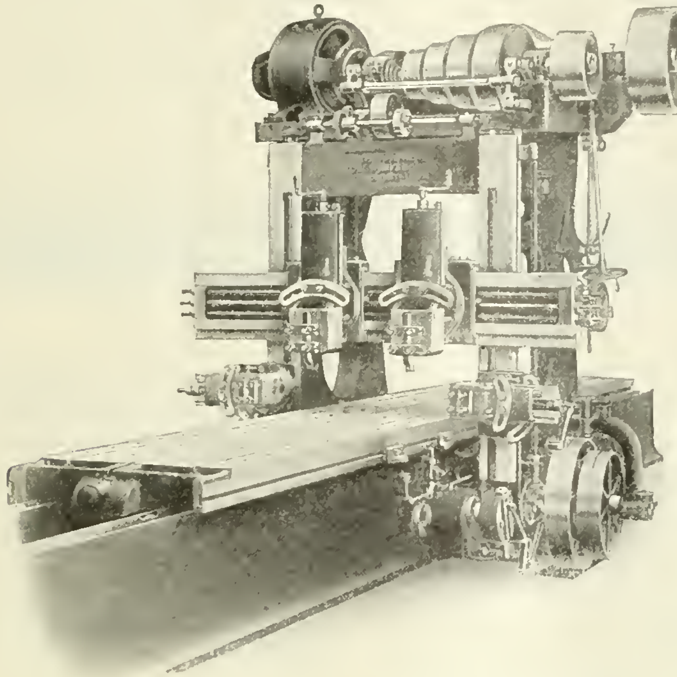


FIG. 1. PLANER EQUIPPED WITH THE NEW SPEED VARIATOR.

The shifting of the belt is novel and very effective. A pair of belt forks are moved alternately along guide rods by means of a pair of cylindrical cams, which revolve alternately through the medium of a set of intermittent gears operated by the hand wheel shown at rear. One revolution of this wheel shifts the belt from one step to another and a stop pin indicates the complete revolution. The cam rolls have spiral slots milled in their peripheries, each belt fork being moved along the guide rods through the medium of a roller operating in the spiral slots. The relation between the cams and forks is such as to shift the belt off the high step of one cone before placing it on the high step of the opposing cone.

Where electric drive is used the motor is direct connected to the variator by spur gearing. A starting box is all the controlling mechanism necessary. Should the motor at any time become disabled, the driving gear on end of variator shaft may be replaced by a pulley, and the planer driven by belt. The tension of the belt is controlled by a vertical lever, operating in a radial slot. This lever is of convenient height and operates a pair of bell cranks through link connections, The bell cranks serve as levers to slide the "driven" cone towards the "driver," thus slackening the belt. This feature, together with the mechanical belt shifting device and the fact that the steps of the pulleys are bevelled on the edge, so as to offer little resistance to the passage of the belt, permits of easily making rapid changes of speed, even though the belt is very wide. After the belt is placed for a desired speed, it is brought up tight by moving the hand lever to the point where tension is sufficient for the work, after which the lever is securely clamped by the binder handle. The driven cone being moved towards the driver, which latter carries the planer driving belts, is a distinct feature, inasmuch as the tension of the vertical belts is not disturbed when making speed changes, and the danger of their flying off, or becoming loose, is overcome.

Speeds can be changed without stopping, with this drive it is far easier to make the changes while in motion than not. Driving pulleys have flywheel rims, the momentum of which reduces to a minimum all shocks to the driving mechanism due to intermittent cutting and at reversing, also insuring a steady, even pull at the cutting.

Cutting speeds can be arranged suitable to individual requirements, but are regularly furnished to provide 20 ft., 30 ft., 40 ft. and 50 ft., with a constant return speed of about 80 ft. Belt drive is regularly furnished by the makers with this variator, the tight and loose pulleys being applied to the rear cone shaft. The drive can be obtained direct from a line shaft, provided it has a sufficient speed, but, slow shafts of about 150 r. p. m., require an intermediate or "jack" shaft. With this construction it is a simple matter to convert the belt drive into a motor drive at any time after the machine is installed.

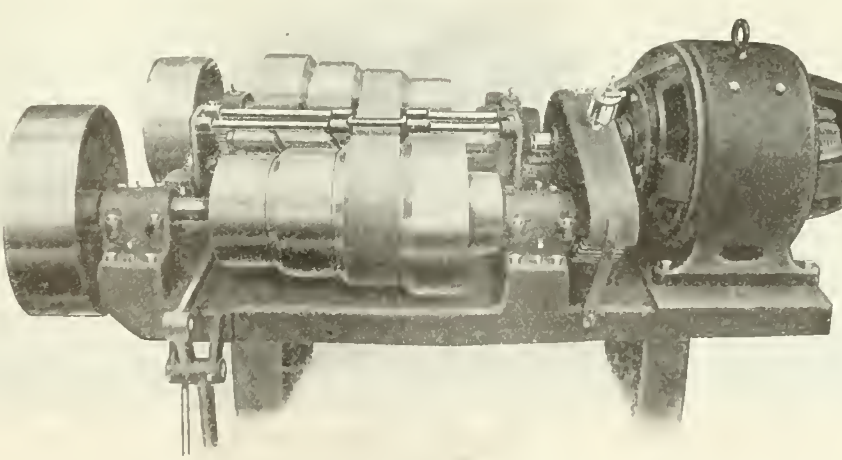


FIG. 2. TOP VIEW OF THE NEW SPEED VARIATOR.

Lathe from Lath.

The word lathe is an extension of the word lath, a thin strip of wood. In the more primitive forms of lathes rotation was given to the machinery by means of a treadle and spring-lath attached to the ceiling. Curiously enough the lath has departed but has imprinted its name on the most useful tool ever developed by human ingenuity.

Good Record Between Shoppings.

The Santa Fe Railroad Employees Magazine for January, 1911 contains among many interesting things an account of the performance of engine No. 1415. This engine made a very good showing between general repairs. One of the points about the good record was the performance of the New Jersey Tube Company's corrugated tubes with which the engine was fitted. We have not been able to secure a photograph of engine No. 1415, but we reproduce one of No. 1414, which is a sister engine. The Santa Fe Employees Magazine when giving an account of the long service between shoppings says:

"Engine No. 1415 was received from the Baldwin Locomotive Works in April, 1906, and went into service on May 1 of that year on the first district of the Albuquerque division, with engineer G. W. Shade and fireman J. L. Fouch in charge. On October 22, 1910, the engine was sent to the shop for general repairs, after making 241,335 miles with one set of flues. Thus, for a period of four years and five months, the engine remained in the care of one engineer and one fireman without having a flue removed. The fireman has since been promoted. During this time the engine turned 15,180,000 gallons of water into steam, which was employed in useful and profitable service.

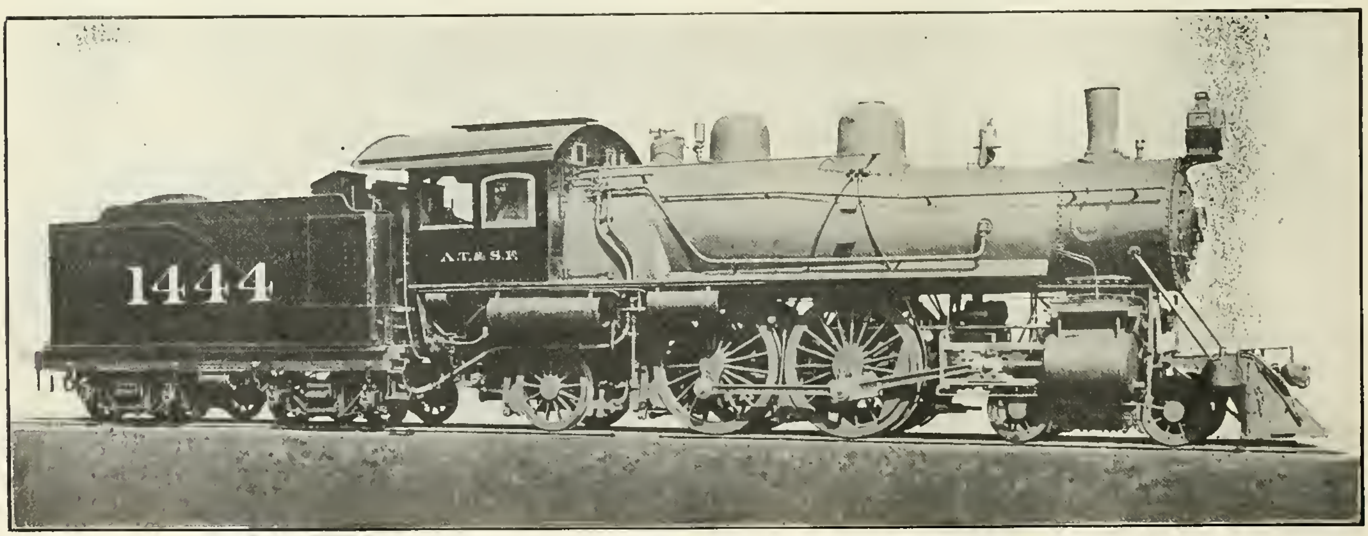
"This extraordinary record is without precedent, the best previous world's record, also made on the Santa Fe, being 227,902 miles, made by engineer Avery and fireman Bazel with engine No. 1402 on the Illinois division in 1909. It is a monument to the untiring efforts and care of two men who knew. It is also eloquent testimony to the efficiency of water treatment as conducted by Mr. W. A. Powers, our chief chemist. The engine ran in a district of treated water. Before the period of water treatment it was only possible to obtain from thirty thousand to forty thousand miles between flue renewals. Efficient water treatment helped efficient operation to obtain results. Back of this period also stands the organization responsible for the care and maintenance of locomotives, with additional credit to the forces under the direction of Mr. S. L. Bean, mechanical superintendent."

We also illustrate, in connection with this record, the New Jersey Co.'s spirally corrugated tubes upon which rest much of the good engine performance. The makers, whose factory is at Harrison, N. J., tell us that the advantages claimed are increased heating surface and evaporation; increased strength to resist collapse; better combustion, by breaking up and retarding the passage of the gases, and forcing them in contact with the walls of the tubes all the way through, and by mixing the gases better; practically no live sparks from the smokestack or in front end; greater stiffness and consequently less vibration and leakage; corrugation, with reduced firebox ends, can be adapted to any degree of draft by changing the "pitch" of the corrugations.

SPIRALLY CORRUGATED LOCOMOTIVE TUBE.

A few of the leading dimensions of the engine are given below:

Cylinders, 15 and 25 x 26 ins.
Valve, balanced piston.
Boiler—Type, wagon top; material, steel; diameter, 66 ins.; thickness of sheets. 11/16 and 13/16 ins.; working pressure, 220 lbs.
Firebox—Material, steel; length, 107 15/16 ins.; width, 66 ins.; depth, front, 75⅞ ins.; back, 67⅜ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, 9/16 in.
Water Space—Front, 4½ ins.; sides, 5 ins.; back, 4 ins.
Tubes—Material, New Jersey Tube Co.'s corrugated boiler tubes; wire gauge, No. 11; number, 273; diameter, 2¼ ins.; length, 8 ft. 10 ins.
Heating Surface—Firebox, 190 sq. ft.; tubes, 3,015 sq. ft.; total, 3,205 sq. ft.; grate area, 49.5 sq. ft.
Driving Wheels—Diameter, outside, 79 ins.
Engine Truck Wheels—Diameter, front, 34¼ ins.
Trailing Wheels—Diameter, 50 ins.
Wheel Base—Driving, 6 ft. 10 ins.; rigid, 15 ft. 9 ins.; total engine, 30 ft. 3 ins.; total engine and tender, 59 ft. 6¾ ins.
Weight—On driving wheels, 108,200 lbs.; on truck, 50,850 lbs.; on trailing wheels, 44,400 lbs.; total engine, 203,450 lbs.; total engine and tender, about 364,000 lbs.
Tender—Wheels, diameter, 34¼ ins.; tank capacity, 8,500 gals.; fuel capacity, 13 tons; service, passenger.



ATCHISON, TOPEKA & SANTA FE ENGINE 1444, SISTER ENGINE OF 1445.

Many Trespassers Die.

Trespassing on Pennsylvania Railroad System's property in violation of the law has caused the deaths of 7,996 people, approximately two a day, since Jan. 1, 1900. In the same time 7,838 people have been injured as a result of trespassing. These facts are brought out in the records up to Jan. 1, 1911. In 1907, when 916 people were killed while trespassing on Pennsylvania Railroad property, the management of that company inaugurated a campaign to educate the public as to the dangers of trespassing. The co-operation of city and county authorities was invited, and wide publicity was given to the efforts the company were making to put an end to this evil, which is annually costing so many people their lives. As a result, the number of trespassers killed on the Pennsylvania Railroad in 1908 was brought down to 743, a reduction of 173, or a decrease of more than 18 per cent. The railroad people redoubled their activities in this matter in 1909, and again the death roll from trespassing was reduced to only 633, or about 15 per cent. There has been a further reduction of 36 per cent. in the last four years, as records for 1910, just completed, show that only 585 deaths resulted from trespassing on Pennsylvania Railroad property.

In waging war on trespassing, the Pennsylvania management have posted the right of way with signs warning people against using railroad tracks as thoroughfares. Division officers have co-operated with their local newspapers in giving publicity to the awful results of trespassing. The general managers of the different lines of the system have been unceasing in calling to the attention of their staff officers the necessity for showing the public that while it is a rare occurrence that passengers on trains suffer any injury, it is equally true that thousands of people trespassing on railroad property in violation of the law are killed every year, or are maimed for life.

Locomotive Running Repairs

XIII.—Guides and Crossheads.

It is not only essential that guides and crossheads should be perfectly true with the center of the cylinder along the entire length of the guides and path of the crosshead when the locomotive goes into service, but it is equally important that as near an approach as possible to accuracy should be maintained during the period that the locomotive is in service. The action of the main crank on locomotives that are usually run in one direction only is to create an unequal amount of wear on the guides and crossheads and apart from the inevitable rapid increase of lost

SINGLE-BAR CROSSHEAD.

motion there is a distortion in the alignment that cannot be rectified by a mere haphazard removal or introduction of an equal amount of liners between the guides and guide blocks.

It may be mentioned at the outset that the original perfectly parallel adjustment of the bearings of the crosshead to the direct path of the piston is a prerequisite that is usually carefully provided for by attaching the piston to the crosshead, and adjusting the surfaces of the crosshead bearings to be planed in perfect parallel with the piston rod. This insures a full bearing of the entire surface of the crosshead bearings, that is, if the guides are properly adjusted. On the other hand, if the crosshead bearings are not in the same plane with the piston rod no amount of tinkering with guide blocks or liners can ever remedy the defect.

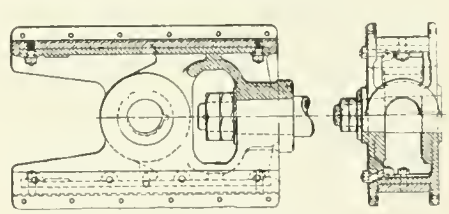
Assuming that the piston rod and crosshead bearings are straight and that the piston is removed from the crosshead, the operation of lining the guides in place should be proceeded with by first ascertaining the exact center of the hole in the crosshead into which the piston rod has been fitted. This may be readily done by fitting a piece of wood into the hole and attaching a piece of tin or copper to the wood and with a pair of hermaphrodite calipers mark the exact center, when found, with a fine center punch. Supposing the crosshead to be of the alligator variety, adapted to run in two-bar guides, the distance from the bottom bearing of the crosshead to the center punch mark may be obtained by extending a parallel strip, or straight edge, along the bearing and carefully measuring the distance at a right angle from the straight edge to the center mark. It should not be assumed that the figures shown on some drawing of that particular class of engine are always exactly duplicated in the work, even admitting that the work may have passed through the hands of the most skilled mechanics. Perfection in mechanism, as in art, eludes and ever will elude the seeker after the ideal. Hence the necessity for repeating our measurements as we proceed from point to point.

Some careful mechanics use a guide gauge, consisting of an adjustable needle slidably engaged on a graduated scale, the lower end of which may be held on the straight edge while the needle is adjusted to the mark. Having obtained the exact distance, a fine line or wire should be stretched through the cylinder and fastened at some movable point beyond the guides. This line should be set by the counterbore in the cylinder. If the counterbore in the back of the cylinder cannot be conveniently reached and the line clearly seen, the line may be adjusted by the stuffing box. In any event it should be borne in mind that on the careful and exact adjustment of this line along the center of the cylinder the complete success of the operation entirely depends.

The lower guide bar may now be clamped in place, and the guide gauge or scale will readily show its location in relation to the center line. While adjusting the guide bar longitudinally to its true position by liners or otherwise, it should be noted that it is perfectly level crosswise. It is good practice to have the guide bar correspond with the upper face of the cylinder. In the case of a locomotive equipped with piston valves, a straight edge laid across the frames will furnish a suitable basis for levelling. It need hardly be said that it would be poor practice to set the guide bar exactly level while the frames might be showing some variation. The guide bar should correspond with the frames, or valve seat base, as the case may be.

It will be borne in mind that in adjusting the bearings of guides and crosshead, almost all kinds of crossheads are furnished with gibs. These form a part of the complete crosshead and should be securely clamped in place while taking the measurement to or from the center, and with guide blocks already in place, it may be found advantageous to place a liner of tin or other metal between the gib and body of the crosshead. In some railway repair shops a standard size of crosshead gib is maintained, the aim being to entirely obviate the use of liners, the gibs being replaced with the standard size when a certain amount of lost motion has manifested itself. This, of course, is a matter of detail generally left to the individual judgment of the superintendent.

Coming back to the double bar guides, when the bottom guide is securely placed, the upper guide should be placed in position and also tried with the gauge or scale, noting that it should be parallel with the bottom guide, which after being properly adjusted becomes the basis of the operation. When both guides are attached it will be readily noted by the use of the straight edge and scale whether the upper guide is centrally located sideways as well as parallel with the central line. The crosshead may be calipered with gibs attached and the



2-BAR CROSSHEAD.

guides so adjusted that the gibs may not require any liners. The crosshead may then be placed in the guides and the gibs put in position and the outer plates attached, care being taken to note that the crosshead moves easily the entire length of the guides. Variations that may occur in the location of the holes on the guide blocks may be readily rosebitted and new bolts fitted, care being taken that the clamps holding the guide and guide blocks together are properly secured against the contingency of moving.

In the older type of engines where four-bar guides are in use the same methods may be employed, the bottom guides being set parallel, longitudinally and crosswise with the line, an allowance of 1-32 of an inch being added to the distance between the bars to allow for lateral motion and avoid excessive friction in the movement of the crosshead. When the bottom guides are properly placed the line may be dispensed with and the crosshead placed in position and the top guides adjusted to suit the crosshead. While the fine adjustment of the four bars is a more difficult task than setting the two-bar guides, they are more readily moved in the event of tightening at some part of the crosshead's movement. A piece of paper inserted at a certain edge of the guide block will have the effect of slightly twisting or even bending the guide the necessary amount to relieve some tightening point in the movement of the crosshead.

A peculiarity in the refitting of guides and crossheads will be noticed by the observing mechanic is that in stretching a line a considerable distance beyond the guides and measuring the distance that the line may be away from the frame, it will rarely be found that the line is exactly parallel with the frame. It will also be found that the lines passing through the two cylinders are rarely, or never, exactly parallel to each other. Original organic defects there may be, arising from the planing of the saddle and cylinder faces. Modern machine shop tools by their sheer weight and massiveness of construction turn out better work than the older and lighter machines. As is well known, cutting tools penetrate metals deeper at the beginning of the cut than at the end. The variation may be very slight, but when a number of planed surfaces are bolted together the variation becomes more apparent. In this connection it may be added that what is known as the fatigue of metals exhibits itself in a slight shrinkage of the metallic molecules that are exposed to varied climatic conditions such as the front of a locomotive experiences, whereas the back end of the cylinders and related parts may properly be said to be less exposed. Whatever of fact or fancy there may be in this theorizing, certain it is that the lines stretched through cylinders at different periods of the working life of a locomotive will be found to vary slightly and always in an outward direction. In this connection it may be added that on finding that the hole in the guide block is somewhat out of line with the hole in the guide, it is sometimes better practice to plug the hole through which the guide block is attached to the guide yoke rather than apply the rosebit to remedy the variation, the fact that the guides frequently are hardened their entire length, thereby rendering the operation of rosebitting impracticable unless a softening process be applied to the end of the guide.

In the case of guides that are set above the center of the cylinder it will readily suggest itself to the intelligent mechanic that the upper guide must first be placed in position and precisely adjusted by the center line to suit the distance from the crosshead center, the lower guide following by calipering and levelling as already described. In the case of the single bar guide the crosshead and guide may be placed in position together and the line stretched through the cylinder and through the hole in the crosshead, the crosshead being readily moved from end to end of the guide as required, and the guide adjusted to suit the requirements of the situation as shown by the line in the hole in the crosshead.

A clever device has occasionally come into vogue in some of the leading railroads in regard to babbitting crossheads. The single-bar guide and crosshead being set in their proper positions apart from each other, the cap and sides of the crosshead forming an enclosed vacant space which is filled with the molten metal, which, when cooled, forms a perfect bearing with just sufficient clearance to make a fine running bearing, requiring no after adjustment until sufficiently worn to necessitate another application of a fresh supply of the molten compound. It need hardly be added that the oilway is provided for by a small rod extending through the cap of the crosshead, which is easily withdrawn when the metal has sufficiently hardened.

In what may be called the lighter running repairs, the lost motion in several varieties of guides may readily be taken up by calipering the space between the piston rod and guide when the crosshead is at the back end of the guide. If the piston and guide are parallel the liners should be placed between the top gib and crosshead cap. In the case of the piston being low at the back a sufficient amount of liners should be placed under the lower crosshead gib to bring the piston parallel with the bottom guide. As we previously stated the top guide will wear more rapidly than the bottom guide on forward-running engines, the impact from the piston in the larger part of the stroke having a tendency to strike hardest on the top guide.

It will also be noted by the experienced mechanic that there is a slight variation in the guides when the locomotive is in running service as compared with their position while the engine is resting on blocks in the shop, the slight flexibility of the metal, massive as it may appear to be, having the effect of slightly raising the back end of the guides. Some claim that this variation amounts to 1-32 of an inch, but it is doubtful if the ponderous frames and attachments of the modern locomotive can be moved as much as that, but it is better practice in adjusting the guides to allow a preference for their being a fraction lower in the back rather than higher. These are among the finer shades of the mechanician's work, and in common practice need not be very seriously regarded.

Boy Inventors.

We sell hundreds of our educational charts yearly to boys, who make good use of them in the construction of working models of locomotives.

The average American boy displays a keen tendency to working out mechanical inventions as a source of amusement. In a recent issue, *Van Norden's Magazine* says:

"Wireless telegraph and the conquest of the air have taken a firm hold on the youths of America, the hundreds of lads of tender years, but advanced ideas devoting their talents to the invention or construction of machines in both these lines.

"While these devices are largely for pleasure, young America has proved his ability to turn inventive genius into utilitarian channels. One of the most remarkable inventions made by a boy is a device for signaling on elevated roads. It is in use on part of the Brooklyn 'L' system, and is the work of Morris Schaeffer, 15 years old, a public school boy. Morris was offered $18,000 for his patent, but on the advice of friends refused it. The boy expects to be able to get $50,000 for the idea from the railroad company.

"Of quite a different caliber is the machine invented by Donald H. Miller, a student at Columbia University. This, by the mere touching of keys, similar to those on a typewriter, translates Chinese into English. It can also be used to translate any other language. The contrivance resembles an adding machine.

"From darkest India comes the record of the achievement of Claude Moore, the son of a poor coal miner. Young Moore, who is 20 years old, was reduced to the sum of 2 cents when he received word from the Patent Office that it had issued a patent on a corn husker. Thereupon Claude, who is a thrifty youth, sold his patent to the harvester trust for considerable real money.

"A most ambitious piece of work has just been successfully finished by Francis Lee Herreshoff, the young nephew of the famous yacht designer. This is the construction of a high-power racing automobile with which has been developed the tremendous speed of eighty miles an hour.

"Herreshoff has also patented a device for subduing the glare of acetylene lamps. The mechanism does away with the necessity of extinguishing the lamps, for it softens the glare, making it hardly more noticeable than an oil lamp."

Turbo-Generator Set.

The Lehigh Valley Transit Company, of Allentown, Pa., has placed an order with the Westinghouse Machine Company, Pittsburgh, Pa., for one 4,000-Kva. turbo-generator set. The turbine is to operate between 175 lbs., 100 degs. superheat and a 28-ins. vacuum, and the generator is designed for 3-phase, 25-cycle operation at 13,300 volts.

Questions Answered

YOUNG'S ROTARY VALVE.

16. C. W., Green Bay, Wis., writes could you give an illustration by diagram or cut of Young's valve for locomotives. It is a circular valve, one for each end of the cylinder. Can it be used with either Stephenson or Walschaert valve gear?—A. Yes, Young's valve can be operated by any of the valve gears now in use. A diagram and explanation of the valve appeared in our paper for January, 1905, page 8.

RADIUS OF GYRATION.

17. Subscriber, Covington, Ky., asks, Will you please explain the expression, radius of gyration in connection with finding the strength of beams?—A. Yes, read article in another column of this issue on the meaning of the expression you ask about, but bear in mind that while moment of inertia (see page 70 February issue) refers to the strength of beams, the radius of gyration refers to the stiffness of columns and struts. Both expressions are the mathematical formulas in which strength due to the form of the structural shape is expressed.

LOADING OF LONG TIMBER.

18. Subscriber, Covington, Ky., writes: When logs are loaded on flat bottom coal cars, what are the rules? That is how high above the sides of the car can the logs extend in pyramidal form, or straight up from the sides? The rules for loading logs are not explicit enough.—A. The rules laid down by the M. C. B. Association for the loading of this kind of material are the only rules there are on the subject. They are to be found in the interchange code which you can get from Mr. Joseph W. Taylor, secretary of the Association, 390 Old Colony Building, Chicago, Ill., for a nominal charge. The best way is to take a conservative view of what the existing rules mean and be governed accordingly, making safety the prominent feature. If you think the rules are too vague bring the matter up in your railroad club and have your ideas discussed and formulated into a recommendation by the club which will be submitted to the arbitration committee. Write to us and express your views; others may give theirs.

EXPANSION OF AIR PRESSURE.

19. J. M., Ft. Wayne, asks: Can you explain to the satisfaction of anyone of average intelligence, why a 20-lb. brake pipe reduction results in the same brake cylinder pressure, regardless as to whether the auxiliary reservoir pressure is 70, 90 or 110 lbs.?—A. The reason is, that the same number of cubic inches of free air, or at atmospheric pressure, leave the auxiliary reservoir in each instance. To make this entirely clear or to prove it by a simple mathematical calculation, it would only be necessary to determine the number of cubic inches of air at atmospheric pressure contained in the reservoir in each instance, and then find the number of cubic inches of atmospheric air that escape from the reservoir as the result of the brake pipe reduction. In 110 lbs. gauge pressure, there is contained about 8.5 atmospheres, or if the reservoir pressure under 110 lbs. was expanded, it would fill to atmospheric pressure (14.7 lbs.) a reservoir 8½ times the size of the one being considered, therefore, to find the number of cubic inches of free air contained in the reservoir, the capacity of the reservoir in cubic inches must be multiplied by the number of atmospheres contained. At 90 lbs. pressure the reservoir will contain about 7 atmospheres, at 70 lbs. pressure, 5.5 atmospheres, and in each case the cubic inch capacity of the reservoir multiplied by the number of atmospheres contained will give the number of cubic inches of free air in the reservoir.

As to the amount of air that escapes from the reservoir during the reduction, if the reservoir pressure is 110 lbs. and 1 lb. escapes, 1/110 of the volume has escaped; if 20 lbs. escape, 20/110 or 2/11 of the volume in cubic inches of free air has escaped. If the pressure is 90 lbs. a loss of 1 lb. means 1/90, and at 20 lbs., 20/90 or 2/9 of its volume; if at 70 lbs. pressure, the loss of 1 lb. will be 1/70 of the volume, or if 20 lbs. loss, 20/70 or 2/7.

Applying this calculation without any further explanation, using a reservoir of 3,000 cu. in. capacity we would have the following, from which it will be seen that about the same number of cubic inches of free air leave the reservoir in each case:

3,000×8.5=25,500	2/11 of 25,500=4,600.
3,000×7 =21,000	2/9 of 21,000=4,600.
3,000×5.5=16,500	2/7 of 16,500=4,600.

PISTON AND D-SLIDE VALVES.

20. J. T., Germiston, South Africa writes: I would like to know which is the more economical, the ordinary D-slide valve or the piston valve; and why on the American built locomotives known as the Mallett class, the h.p. valve is a piston and the l.p. a D-slide. Also what pressure should the low pressure engine register when drawing 1,500 tons. The boiler pressure being 200 lbs., the gradients being 1 in 100 most of the way.—A. The object in using the piston valve for the h.p. cylinders with 200 lbs. steam pressure is that the valve can be more easily balanced when in the piston form. The intercepting valve is set so that when working simple the engine receives 40 per cent. of the boiler pressure and when working compound with the exhaust steam from the h. p. cylinders filling the l. p. cylinders; the latter are only getting 30 per cent. of boiler pressure. These percentages are maintained and are not altered by the character of the work the engine is doing or the amount of the grade upon which the engine is working.

THRUST OF MAIN ROD.

21. H. W., Newcastle, Pa., writes: In traveling ahead from front to back center, does the thrust of the main rod on the crank pin force the driving-box against the wedge and back pedestal jaw. If it does what forces the engine ahead. If it does not take place what causes the driving-box to pound between the wedges?—A. The backward thrust of the main rod does cause the box to go against the back pedestal and the reason the locomotive goes forward under the circumstances is that the pressure of steam on the front cylinder cover communicated to the frame moves the engine forward, while the backward thrust of the main rod at a smaller leverage has a tendency to stop the engine, but this is overcome by equal steam pressure applied through a longer lever arm, the rail being the fulcrum. This subject was dealth with in an article in our September, 1899 issue, page 408.

BY-PASS VALVES.

22. L. H. L., Lexington, Ky., writes: As a subscriber and reader of your magazine I would like to request that you publish an article on "By-Pass Valves," such as are used in connection with the modern piston valves; showing why they are used, what they are for, how to detect them when broken and how to make the necessary repairs.—A. If you will turn to another column in this issue you will find your question answered.

BRAKES APPLYING.

23. J. M., Ft. Wayne, Ind., asks what will cause the brake on an engine equipped with the H6 brake to apply when the handle of the automatic brake valve is placed in release position and allowed to remain there when no leaks can be found in the pipes and the proper pressures are carried?—A. In this position of the brake valve handle, main reservoir pressure is free to enter the brake pipe and pressure chambers of the distributing valve, and when charged the governor stops the pump, then a fall in main reservoir, and consequently brake pipe pressure occurs through the warning port of the brake valve, and the relief port in the neck of the governor. The fall of pressure is quickly restored, as the governor again opens and starts the pump, and this alternate rising and falling of pressure is often sufficient to move the equalizing valve of the distributing valve toward

application position and back to release position upon each variation, especially if the governor is not very sensitive. Each time the equalizing valve is moved, a very small quantity of pressure chamber air may enter the application cylinder, and as the increase of pressure returns the valve to release position, this application cylinder pressure is exhausted into the release pipe, but cannot escape, as the brake valve handle is in release position, and eventually enough pressure to apply the brake is built up in the application portion of the distributing valve. Even if the governor is sensitive and allows the pump to start promptly upon a fall in pressure, a feed valve with a very neatly fitted supply valve piston may cause variations in pressure in the main reservoir and brake pipe when opening and closing to supply the air pressure escaping through the warning port of the brake valve, which is from the feed valve pipe, and the variation of pressure may affect the equalizing valve, as described before, and with the same effect of gradually applying the engine brake while the automatic valve handle is in release position. There is nothing serious about this action of the brake, as it is intended to be applied while the valve handle is in train brake release position.

DISABLED H. P. CYLINDER ON A BALDWIN-MALLET COMPOUND.

24. J. C. S., Clovis, N. M., writes: If one of the main valves on the high pressure unit of a Mallet compound becomes disabled, can engine handle all or part of a train? I believe the low pressure engine would get so much steam that the drivers would constantly slip. I have seen engineers here give up a train on account of all the valve rings in left h. p. valve broken. What do you say?—A. The engine you refer to is probably a Baldwin Mallet compound, and if that is the case, if the valve on the disabled side is intact, it should be securely blocked in its middle position, and the main rod taken down. The locomotive can then be run with one high pressure cylinder and two low pressure cylinders, and under these circumstances no difficulty should be experienced on account of slipping. If however, one of the high pressure valves is broken, live steam will pass direct from the throttle valve through the low pressure exhaust, and thence to the low pressure cylinders. Under these circumstances, the remaining high pressure cylinder will work against a heavy back pressure, while the low pressure cylinders will receive steam at nearly boiler pressure, and the low pressure engine will of course slip. The throttle valve should therefore be used as a reducing valve, that is, it should be opened only very slightly, allowing the steam to wire draw and so reducing its pressure in order to prevent the slipping. The engineer will soon discover how far he can safely open the throttle under these circumstances. When running in this way, the locomotive will develop about half its maximum tractive force.

The rule published in the American Locomotive Company's Bulletin, No. 1,006, refers to a Mallet compound, constructed differently from the Baldwin type. We quote the rule here for the benefit of our readers. It reads, "In case of any break-down, in which one or more of the cylinders can be disconnected and the locomotive run in with the remaining cylinders active, simply throw the emergency operating valve in the cab, into the simple position, and proceed as with a simple locomotive; namely, disconnect and block the disabled cylinder or cylinders. This is the only rule to follow and the only one to be remembered, and covers all cases of accidents which do not entirely disable the locomotive."

STRENGTH OF CYLINDER STUDS.

25. H. W., Newcastle, Pa., writes: A 20-inch cylinder will have an area of 20 x 20 x .7854=314.16 sq. ins., and with 100 lbs. steam pressure will have a total pressure of 31,416 lbs., omitting the counterbore, on the front cylinder cover. This cylinder will probably have 11 or 12 studs ⅞ ins. diameter. A ⅞-in. stud will twist off easily by the use of a 3-ft. goose-neck wrench. They are generally tightened to what they will stand, say within 1,000 lbs. of the breaking point. How do the studs stand the additional steam pressure of 31,416 lbs., or more and how about the factor of safety?—A. We think you have overstated the strain of tightening up the nuts; 12 studs ⅞ ins. diameter would have a total area of about 7⅕ sq. ins. The steam pressure, therefore, puts about 4,360 lbs. on each stud, and at even 30,000 lbs. tensile strength the stud has 25,640 lbs. yet. That is a factor of safety of over 5.

Tightening up the nuts with a 3-ft. wrench a tortional strain is probably introduced as well as the direct pull, which may account for the ease with which studs can be broken and moreover a man putting his strength on a 3-ft. wrench has a leverage on a ⅞-in. nut of about 36 to 1 and as the thread on the stud usually holds less than the fiber of the stud, the thread may be stripped. The steady pressure of the steam is not like the action of a wrench under these circumstances and the threads may not be well cut so that all do hold at the same time, and in tightening up hard the threads give. The nuts on these studs should be tightened only enough to ensure a good steam-tight joint between cylinder cover and cylinder.

Selecting Proper Material.

The Master Car Builder, said Mr. Tewkesbury, at the Central Railroad Club, "when he has troubles with sheared coupler rivets or broken-down bolts, is prone to say it is rough-handling, and the general yardmaster is most likely to get a letter mildly calling his attention to the fact; but an analysis of the iron in the bolts would have surprised the M. C. B., when he found that the trouble was due to red short iron.

"I know of an order placed a few days ago for steel for knuckle pins, and I was asked what grade of steel was suitable for that purpose. This Master Car Builder may, or may not, get just what he wants, but had he been in a position to have specified the chemical analysis of the steel ordered (Vanadium, for instance), he would have been more liable to have received an article just suited to the service for which it is to be used. The makers may not always know what the steel is to be used for, or even if they did they may not be versed on the requirements for that particular service. The order may simply pass through an order department and through the hands of clerks who specify so many tons of soft coal. Possibly some roads do make analytical tests and specify, but I believe the greater number do not, and the cars owned by those who do not, travel from one end of the country to the other, and the painstaking roads are obliged to handle the other fellows' cars, consequently are caused to suffer loss and delay by reason of that other fellow's neglect.

HAVE THE PAINT ANALYZED.

"We have reached a point in the car building when nearly everything is steel, and the proper protection of steel is one of the problems with which we have to deal. I think we all agree that unless the steel is protected with a preserving coating that kept it from the oxidizing effects of the atmosphere, and in the coal car from the action of sulphurous fumes or acids in the coal, that the car will be of a comparatively short lived. Therefore it is a question of paint of the right quality. The same is true of our bridges and other steel structures, without which the cost of maintenance is sure to be higher."

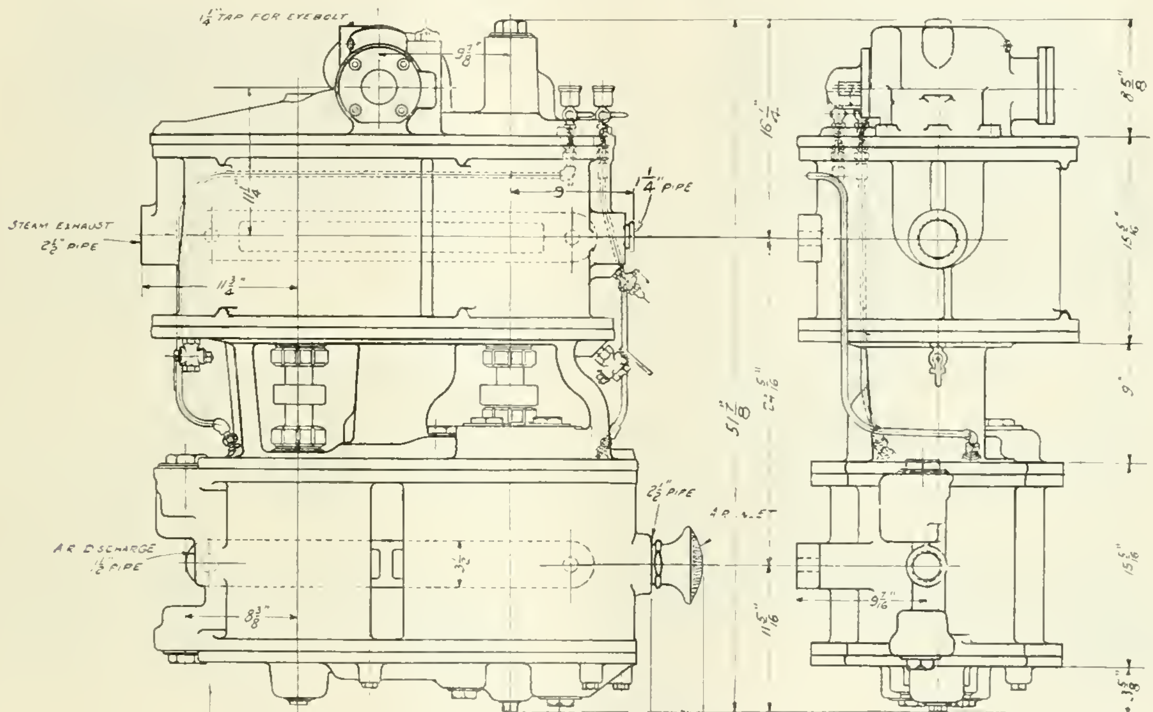
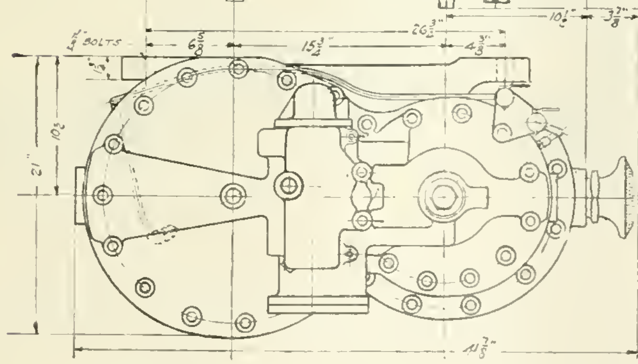
In a big Atlantic liner there are over 1,000 tons of piping of various kinds. The boiler-tubes, if placed end to end, would stretch about ten miles, the condenser-tubes over twenty-five miles. The condensers pump up more than 50,000 tons of water a day, and the furnaces consume about 8,000,000 cubic feet of air per hour. No fewer than 50,000 separate pieces of steel are used in the main structure of the ship.

Air Brake Department

Conducted by G. W. Kiehm

10½-in. Cross-Compound Pump.

The illustrations shown are of the Westinghouse 10½-in. cross-compound air pump. This compressor was originally intended for industrial enterprises, as it is capable of delivering a high air pressure with a comparatively low steam pressure. Such being the case, it is obvious that it is particularly adapted for the types of locomotives using superheated steam, and in some instances is used on locomotives which do not use superheaters.

10½-IN. CROSS COMPOUND AIR PUMP.

The construction of the pump is identical with that of the 8½-in. compressor, but the high pressure steam piston is 10½ ins. and the low pressure steam piston is 16½ ins., as against 8½ ins. and 14½ ins., respectively, with the smaller pump, but the bore of the air cylinders remains the same, low pressure, 14½ ins., high pressure, 9 ins.

From the illustrations it will be observed that the piston valve is used for distributing steam and the reversing gear embraces the usual valve and rod, as with all Westinghouse steam-driven pumps.

The pump is tapped for a 1½-in. steam pipe and a 2-in. exhaust, and under superheat steam pressure the performance of this pump would be as follows, it being understood that superheated steam is referred to only as a basis for steam pressure per sq. in., which is usually about 150 lbs. on this class of locomotive.

With 148 lbs. steam pressure this pump compressed air to 160 lbs. gauge pressure and worked against this pressure at a speed of 130 strokes a minute. With 130 lbs. steam pressure the pump compressed air to 140 lbs. pressure and operated at a speed of 130 strokes a minute.

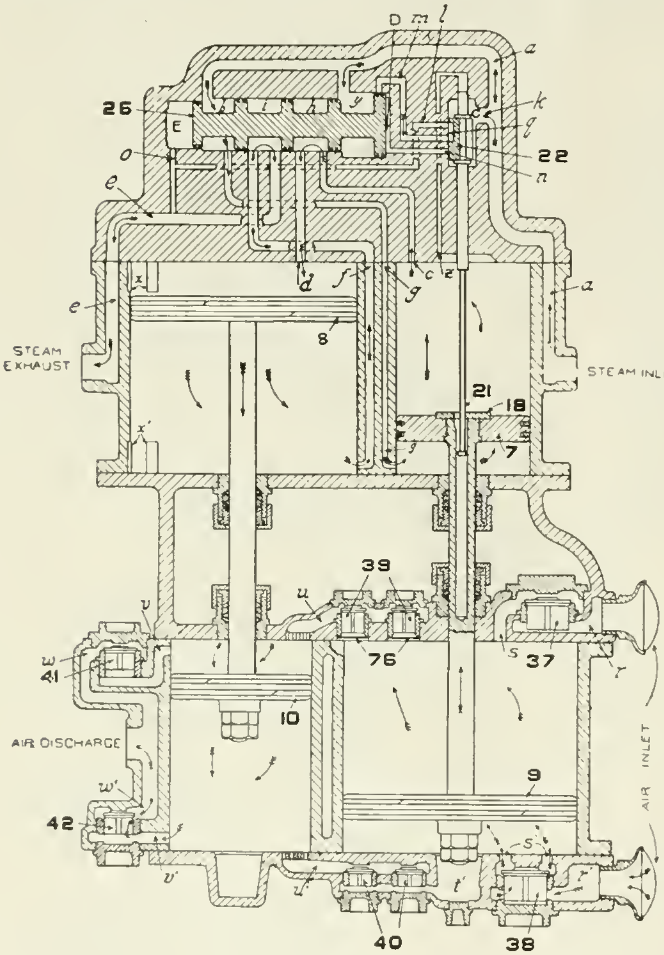
Under the conditions mentioned the pump shows an efficiency of 83 per cent., and when steam pressure falls to 100 lbs. the pump will run at a rate of 128 strokes a minute against 80 lbs. air pressure. The advantages of this type of compressor under low steam conditions is apparent.

Expensive Repair Work.

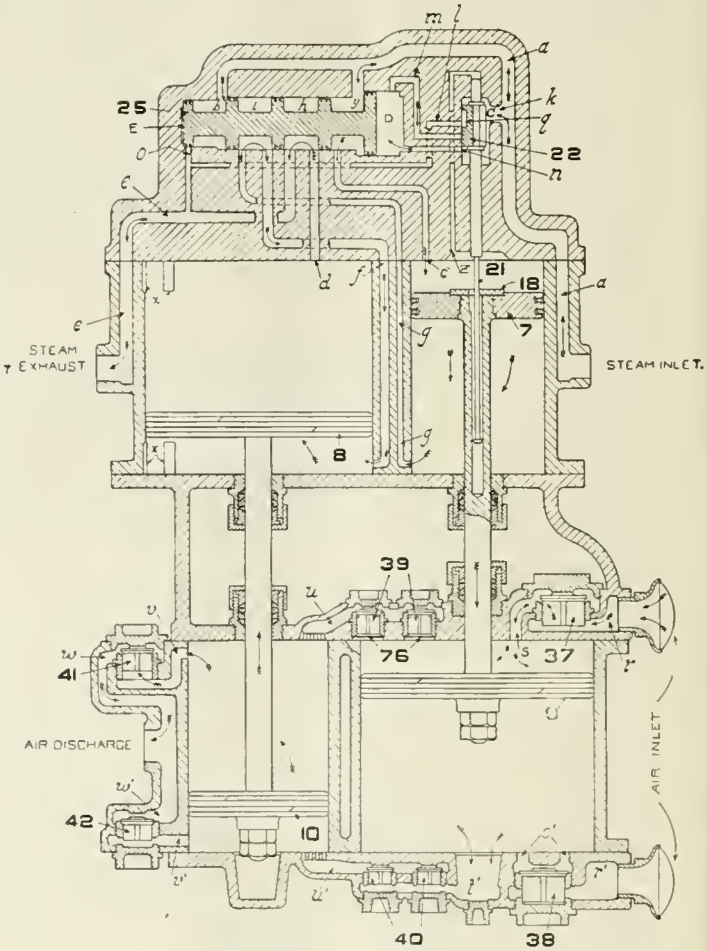
Costly methods and extravagant habits in air brake repair work have been frequently alluded to in these columns, but the fact that economical methods of repair work may be adhered to for a time and then forgotten, makes the subject a live one at all times and all air brake men recognize the fact that the subject is a broad one. An economical system of repair work may be in effect, when a change of repairmen or a change of foremen may upset the entire system and slowly, but surely, the practices of years ago and the job that is "good enough" comes into vogue.

This is particularly true of air pump repair work, especially in the engine house, and instead of giving any detailed account whereby a saving on repair work can be effected we will relate a number of actual happenings without any particular comment, and the reader may judge for himself as to whether it is possible to make an improvement and save a railroad company money in purchasing repair parts for air pumps when conditions tend to approximate those that will be mentioned.

All air brake men have come to realize that it is folly to attempt to carry on air pump repair work in a roundhouse, but when their objections are brought before the proper person, that person sometimes concludes that the air brake man has drawn upon his imagination concerning the amount of money that could be saved annually by entirely eliminating roundhouse repair work on air pumps, hence the reason for placing before our readers an account of the incidents referred to, which have very recently occurred on one of our large railroads.



AIR PUMP, UP STROKE.



AIR PUMP, DOWN STROKE.

In following up a work report of some real or fancied disorder of the air pump on a locomotive, arriving at a terminal, a roundhouse examination of the pump was attempted without first noting its condition with a view of replacing the pump with a repaired one, if necessary, and during the operation the threads were stripped out of the reversing valve chamber of the top head. Now, instead of removing this pump that had become disabled by the attempted examination, a top head was removed from a pump that had been repaired and tested, both operations requiring at least twice the length of time necessary to replace the disabled pump with the repaired one, and during the excitement the valve rod was bent while the top head was put on the pump on the locomotive, and five miles from the terminal the bent rod worked around until the button caught in the offset under the reversing plate and an engine failure was the result.

The return of the engine required another examination and removal of the top head, and a cap nut was lost and another valve rod ruined during this operation, until finally the cost of the material destroyed was as follows: A top head complete tested, at $24; 1 cap nut, at 90c.; 2 valve rods, at $1.15 each; 1 gasket, at 50c., or a total of about $28.

In addition to this is the time lost by the workman, if it takes 4 or 4½ hours, all told, to do what should be accomplished in from 25 to 30 minutes by a change of 9½ in. air pumps, the workman's time is worth from 3 to 4 cents an hour to the company when being paid the standard rate, and the loss to the company is the difference each hour between the 3 or 4 cents and the standard rate. Comment upon the cost of the engine failure and abandonment of train is unnecessary, and it is understood that an argument such as "if competent men were employed this could not occur" is permissible, and it is also understood that it is extravagant and worse than useless to permit air brake work to be done or directed by anyone having no knowledge whatever of size, standard or fit of repair parts, for this occurrence is related for the purpose of showing what roundhouse repair work may result in.

Assuming that the aforesaid loss could have been avoided had the work been in the hands of, or directed by, competent men, we will cite another incident that occurred at about the same time. An air brake repairman sent to "examine" an air pump found an air valve and seat in such a condition that a renewal of both the valve and seat was necessary, but the seat had corroded in the threads in the cylinder and could not be moved with a wrench, whereupon the repairman said the pump should be removed, but he was told to cut out and renew the seat.

Now, the location of the pump and footboard on the locomotive was such that it was a difficult matter to even hit the valve seat with a hammer and chisel, and would have been something bordering upon the miraculous to have cut the seat out without damaging the threads, and in addition to this, and in spite of the precaution taken, a piece of the seat worked back into the air cylinder; however, a new valve and seat was applied, but the piece of steel remained in the cylinder, and there was a bad leak from the main reservoir into the pump past the damaged threads in the air cylinder.

It is obvious that the pump was then pounding and running hot and was removed for repairs at another station, where it was found that the air cylinder was worn enough to require reboring, which was done, and it was also noted that the air piston was ruined, having small pieces broken out of the upper outside edge from having struck the piece of steel in the cylinder, and when the valves in the air cylinder were examined the upper valve and seat on the discharge side were apparently in good condition, and when the pump was finished and placed on the test rack a leak from the discharge valves was observed. A test indicated that the upper valve was leaking, and after it was known to have a good bearing on the seat the valve seat was removed and the damaged threads discovered and the cylinder was removed and thrown on the scrap pile.

The cost of the roundhouse repair job in material was: One 11-in. cylinder, listed at $40; an air piston, at $5, and a valve seat, at $1; total, $46. The time lost was two hours on the boring mill and three hours in removing the cylinder and replacing it after the damaged part had been discovered.

In another instance a pump was reported as having stopped in service, and instead of removing the pump an examination of the main valve and reversing gear was made and nothing was found wrong, and the engine was again allowed to go out on the road, and an engine failure resulted as the pump again stopped and could not be started.

Upon the removal of the pump it was found that a piece had broken out of the lower side of the steam piston which prevented the reversal of the pump. Evidently a small piece had first broken out and stopped the pump, but shutting off the steam had permitted the reversing valve to fall of its own weight, which resulted in an up stroke when the steam was turned on and the following down stroke knocked the broken piece into the extreme outer edge of the cylinder, where it remained until the following trip, when it caused a larger piece to be broken out of the piston, and a pump failure resulted.

Removing the pump in the first place might not have been the means of saving any material, but it would have avoided an engine failure, and the loss of the time consumed in "examining" the pump. However, a repairman's time cannot be worth very much to the company, anyhow, if it is spent in attempting to do air pump repair work in a roundhouse.

These occurrences are mentioned solely for the purpose of showing that roundhouse repair work is not only productive of engine failures, but a terrific waste of material and consequently of time.

If the saving of a few drops of oil is of any advantage financially, surely the saving of costly material should be of some consequence to a railroad company, and if money can be saved on oil, is it not possible to save money in purchasing air brake repair parts when 18 top heads for the 9½-in. pump, 21 air cylinders and eight 11-in. cylinders are consumed in one year at a small station handling less than 40 engines daily? Those heads are listed at $24 each and the air cylinders at $22 and $40 respectively, and as all the moveable parts of the top head work in bushings, which can be forced out and renewed from time to time, it naturally follows that the only way in which a head can be destroyed is by an accident or by deliberately breaking it or stripping out the threads in the reversing valve chamber.

Air cylinders can be rebored until they reach the sizes of 9⅞ and 11⅜ ins., but the manner in which they are ruined is by the threads into which the seats and cages screw being broken and stripped by "examining" valves, especially while the air cylinder is overheated, and by disregarding the Air Brake Association's recommended practice in regard to coating valve seats and cages with a mixture of oil and graphite or plumbago before screwing them into the cylinder, and this applies to repair room work as well.

While it is possible for the pump to be neglected until it becomes overheated to such an extent as to literally burn the threads out of an air cylinder, it usually requires something more than heat alone to entirely destroy the threads. However, the overheating and cooling may warp the cavity in the cylinder slightly, and when a valve cage is forced into the cavity a small piece of the cast iron thread may crumble or break out and imbed itself in the threads of the brass cage, and when an attempt is made to remove the cage, the broken piece remains imbedded in the brass and ruins all the rest of the threads it comes in contact with while being screwed out.

Air pump repair work on the locomotive is certainly a thing that belongs to the past, but so long as those who have any voice in the matter are indifferent as to how or where repair work is done, as long as some effort is being made to follow up the work reports, the repair work cannot be done economically.

It is not difficult to convince the repair man of this fact, but it is difficult to enforce any rules in regard to repairing air brake apparatus, especially where there is no one to go from shop to shop and investigate the methods employed. The average Engine House Foreman's attitude toward the brake equipment on a locomotive has the tendency to create the impression that the brake is a necessary evil kept there solely through the agency of the Interstate Commerce Commission, and naturally his interest in repair work extends no further than getting the engine out on the road, and is confident that the end justifies the means.

Of course, allowances must be made for emergency cases, but every repair job on a locomotive cannot be considered an emergency case, and there is very little common sense displayed in doing a piece of work wrong, under the plea of haste, when it requires more time than it would take to do the work right, in the first place.

If, for instance, a triple valve piston and slide valve can be removed from one triple valve and pushed into another valve body without any regard for slide valve or packing ring leakage, when the entire triple valve could be changed in about the same length of time, there is something radically wrong with the repair work and its supervision, and even if the engine does make a successful trip under such conditions, that kind of repair work makes those responsible for the purchase of expensive triple valve test racks look foolish in the eyes of the uninitiated, as those racks are purchased under the assumption that the condition of a repaired triple valve cannot be determined with the eye. Permitting the repair work to be done in this manner makes it appear to those who know no better, that the test racks are merely an unnecessary expense.

A month very seldom passes in which the celebrated *Literary Digest* of New York fails to publish extracts from Railway and Locomotive Engineering. Although diligent search has been made we have failed to find extract made by the *Digest* from any other railway paper.

Electrical Department

The Direct Current Compound Motor and the Induction Motor.

By A. J. Manson.

(Continued from page 82.)

The direct current compound motor gets its name because it is the result of bringing together or compounding the series and shunt motors. This type of motor has both a series field and a shunt field, wound on each of the poles. Referring to Fig. 5, which is a diagrammatic sketch of a compound motor, the shunt field is connected directly across

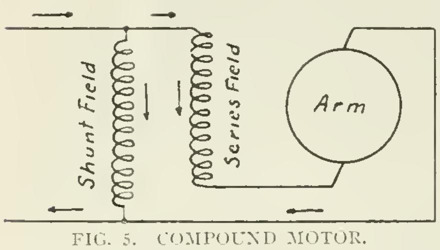


FIG. 5. COMPOUND MOTOR.

the line, as in a shunt motor, and the series field is connected in series with the armature, as in a series motor. Having both of these types of motors combined into one motor we should expect that the characteristics would be a combination of the two motors, and this is true. The shunt field is constant in value, with same pressure or voltage at the terminals of the machine; the series field varies with load, or work the motor is doing. Therefore with this type of motor when starting up against a heavy load, the motor will run as a series motor, at a very slow speed, economizing on the electric power, and will accelerate or increase in speed rapidity. As the speed increases the series field will grow weaker, with the drop in amount of current, and the shunt field remaining constant will begin to predominate, so that on light loads the motor will be like a shunt motor, running at constant speed. Thus we can say that the advantages of this motor are many. It has all of the best qualities of a series motor, i.e., a slow speed with heavy loads and large starting pull, without excess power required, and it has the best quality of a shunt motor, i.e., constant speed. This motor will not run away when the load is taken off.

The general arrangement of wiring is shown in Fig. 6. Compound motors are used principally for elevators. The requirements of an elevator are to start up against a heavy load, increase in speed rapidly, and then run at a constant speed. A compound motor is just suited to fulfil these requirements. Usually the motors used on this class of work are arranged so that after a certain speed is reached, the series fields are cut out of the circuit and the motor runs as a shunt motor and at constant speed. Compound motors are also used for planers, shapers and other reciprocating machine tools, where at the instant of reversal a sudden increase of power is required, and where heavy loads are thrown on suddenly.

All of the above mentioned motors may, under certain conditions, and when operating with heavier loads, higher pressure or voltage, and higher speeds than built for, show sparks and flashes at the carbon brushes. These sparks heat up the commutator and in time will cause pitting and blackening, so that it will be necessary to put the armature in a lathe and turn down the commutator to a smooth surface. If these conditions are carried too far, flashing may occur which will cause the motor to "buck-over," i.e., the flash will extend from one brush around the commutator to the next brush, and the motor may be damaged greatly.

In order to increase the limit of operation of the motors over a wide range of current, voltage, and speed, small field poles, on which are wound turns of wire connected in series with the armature, are placed between the main field poles. These small poles are called interpoles and motors with these interpoles are called *Interpole Motors*. Fig. 7 shows the position of these poles and how they are connected for a shunt motor. Interpoles are also used on the series and compound motors.

It has been only a few years since the interpoles were first used, but now they are very common and are used extensively on motors for machine tools, elevators, presses, etc., and on service where a wide range of speed is required. A motor can be built to suit almost any condition of service, but any great change from this makes what is called an unstable condition, and the motor will flash. In machine tool practice where many speeds are required for one machine over a wide range the interpole motor is essential for satisfactory operation. The interpole has also been embodied in the railway motor for street cars, multiple—unit trains and electric locomotives. The railway motor has very much more severe work, under much worse conditions, than motors in a machine shop. They are subjected to dirt and may be interfered with by moisture, vibration and voltage surges.

A surge is a higher voltage than normal on the third rail, which travels momentarily and with decreasing power for some distance from the point where it began. Surges are due to many causes, and among the most common may be mentioned the sudden throwing off of the power from the train, the "bucking-over" of a motor and a flash from the third rail to ground. A surge is analogous to the pound in a water pipe which occurs when a valve is suddenly closed. This momentary rise in voltage, amounting perhaps to twice the third rail voltage, will be impressed on all the motors in the vicinity of the trouble, and will probably cause many motors to "buck-over." Almost all of this difficulty and trouble, due to surges, is eliminated by the application of the interpole to the railway motor. The motor will last longer and will require less attention and repairs.

The induction motor is the most common type of motor for use with two or

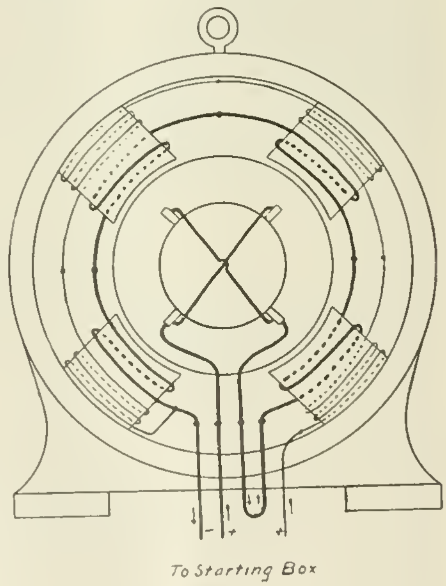


FIG. 6. COMPOUND MOTOR.

three phase alternating current. This motor consists of two parts, the stator or stationary part, also called the field, and the rotor or rotating part sometimes called the armature. The stator has coils of wire placed symmetrically around the inside of the frame in slots, and these coils are connected to the electric power supply. The rotor also has coils in slots, but there are no connections to the power circuit.

The principle of the induction motor

depends on Lenz's Law, which in substance is as follows: If a magnet or field is passed by near a coil of wire there is induced in this coil a current which exerts a drag on the magnet or field tending to pull the same back. It is this induced current which makes the motor work, hence the name induction motor. Although the windings around the frame

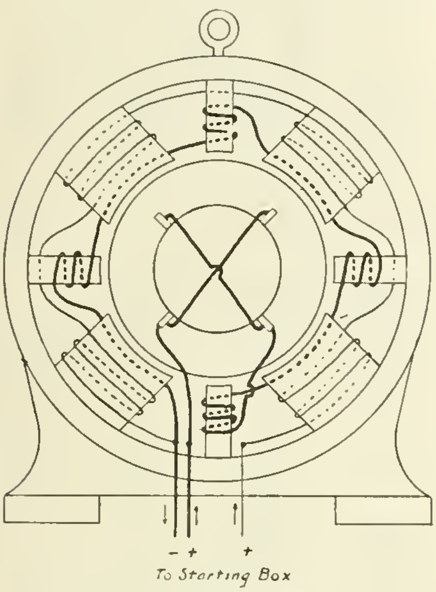


FIG. 7. INTERPOLE MOTOR.

of the stator are equally distributed mechanically, they are grouped electrically into a certain number of sets, according to the number of poles of the machine. Fig. 8 shows the scheme of connections for the stator of a four-pole, three-phase induction motor, and there are around the stator twelve groups, each consisting of six coils; one group for each pole per each phase.

Alternating current does not give a constant force like direct current, but changes in value. Starting at zero value it reaches a maximum, then decreases to zero again, and reverses to the maximum and back to zero, all in a fraction of a second. This change from zero back to zero is called a cycle, and a twenty-five cycle current is one in which there are twenty-five of these cycles per second. It is similar to a locomotive where the steam first pushes the crosshead, then pulls it with varying force and which is zero at points of reversal or ends of the strokes.

In a three-phase circuit the current is not a maximum in all three phases at one time, but at different times, and is similar to three cranks on an engine shaft 120 degs. apart, each connected to double-acting cylinders. Taking this fact regarding three-phase alternating current and referring to Fig. 8, there is at a certain time four-poles or fields, the centers of which are under the groups a, a, a, a, when the current in phase A is a maximum. This corresponds to one of the three cranks exerting its maximum thrust. Due to the change of value of the current in the different phases in the next fraction of a second, the centers of the poles have moved under groups b, b, b, b, as the current in B phase increases and that in A phase diminishes, which corresponds to the No. 1 crank passing by the point of maximum thrust and No. 2 crank coming into the same position. The centers of the poles will next be at c, c, c, c,; and due to the reversal will next be at a, a, a, a, again, and will continue around the stator winding, keeping the same distance apart.

The speed at which this electrical rotation takes place in revolutions per minute depends on the number of poles of the motor, and on the number of cycles per second, or frequency, of the alternating current. The revolving field passing by the coils on the rotor, induces a current tending to stop this rotation of the field or poles. As the poles cannot stop, and the stator winding cannot move, the rotor is dragged along. When the motor is not doing any work the speed of rotation of the rotor will be the same as the speed of the field or poles around the stator. The formula for obtaining this speed is:

$$\text{rev. per min.} = \frac{2\ f\ 60}{p} \quad \text{where}$$

f = frequency of the circuit (cycles per second),

p = number of poles.

When load is put on the motor the rotor does not run as fast as the field rotates in the stator (which remains constant for constant frequency of the current) and this difference in the two speeds is called the "slip." The slip, starting torque, and current taken from the circuit, depend on the resistance of the rotor. The greater the resistance the greater the slip and the starting torque, and the lesser the current within the limit of maximum torque obtainable from the motor.

The rotor of the induction motor can be designed with a very low resistance so that there is very little slip between no load and full load, and the motor has speed characteristics similar to the shunt motor. A motor designed in this manner is called a constant speed induction motor. This type is used where the power required is nearly constant, and where continuous service is required, such as for driving shafting, drills, blowers, compressors, circular saws, etc.

Resistance of various steps can be inserted in the rotor, by connecting the windings of the rotor to three small rings pressed on the motor shaft just inside the bearing, and by means of brushes, pressing on these rings the induced current is passed through an external stationary resistance. Different speeds can be obtained by designing a resistance having different steps, and there will be a different speed of the motor for each resistance. A small induction motor can be connected direct to the line without trouble, but when starting a large motor the above method of inserting resistance in the rotor is used, as otherwise there would be a great amount of current required. By this method the induction motor can be applied to the same classes of work as the compound motor. Motors with external resistance are used where frequent starts are made and where the power or speed required at the machine varies greatly, such as for elevators, hoists, planers, etc.

Compounds for the C. M. & St. P.

We are able to place before our readers this month an engraving of, and some facts concerning the Mallet Articulated Compound engines for the Chicago, Milwaukee & St. Paul Railway, which were built by the American Locomotive Company. There were twenty-five engines in the order and they are to be used both in regular road service and also as pushers. Some of the engines are in service on the Chicago, Milwaukee & St. Paul Railway, and some on the Chicago, Milwaukee & Puget Sound line of that system. In pusher service, one of their duties will be to assist passenger trains over heavy grades on the mountainous divisions. The heaviest grades on either of these two roads are 2.7 per cent. On this gradient, the engines have a theoretical hauling capacity, based on 5 lbs. per ton frictional resistance for cars, of 900 tons at a speed of 6 to 8 miles an hour. On a

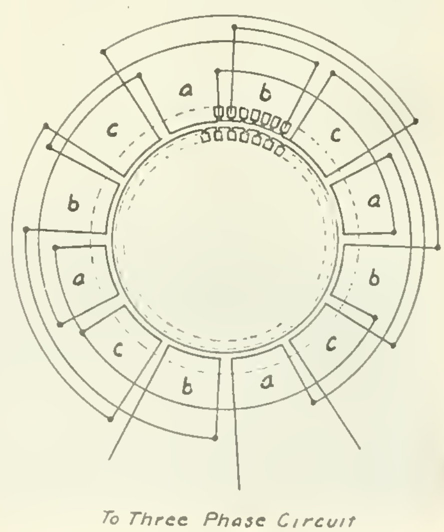


FIG. 8. INDUCTION MOTOR WIRING.

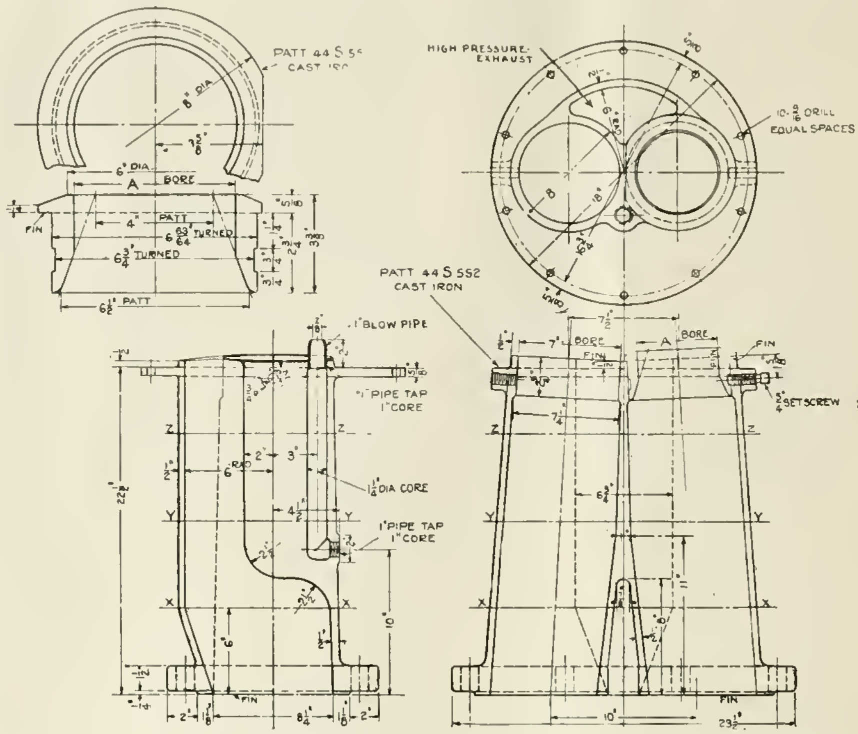
1 per cent. grade, their capacity on the same basis and at the same speed is 2,575 tons. Seventeen out of the twenty-five ordered are equipped for burning coal, while in the remaining 8, will use oil as fuel. The oil burners will be run on the sections traversing the Idaho Forest Reserve.

In design, these engines are very similar to the twenty-four Mallets built for the Chesapeake & Ohio Railway, which were also of the 2-6-6-2 type of wheel arrangement. In the St. Paul engines, however, the cylinders are 23½ and 37 ins. in diameter by 30 ins. stroke; while the Chesapeake & Ohio locomotives had cylinders 22 and 35 by 32 ins. The engines here illustrated use a working pressure of 200 lbs. per square inch. These and other changes together with the one inch increase in the diameter of the driving wheels, making them 57 ins., give the St. Paul engines a rated tractive power working compound of 75,000 lbs., as compared with the tractive power of 82,000 lbs., of the Chesapeake & Ohio design.

As far as the boiler construction is concerned, the two classes of engines are almost identical. In both, the tubes were 24 ft. long and 2¼ ins. in diameter, and in each the boiler carries a long combustion chamber, bringing the firebox back of the rear driving wheels. This construction permits a good depth of throat sheet. In the design here illustrated, the depth from the top of the grates to the center of the lowest tube is 24⅛ ins. There are 439 tubes in the boiler. This gives a tube heating surface of 536 sq. ft. The total heating surface being 6554.6 sq. ft.

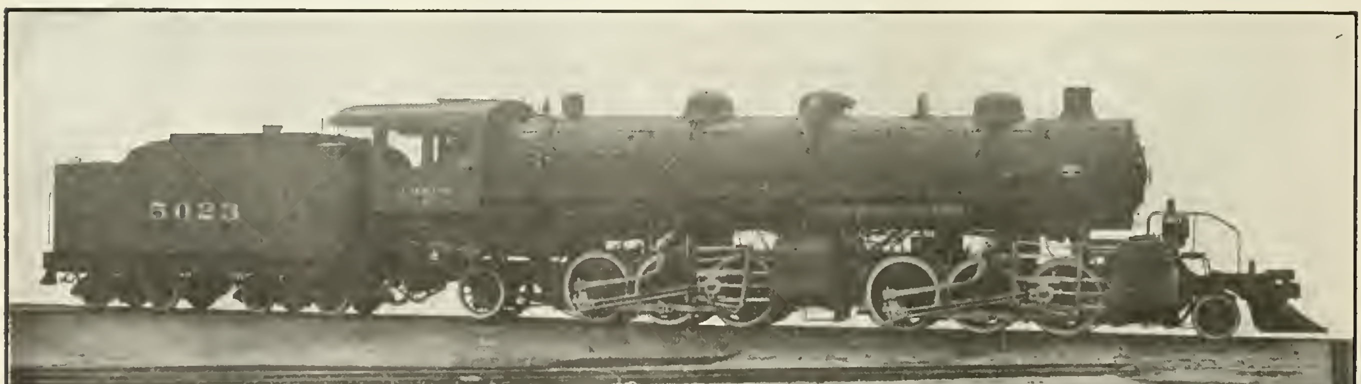
In the details of the design, the St. Paul engines present a number of new and interesting features. Principal among these is the arrangement providing a separate exhaust pipe for each low pressure cylinder. This was designed by the builders and it was thought that this ar-arrangement would tend to reduce the back pressure in the low pressure cylinders, yet such a construction necessarily increases the number of flexible joints.

design developed by Mr. J. F. De Voy, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, which has been adopted as standard by the road. Except for the necessary modification required in the construction of the firebox, ash-pan, exhaust-pipe and tender,



DOUBLE EXHAUST NOZZLE. C., M. & ST. P. RY.

due to the use of oil as fuel, the oil and coal burning locomotives are identical in design. These changes, however, make a difference in the total weight of the engine of 2,500 lbs. The locomotives equipped for burning coal have a total weight of 390,000 lbs., while those arranged for burning oil have a total weight of 387,500



MALLET ARTICULATED 2-6-6-2 FOR THE C., M. & ST. P. RY.

A. E. Manchester, Superintendent of Motive Power. American Locomotive Company, Builders.

This it is believed would not prove to be a serious objection in view of the advantages claimed for it and results from its use will, therefore, be interesting.

The construction of the frames and the arrangement of the spring rigging of the front engine also present some new features. The trailing truck is of the

lbs. Between the weights of the tenders of the two classes of engines there is only a difference of 700 lbs. in favor of the oil burning class.

Some of the principal dimensions are given below for reference:

Cylinder—Type, compound; diameter, 23½ x 37 ins.; stroke, 30 ins.

Tractive power, 75,000 lbs.

Wheel Base—Driving, 30 ft. 6 ins.; total, 48 ft.; total, engine and tender, 79 ft. 8¼ ins.

Weight—In working order, 390,000 lbs.; on drivers, 323,500 lbs.; engine and tender, 555,700 lbs.

Heating Surface—Tubes, 6,182 sq. ft.; firebox, 346.5 sq. ft.; arch tubes, 26.1 sq. ft.; total, 6,554.6 sq. ft.

Grate area, 72.3 sq. ft.

Boiler—Type, conical Conn.; O. D. first ring, 83¾ ins.

Firebox—Type, wide; length, 108 1/16 ins.; width, 96¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 4½ ins.; back, 4½ ins.

Crown staying, radial.

Tubes—Number, 439; diameter, 2¼ ins.; length, 24 ft.; gauge, No. 11 B. W. G.

Brake—Air pumps, two 8½ C. C.; reservoirs, one 22½ x 108 ins.; one 22½ x 72 ins.; one 22½ x 60 ins.

Trailing Truck—DeVoy non-radial with inside journals.

Smokestack—Diameter, 20 ins.; top, above rail, 15 ft. 5⅞ ins.

Tender Frame—13-in. steel channels.

Tank—Style, U-shape, gravity slides at sides and back; water capacity, 9,000 gals.; fuel capacity, 14 tons coal.

Valves—Type, H. P., piston; L. P., double-ported slide; travel, H. and L. P., 6 ins.; steam lap, H. P., 1 in.; L. P., 7 ins.; total, 8 ins.; ex. cl. H. and L. P., 5/16 in.

Setting—H. and L. P., 3/16 in. lead.

Wheels—Driving, diameter outside tire, 57 ins.; material, cast steel; diameter of trailing wheels, 43 ins.

Items of Personal Interest

Mr. Willard Doud, shop engineer of the Chicago, Burlington & Quincy, at Lincoln, Nebr., has resigned.

Mr. A. G. Ott has been appointed assistant road foreman of engines of the Buffalo division of the Pennsylvania Railroad.

Mr. John Roberts has been appointed signal engineer of the New York, Westchester & Boston, with office at New York.

Mr. W. L. Orem has been appointed storekeeper of the Northern Central at Baltimore, Md., vice Mr. W. C. Heaton, transferred.

Mr. Fred B. Edwards has been appointed assistant road foreman of engines of the Buffalo division of the Pennsylvania Railroad.

Mr. Peter L. McConnell has been appointed assistant road foreman of engines of the Allegheny division of the Pennsylvania Railroad.

Mr. J. B. Emery has been appointed master mechanic of the Texarkana & Fort Smith, with office at Texarkana, Tex., vice Mr. E. Gilroy, resigned.

Mr. J. W. Marden, superintendent of the car department of the Boston & Maine, at Boston, Mass., has resigned, and that position has been abolished.

Mr. V. W. Ellet has been appointed general foreman of the Rock Island Lines, with office at Rock Island, Ill., vice Mr. J. E. Loy, assigned to other duties.

Mr. G. S. Hunter has been appointed a master mechanic of the Missouri, Oklahoma & Gulf, with office at Muskogee, Okla., vice Mr. J. F. Grealy, resigned.

Mr. J. Y. Calahan has been appointed assistant general passenger agent of the New York, Chicago & St. Louis Railroad, with office at 107 Adams street, Chicago, Ill.

Mr. W. Q. Daugherty has been appointed master mechanic of the St. Louis division of the Mobile & Ohio, at Jackson, Tenn., vice Mr. G. L. Lambeth, transferred.

Mr. Arthur Dale has been appointed terminal foreman of the New York Central & Hudson River, with office at Gardenville, vice Mr. J. J. Cunningham, transferred.

Mr. E. Laking, of division 100, B. of L. E., has been appointed road foreman of engines on the Chicago division of the C. & E. I. Railway, with headquarters at Danville, Ill.

Mr. T. A. Albright, member of division 219, B. of L. E., Marshall, Tex., has been promoted to the position of road foreman of engines for the Texas Pacific Railway.

Mr. Willard Doud, shop engineer of the Chicago, Burlington & Quincy at Lincoln, Neb., has been appointed shop engineer of the Illinois Central, with office at Chicago.

Mr. J. H. Ruxton has been appointed superintendent of motive power of the St. Paul & Des Moines Railroad, with office at Des Moines, Ia., vice Mr. C. H. Montague resigned.

Mr. W. J. Hoskin, shop master mechanic of the Chicago & Alton at Bloomington, Ill., has been appointed road master mechanic on the Northern and Southern divisions of that road.

Mr. T. M. Price, assistant master mechanic of the Detroit, Toledo & Ironton at Jackson, Ohio, has been appointed general foreman, with office at Jackson, vice Mr. H. F. Martyre, resigned.

Mr. W. P. Carroll, terminal foreman of the New York Central & Hudson River, at Buffalo, N. Y., has been appointed master mechanic, with office at Rochester, N. Y., vice Mr. F. M. Steele, resigned.

Mr. A. G. McLellan, formerly with the Grand Trunk Railway at Battle Creek, Mich., has been appointed shop master mechanic of the Chicago & Alton at Bloomington, Ill., vice Mr. W. J. Hoskin, transferred.

Mr. Elmer E. Wiles, member of division 36, B. of L. E., has been appointed to the position of assistant road foreman of engines of the Newark division of the B. & O. R. R., with headquarters at Newark, O.

Mr. M. Weber has been appointed master mechanic of the Albuquerque division of the Atchison, Topeka & Santa Fe Coast Lines, with office at Winslow, Ariz., vice Mr. William Daze, assigned to other duties.

Mr. John H. Guess, formerly general purchasing agent of the National Railways of Mexico, has been appointed assistant general purchasing agent of the Grand Trunk Railway, with office at Montreal, Que., Canada.

Mr. J. J. Cunningham, terminal foreman of the New York Central & Hudson River, at Gardenville, has been appointed terminal foreman of that road, with office at Buffalo, N. Y., vice Mr. W. P. Carroll, promoted.

Mr. Henry Shulte, assistant road foreman of engines of the west end of the Buffalo division of the Lehigh Valley Railroad, has been appointed road foreman on the same district, with headquarters at Buffalo, N. Y.

Mr. E. T. Millar, general foreman of the car department of the Boston & Maine, at Concord, N. H., has been appointed general car inspector, with office at Boston, Mass., vice Mr. F. S. Sanborn, assigned to other duties.

Mr. J. H. Bransford has been appointed general foreman on the Chesapeake & Ohio Railway, at Thurmond, W. Va., vice Mr. Frank J. Walsh, resigned to accept a position with The Chicago Pneumatic Tool Company.

Mr. G. L. Lambeth, master mechanic of the St. Louis division of the Mobile & Ohio, at Jackson, Tenn., has been appointed master mechanic of the Mobile division, with office at Whistler, Ala., vice Mr. E. G. Brooks, assigned to other duties.

Mr. David Ross, member of division 500, B. of L. E., Cleburne, Tex., has been appointed to the position of road foreman of engines, with jurisdiction of the Southern division, Cleburne to Galveston & Lampasas branch of the Gulf, Colorado & Santa Fe.

Mr. George H. Robinson has been appointed general storekeeper of the Oregon Short Line and the Southern Pacific Company's lines east of Sparks, with office at Pocatello, Idaho, vice Mr. F. W. Taylor, resigned to accept service with another company.

Mr. C. W. Dieman has been appointed master mechanic of the Green Bay & Western, the Kewaunee, Green Bay & Western, the Ahnapee & Western and the Iola & Northern, with office at Green Bay, Wis., vice Mr. W. P. Raidler, resigned to engage in other business.

Mr. F. O. Walsh, master mechanic of the Atlanta & West Point and the Western Railway of Alabama, at Montgomery, Ala., has been appointed mechanical assistant to the general manager of the Brazil Railroad Company, in charge of the mechanical department, with office at Sao Paula, Brazil, S. A.

Mr. F. K. Shults, until recently connected with the American Steel Foundries as their representative in New York and Eastern territory, has taken a similar position with the Bettendorf Axle Company, of Bettendorf, Iowa, and of which company he has been made a vice-president. Mr. Shults has opened an office in room 2040, Grand Central Terminal Building, New York City; the office at 30 Church street, room 1021, Cortlandt Building, will remain in charge of Mr. G. N. Caleb, vice-president, who has been with the Bettendorf Company the last eight or ten years.

Joint Meetings to be Held.

Mr. B. L. Winchell, president of the St. Louis & San Francisco Railroad, at St. Louis, has established what may be called a school for officials and shippers. Its object is to promote more congenial relations and a better understanding, which will contribute to the success of the road.

In the opinion of Mr. Winchell much can be gained by both if they meet together often and discuss points at issue. The plan is to have an executive officer of the system, with a local agent and other representatives, meet shippers at some designated point for the discussion of subjects of common interest, and to get data bearing upon what are deemed just causes for complaint.

In this way Mr. Winchell believes they will keep in closer touch with one another than they have been, and better knowledge will be had concerning the wants of communities and individuals. The meetings will be akin to an arbitration conference, and the idea is that much of the hard feeling which causes complaints to federal and State bodies will be averted. No expense is to be involved and a saving of time and correspondence is expected.

Abuse of Rapid Transit Railways.

The managers of urban and suburban railways in all parts of the world, where city crowds have to be moved in short time, are the objects of captious fault finding. The New York public seem to take the lead in abusing the management of the urban rapid transit railways, and no amount of enterprise has ever given them the least satisfaction. It is currently said among the subway and elevated railway people that when a New York City editor is short of copy he directs the reporters to look for something discreditable to the local railroads, and that they never fail to find or to manufacture what they want. It was said that captious newspaper criticism drove Col. F. K. Hain, of the New York elevated railroad to a premature grave. The same kind of criticism does not appear to affect Mr. Frank Hedley, who has now added the extra work of presiding over the New York Railroad Club to his duties as general manager of the Interborough Rapid Transit Railway.

Answer Circulars.

Mr. W. O. Thompson, secretary of the Traveling Engineers Association, has sent out circulars from committees asking for information to be worked into reports for next convention. We cordially endorse the following appeal sent out by Mr. Thompson:

"You will all agree that the subjects are live ones and worthy of a good deal of consideration. Our president is very anxious that all assistance possible be given to the committees by the members, as the assistance that they get is valuable to them, and it is hoped that you will not put these circulars in the pigeon hole and forget them, but that you will answer them promptly and give the committees all the information on the different subjects, that you have."

Early Mechanical Transportation.

So much scientific and literary ability is displayed and brought to light by papers submitted to the various railway clubs, that it is almost invidious to select one for comment; yet we cannot help directing attention to a paper read last year before the Central Railroad Club by Mr. E. M. Tewkesbury, general superintendent of the South Buffalo Railway. The subject was "Analysis—Chemical and Otherwise," which gave the author a wide scope utilized in a most masterly manner.

The paper opens with comments on the long-felt want for improved methods of transportation with notes on how that want began to be filled. The ability of railway men is given due credit; then comes comments on rolling stock and its development. The influence of chemical analysis on improving material purchased by railway companies is dwelt upon, and the most entertaining part of the paper relates to analyses of the individual characteristics of various classes of railway men.

We intend publishing most of the paper, but the rule of our magazine requires that it should appear piecemeal, meanwhile here is a beginning:

"The first glance we have of human society in the dim light of history, is when the tribe was the only social organization. It was held together by the ties of blood and family. Property was largely held in common. The spoils of the chase, pillage in wars with neighboring tribes, and the feeding of flocks were the main object of human effort.

"When men ceased to roam through the forests or over the plains, and selected and occupied fixed places of abode, a division of labor became necessary. Some tilled the soil and others developed the mechanical arts. Diversity of labor developed the idea of private property and made necessary the exchange of products of individual labor. In this way trade and commerce began. It is simply the exchange of products of one man for the products of another. In order to effect these exchanges transportation is necessary.

"The waterways were first employed for that purpose. The great cities, the marts of interchange in ancient times, men located on seas or on the rivers tributary thereto. The beginning of commerce was also the beginning of civilization. It first shone along the seacoast. The interiors, where no facilities of transportation existed, were long enshrouded in darkness or barbarism. Commerce slowly extended into the interior. The farther it advanced the more necessary became an equally extended system of transportation.

"First came the trail through the forest, then the public highway, then the canal and finally the railroad. The greater part of modern history covers a period wherein there was no means of transportation except by pack horses, carts or wagons and stage coaches. The first national highway was the turnpike. The most celebrated turnpike was constructed by the United States, called the National Pike or the Cumberland Road. It was commenced in 1806. It extended west from Cumberland, Md., through Wheeling and Columbus, and finally reached Vandalia, Ill. The plan contemplated an extension to Jefferson City, Mo., but before it was completed the era of railroad building began, and further effort in turnpike building was abandoned.

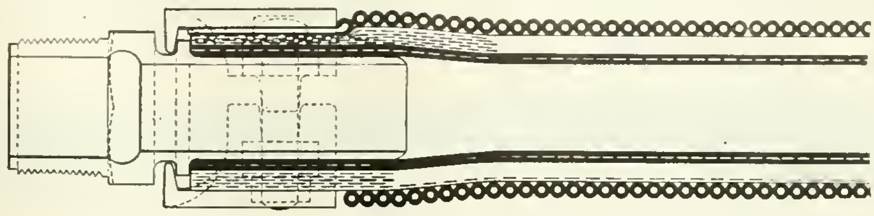
"In 1825 our Erie canal was built from the Hudson River to Lake Erie, and from thence numerous canals were built in the different States. Most of them are now obsolete and long since abandoned as a means of transportation. It is hard to believe that the entire present system of railroads, which cross and recross the country with its network of steel, which climbs over or bores through mountains, which span rivers or tunnels under them, reaching almost every hamlet in this vast country, has been originated, constructed and extended within the lifetime of men now living.

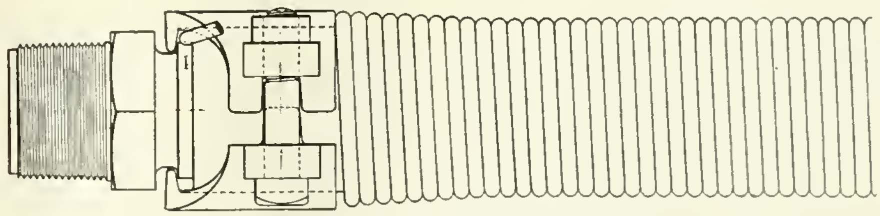
"The first railroad is said to be the Baltimore & Ohio. That company was chartered in 1827 and construction began in 1828, but in the first two years only 13 miles were opened for traffic. There are many persons now living within the range of your acquaintance who are more than 82 years of age—this including my own father. They were living when the first mile of railroad was built, and they have seen this vast system developed, which now comprises over 240,000 miles."

Some Advantages Which Come from Good Design

There are few things that get harder useage in railway operation than the flexible hose couplings between engine and tender. An ordinary good rubber hose with suitable connections seems to be a simple thing, but there are several important details which have to be considered in order to produce a thoroughly good, durable, and one may say "all-round, workable" device. For example, let one try to get up a good steam heat hose, and he will find himself confronted with some things which require a good deal of thought. The hose hanging down from engine and tender, at once produces a pocket in which the water condensation may lodge. After steam has been shut off, in winter, this water would freeze. The vibration and oscillation of engine and tender has a tendency to disconnect the couplings, and at times the hose itself has a tendency to blister and burst.

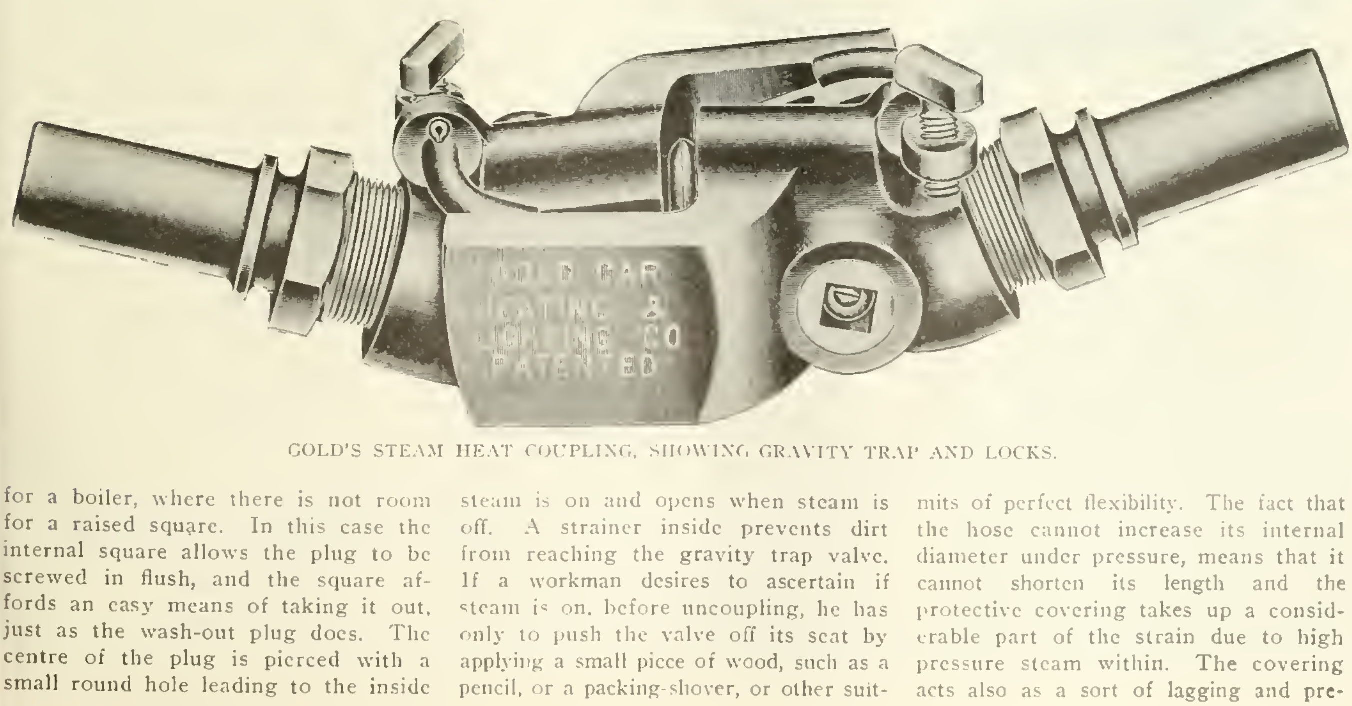
In studying out the interesting question of the design of details, a good example helps to demonstrate the principle involved, and among the many good railroad appliances, one may with justice take the hose coupling, etc., designed and patented by Mr. Edward E. Gold, president of the Gold Car Heating & Lighting Co. of New York. In the matter of practically eliminating the pocket formed by the sag of the hose, we find in this device that a very simple and effective gravity trap has been introduced into the coupling. It consists of a circular brass plug screwed into one side of the coupling. The plug contains a square socket exactly like a common form of wash-out plug for a boiler, where there is not room for a raised square. In this case the internal square allows the plug to be screwed in flush, and the square affords an easy means of taking it out, just as the wash-out plug does. The centre of the plug is pierced with a small round hole leading to the inside or main steam passage of the coupling. In this hole a loosely fitting stem is placed. This stem has on its outside end a washer and screw, so that although the stem is quite loose it cannot work into the interior of the coupler head. The inside end of the loosely fitting stem is secured to a valve which seats against the inside face of the plug. The internal pressure of steam in the coupling seats the valve and makes the coupling tight. As soon as steam is shut off, the valve, being heavier than the little screw and washer on the outside, falls away from the seat, as the stem has been made slightly long, so as to permit of this, and moreover, the stem being loose in the hole in the plug, the water of condensation readily drips out. The valve is tight when steam is on and opens when steam is off. A strainer inside prevents dirt from reaching the gravity trap valve. If a workman desires to ascertain if steam is on, before uncoupling, he has only to push the valve off its seat by applying a small piece of wood, such as a pencil, or a packing-shover, or other suitable article, to the screw and washer in the square socket, and if hot steam escapes he may in this way save himself the chance of a severe scalding by thus ascertaining the true state of the case. This plug and valve is not only a very simple and effective gravity trap, but it rises to the dignity of a safety appliance in the eyes of the workman.





NIPPLE, WITH AJAX KINKLESS HOSE.

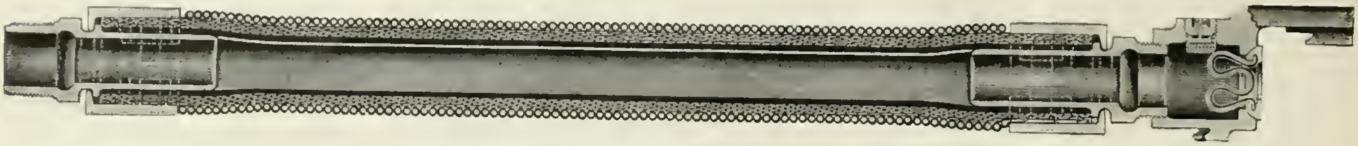
The matter of hose protection has also received attention, for this hose is carefully wound from end to end with a form of insulated wire which affords a waterproof covering for the hose, the insulation of course protecting the wire as well. The ends of this insulated waterproof wire are secured by the clips at each end of the hose. The effect of this covering is to prevent the hose being chafed or cut. It prevents the swelling of the hose under pressure, while it permits of perfect flexibility. The fact that the hose cannot increase its internal diameter under pressure, means that it cannot shorten its length and the protective covering takes up a considerable part of the strain due to high pressure steam within. The covering acts also as a sort of lagging and pre-



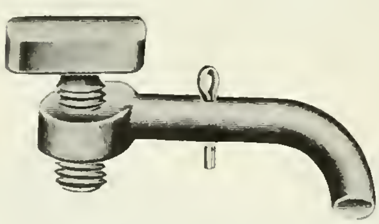
GOLD'S STEAM HEAT COUPLING, SHOWING GRAVITY TRAP AND LOCKS.

vents undue radiation, which enables a workman to grasp it even when steam is on, without being burned—mark the safety idea again for the workman—and thus covered, the hose has an increase of useful life, and gives a very satisfactory performance while it is in service.

The actual contact surfaces, when two couplings are brought together, show evidence of good design, and that is the subject we are considering. The gaskets are made of vulcalebston, which is a substance which can be hammered out of shape and then hammered back to shape without breaking. In this instance, it is made in the form of a ball joint, exactly like the ball and socket rings used with the branch pipes of a locomotive, in the smoke box. These vulcalebston ball socket rings are, of course, smaller than the branch pipe rings, but they are similar in form. In the hose coupling the flat faces meet and the ball side is free to move in a suitable socket in the malleable iron coupling head. When these couplings come together they engage with suitable lugs, but their motion resembles a pair of swing doors, each moving on a center back of the surface where they meet. Swing doors do not usually make a tight contact, but if they



GOLD'S AJAX KINKLESS HOSE AND COUPLING.



COUPLING LOCK.

did they would need some such method of adjustment as these Gold gaskets have. In the case of the couplings the lower edges of the gaskets meet first and give slightly by reason of the hinge-like action of the gradually closing couplings. When the couplings have closed the two flat faces of the gaskets make a steam-tight joint as intended, and the ball and socket gaskets have themselves made all the necessary movements and adjustments to enable the coupling to engage tightly. This movement and adjustment of the gaskets permits of bringing the couplings together without using force. They click together without effort, and the workman—again note the workman—has not to hammer them down into position by repeated blows or any undue expenditure of force.

Having thus easily got the couplings together so as to ensure a tight joint the next idea is to secure them there, and that is accomplished by the use of a positive lock, as simple as it is ingenious. Each coupling has on its upper side a lug, with a half-inch hole drilled in it. Through this hole is a piece of a round iron bar bent at one end like the index finger of a man held in the act of beckoning. The other end of the little iron bar is made wide enough to take a brass thumb-screw. The bend of the bar and the thrust of the thumb screw are at right angles to each other. This little bent bar, or locking device, is prevented from slipping out by a small cotter key on the inside of the lug and as the thumb-screw end can't go through the lug the lock cannot get lost. A few easy turns of the thumb-screw on one coupling causes the bent finger end of the lock to press upon a suitable beveled lug on the other coupling and the tighter the thumb-screw is forced the greater the pressure of the bent finger on the other coupling. The lock is thus direct and positive. It has no tendency to slack out and cannot slip, and when the couplings are thus locked, they are locked tightly, and the workman knows they are, and, moreover, he has the minimum of trouble in making things sure. Here, then, are several features which exemplify the advantages of a good design, even in little things, for the combination of them all makes for efficiency and durability in operation, and they have been designed with a practical eye on the workman, and that is always worth while.

Keys and the Strength of Shafts.

An investigation has lately been carried out dealing with the effect of keyways on the strength of shafts. The work has been done in the laboratory of applied mechanics by the experiment station of the University of Illinois. The mathematical analysis of the strength of the shaft with a keyway cut in it is a problem of great complexity. Not only was the mathematical analysis most carefully performed, but was followed by practical tests. The result of this important piece of work has been embodied in Bulletin No. 42, which can be obtained from Dr. F. W. M. Goss at the experiment station of the university, at Urbana, Ill. The work of testing the shafts was done by Mr. H. F. Moore, assistant professor of theoretical and applied mechanics at the university.

The data and results referring to the ultimate strength of shafts, with and without keyways, is summarized as follows, "It seems that a shaft with a single keyway of common dimensions, has about the same ultimate strength as a shaft without a keyway. In the tortional tests to destruction, after the elastic limit of the shaft had been passed, the keyways gradually closed up, and at rupture they were entirely closed. The larger keyways and the two keyways 90 degs. apart, lowered the ultimate strength somewhat The variation in strength due to difference in the material of the shafting seems to cause more variation in ultimate strength than is caused by different keyways. The elastic limit of a shaft is more significant than its ultimate strength.

Tolstoy's View of Us.

Tolstoy, the famous Russian writer, remarked of Americans that they labored with brain power and mechanical ingenuity to provide means for accelerating methods of transportation and then doubled the mental effort to provide means for spending the time they had saved.

Begging on the Railway.

The slow train between Uitenhage and Graaff-Reinet is still the target for the shafts of the humorist. Recently a wag sent the following letter to a contemporary:—"Sir,—Is there no way to put a stop to begging along the line of the railway? For instance, yesterday afternoon an aged mendicant with a wooden leg kept pace with the express all the way from Kleinpoort to Glenconnor, and passed from one open window to another with importunate solicitations."—*South African Ry. Magazine.*

Wailing Song Sounded Funny.

A young Englishman was once present at a Scottish concert, and he was asked how he enjoyed the singing. He said he enjoyed it very well, and there was one song that he could not help laughing at, and yet he was the only one that could see the fun, for nobody laughed but himself. What was the song? Ah! he did not know what it was about, but the singer finished the verse by crying, "Where's my fourpence, Charlie?" It was "Wae's me for Prince Charlie?" that he heard sung."

Selecting Railway Officials.

The railroad president, remarked Mr. Tewkesbury at the Central Railroad Club, is looking for a bright strong man of some particularly hard division. Finally he gets his eye on such a man through recommendation, or still hunt. The first thing he does is to analyze the man. He applies the manhood test to ascertain if his past and present life is up to a standard that will recommend him to the executive board when his name comes before them, and also to satisfy that he has those gentlemanly qualities that will enable him to become one of the official family, who must of necessity be taken inside the secret workings of the system. Having satisfied himself in that particular, he goes farther in his analysis as to his experience and executive ability, also if he is a leader of men—a most important qualification these days—if he is a diplomat, that his contact with the patrons of the road and the general public will create that general good feeling which today is recognized an essential qualification by the heads of the large railroad systems of this country.

After the president has satisfied himself on these points and the superintendent has been installed and has had sufficient time to put his methods into practice, what does the president then do? Why, he simply renews his analysis by analyzing his payroll costs, per centage of business handled compared with previous records.

If that superintendent is possessed of the qualities that the president's analysis credited him with, it is not necessary to speculate on what that superintendent is doing at the same time, as without doubt he is applying similar analysis to his various assistants.

The Gill Selector.

Railways maintaining a telegraph service will find matter of interest in a booklet just issued by the United States Electric Company, of New York and Chicago, devoted to the Gill Selectors for Telegraph Service. The selective telegraph calling system with the individual calling bell, which is in use on many railways in the United States is held to have overcome the objections to the sounder calling system and to have brought many other advantages in its train. Besides describing the selector the booklet gives a description, with diagrams of the several arrangements in which the Gill selector is furnished to operate in telegraph service, both with and without the answer-back and the automatic calling keys. These last named are auxiliary apparatus designed to promote uniform calling and prompt answers. The Gill telegraphic selector has special advantages as an emergency call in railway service for agents or wrecking crews and affords a practically automatic line-testing arrangement, a point of interest to wire chiefs. The selector outfits to operate are conveniently grouped and designated under the several arrangements described by code numbers. A full and accurated, illustrated description of this selector, and indeed of telephone train despatching, appeared in RAILWAY AND LOCOMOTIVE ENGINEERING for January, page 25.

Grasshoppers Stalling Trains.

A serious trouble experienced in the operation of the Philadelphia & Columbia Railroad, one of the first sections of the Pennsylvania Railroad, were the swarms of grasshoppers. They were so numerous that in addition to becoming a devouring pest on the adjacent farms, they impeded and in some instances temporarily prevented the progress of trains on the railway. One of the remedies adopted was to keep men stationed on the track to sweep the grasshoppers off, as they accumulated in immense numbers, but the aid derived from this expedient not being sufficient to fully meet the emergency, arrangements were made for the first time on that road to provide sanding arrangements.

The first arrangements for sanding the rails were very primitive. A bell mouthed pipe was secured to the running board and a bucket full of sand was carried on the tender. When the engine began slipping the fireman filled a cup with sand carried it out to the sand pipe and dropped it in. Improvements were gradually effected until the modern sand box was evolved.

More Motor Cars.

We are informed by the McKeen Motor Car Manufacturing Company of Omaha, Neb., that they have recently received an order for five 70-ft. motor cars for the Ann Harbor Railroad, Toledo, O. These cars are to be delivered during the next four months. The company states that this makes the thirty-ninth railroad that is using or has ordered this style of vehicle.

Development of Tool Grinding.

When the Sellers tool grinding machine was first put upon the market, nearly all machinists regarded the new fangled labor saving apparatus with scorn. They had always been in the habit of grinding their own tools to suit themselves. That time of prejudice soon wore away, and it is a very poor railroad shop that does not now have a tool grinding machine, and most of the workmen agree that it does the grinding better than they can.

The development of the tool grinding machine is strikingly illustrated in connection with large mining plants. Sharpening the bits of the three hundred rock drills used in the Calumet and Hecla mines, is done automatically, the only labor being to put them on a conveyor at the outset.

They are heated, sharpened, upset, fluted, brought back to exact size and tempered by machines, passing from one to the other mechanically.

The plant is driven by electricity, but the sharpening and upsetting is performed by compressed air hammers, and the fluting is done by an eight hundred pound steam hammer.

With all drills running, about 4,000 bits must be sharpened every day.

Steam Heat Free.

Uncle Rastus always contributed to the coal fund of the A. M. E. Church in a small town over in Jersey. Year after year he dug down in his jeans for his little donation until finally the edifice was remodeled and a new heating plant installed. At the usual time the parson approached Rastus and again asked him to be a cheerful giver.

"Not on yo' life!" returned Rastus, with large emphasis. "Yo' ain't gwine ter git no money out ob me fo' coal this wintah!"

"What am de mattah?" asked the surprised dominie. "Hain't yo' always guv up fo' de coal fund befo' widout de necessity ob usin' stress?"

"Yes, sah," was the prompt reply of the halting one; "but yo' kain't fool me a little bit, Mistah Pahson! Doan I know dat you' had steam heat put in dat church las' week?"—*Philadelphia Telegraph.*

Crosby Pops.

The Crosby Steam Gauge & Valve Company, of Boston, Mass., have recently issued two very interesting pamphlets. One on "the measurement of steam discharge in locomotive pop safety valves," and the other pamphlet is "the Crosby principle in safety valves for locomotives." In fact the Crosby locomotive safety valve is composed of a body and a disc, and each has two concentric seats. The outer seat of the body at its periphery communicates with the open air; the inner seat communicates with a circular well or chamber at the center of the body. This central well has four passages leading to the open air. The two concentric seats divide the disc into two parts; the part forming the area between the outer and inner seats is exposed to the steam when the valve is closed. The disc is simply a cover to the valve body with its concentric seats resting upon the like seats of the valve body, and is held to it by a spiral spring acting upon the center of the valve disc. In shape the disc is the central zone of a sphere without guides; it is held in place by the cylinder which forms the lower part of the spring casing, within which it moves freely without friction and prevents the outflowing steam from entering it. No part of the disc is in the steam space.

The measurement of steam discharge was undertaken by the Crosby Company, and more than a year ago Mr. Edward F. Miller, professor of steam engineering at the Massachusetts Institute of Technology, at Boston, was commissioned to make exhaustive tests of the steam discharge afforded by Crosby muffled locomotive pop safety valves. Every precaution that the best engineering experience, skill and foresight could suggest was observed, to avoid possible errors. All the readings and measurements were made personally by Prof. Miller. Both the pamphlets can be had by direct application to the Crosby Steam Gauge & Valve Company, 97 Oliver street, Boston, Mass.

More Dough Wanted.

A young man, who had not been married long, remarked at the dinner table the other day:

"My dear, I wish you could make bread such as mother used to make."

The bride smiled and answered in a voice that did not tremble:

"Well, dear, I wish you could make the dough that father used to make."

Dixon's Flake Graphite.

Men who have made a careful study of lubricants and who are connected as experts with steam railroads and automobile companies, when dealing with the subject of proper lubrication, have indicated what they think of Dixon's Ticonderoga Flake Graphite and the graphite lubricants by the orders they have sent to the company. Dixon's Flake Graphite, either regular flake or finely powdered flake, form the basis of the two lubricants just referred to. During the year 1910 the Joseph Dixon Crucible Company, of Jersey City, N. J., supplied graphite and graphite lubricants to 210 steam railroad companies. This business with the steam roads has increased 53 per cent. During 1910 this company sold graphite or graphite lubricants to 91 automobile manufacturers, being an increase of this business of 260 per cent.

Serious Railway Accident.

"I went to the Highlands to see my grandmother at the New Year holidays," remarked Harry Lauder, "and I met with a fearful accident and lost all my luggage."

Mrs. Lauder, anxiously.—"How did it happen Harry?"

Harry, pensively.—"The cork came out of the bottle."

Tests of Train Resistance.

Another bulletin has been issued by the engineering experiment station of the University of Illinois. It presents a compilation of tests made on 32 freight trains in regular service by Mr. Edward C. Schmidt, to determine freight train resistance and its relation to car weights. For trains composed of cars weighing 15 tons on the average, the resistance is shown to vary from 7½ lbs. per ton at five miles an hour, to 13½ lbs. per ton at 40 miles an hour. For trains composed of cars weighing 75 tons, the resistance is shown to vary from 3 lbs. per ton at 5 miles an hour, to 5½ lbs. per ton at 40 miles an hour.

Tungsten and Its Uses.

"The world's output of high-grade wolfram ore," says the weekly *Consular Reports*, quoting a London newspaper, "is limited and is estimated to average about 4,000 tons over the past four years. Apart from the use of wolfram for chemical purposes, the demand for wolfram for the manufacture of high-speed tool steel is very large and steadily increasing. The use of wolfram steel for motor cars is becoming general in cars of high-class manufacture, particularly by the French makers. Wolfram is also used in the manufacture of electric lamps.

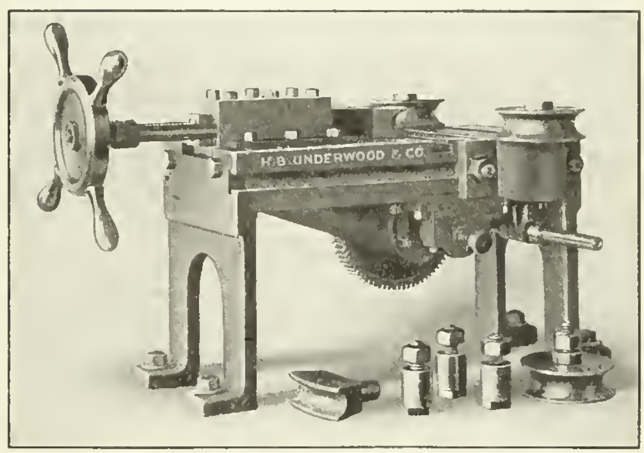
"The manufacture of wolfram metal, which is also known by its trade name of tungsten metal, has been almost exclusively in the hands of German manufacturers; consequently the large English steel works manufacturing ordnance, gun forgings, armor plate, and high-speed tool steel and other forms of steel in which wolfram is employed have always had to depend on the foreigner for their suppies of metal."

Power Bender and Straightener.

This machine for bending pipe, structural iron, round and flat bars of various kinds and sizes, has been developed by H. B. Underwood & Co., of Philadelphia, Pa., after considerable experience with different types of mechanical appliances in this field. It is capable, not only of bending, but also of straightening material quickly and also efficiently. It is adapted for a large variety of work.

Instead of requiring a large number of dies or formers, it is only necessary to have on this machine a set for the different diameters. These may be placed in different locations and permit of bending a great variety of shapes. Being belt driven, with a tight and loose pulley, on the shaft, it is more economical than compressed air and can be used where the latter is not obtainable. Great power can be brought to bear on the work by this machine. The ram is actuated by an eccentric shaft of small throw, and it moves with a fixed stroke. The shaft is strongly back-geared, giving the ram a tremendous power. Sliding in this reciprocating ram, is another, which carries the former to be used, and this is moved in or cut out by a screw operated by the hand wheel. This gives a very delicate means of adjustment in manipulating the work and bending to exact requirements.

Any number of pieces can be bent exactly alike by maintaining the last position of the hand wheel. The effect of bending in this manner, by the former following up the work and exerting at each stroke a little more pressure, is less detrimental to the material than a sudden bend, or trying to shape the piece at one movement. Only a little skill is required to operate this machine, there is no complication and nothing to do but move the pipes along and turn the hand wheel to suit the requirements of the work in hand. The formers or resistance studs on each edge of the bed slide in a T-slot and T-slots are also made across the bed so that formers can be fastened therein and thus allow of many different arrangements. The effectiveness of this machine for straightening work is an important feature of its usefulness in a railroad engine or car repair shop. Pieces of pipe, bars, etc., that have been bent and buckled all out of shape can be straightened easily and quickly. Write to the company direct to Philadelphia, for further particulars.



POWER PIPE BENDER AND STRAIGHTENER.

Temptation and trial do not cause man's weakness; they only show if it is there.—*Church.*

Class Journalism.

The famous and never-to-be-forgotten Bill Nye once started a newspaper. The subscription price had been fixed at two dollars a year.

"Is your paper intended for any particular class?" he was asked.

"Yes," replied the bald-headed humorist, "for the class that has two dollars." This, we are bound to say, was a laudable purpose, wittily expressed, and it showed Mr. Nye's noble public spirit in keeping his price so low, and it also revealed his great knowledge of human nature.

Railway and Locomotive Engineering, while it is intended to reach a class, and the two-dollar class at that, nevertheless recognizes that a step further must be taken, since the now far-off though once Nye days of Bill. We succeed admirably as our increasing 1911 subscription list shows, with the people who not only have two dollars, but who are willing to let go of those two dollars and to forward them by money order, check, post office order, through our regular agents or by coming to the office and delivering up $2—the bank note—themselves, with many protestations of happiness and great joy. Thus they receive good value for their money, and they, by this act, unwittingly do homage to the great wit, in that they bring the bill neigh.

Welding Frames.

Railroad foremen and master mechanics are slowly coming to realize that a broken locomotive frame is a small source of delay since the Thermit welding process was perfected. The Goldschmidt Thermit Co., of New York, inform us that they can weld a locomotive frame and return the engine to service in at most twelve hours. That is very different from the days when the broken frame had to be taken out and welded in the blacksmith shop. Very few frames go to the blacksmith shop to be welded nowadays because railroad men are keeping abreast of the times. They do adopt the most improved methods of doing work, although the "mouth-mechanics" are howling to politicians and others that railroad men are behind the times.

Train Control by Wireless.

At the last meeting of the New York Railroad Club, Dr. J. H. Millener, experimental electrician of the Union Pacific, told the members of the successful experiments that road has been making for four years in the line of wireless telephony from moving trains.

Speaking of his road Dr. Millener said: "The Union Pacific has the finest system of block signals of any railroad in America. Perfect as it is, however, there is this remote but possible element of delay that must be eliminated. The Union Pacific decided that the only way to do so was to devise some means by which an engineer in his cab could 'call up' the train dispatcher's office and find out what was wrong. The solution seemed to be in wireless communication by telephone."

Continuing the speaker said: "Two of these wireless stations will be established soon, one at Sidney, Neb., and the other at Cheyenne, Wyo., 103 miles apart, where the line is a single track. We expect to keep up communication with moving trains between these stations and others that are to be established. We have discovered, through our experiments, that wireless waves will follow the direction of the rails farther than in any other direction. It is well known that they will follow a stream of water or metallic conductors better than they will pass over wooded country or even a treeless plain, and that these waves work better in stormy weather than when the skies are clear.

"The wireless telephone that we have devised and have been using in Omaha is sufficiently powerful to enable messages to be received from a considerable distance simply by attaching the receiving apparatus to an ordinary umbrella, which is held over the head of the person who gets the message. He may be on top of a moving train or walking about the yards. The tones of the human voice are reproduced perfectly. The ribs of the umbrella correspond to the antennæ. Using an umbrella for this purpose is a wasteful method because it requires more electricity. It must not be inferred that all our train employes will carry umbrellas in the future."

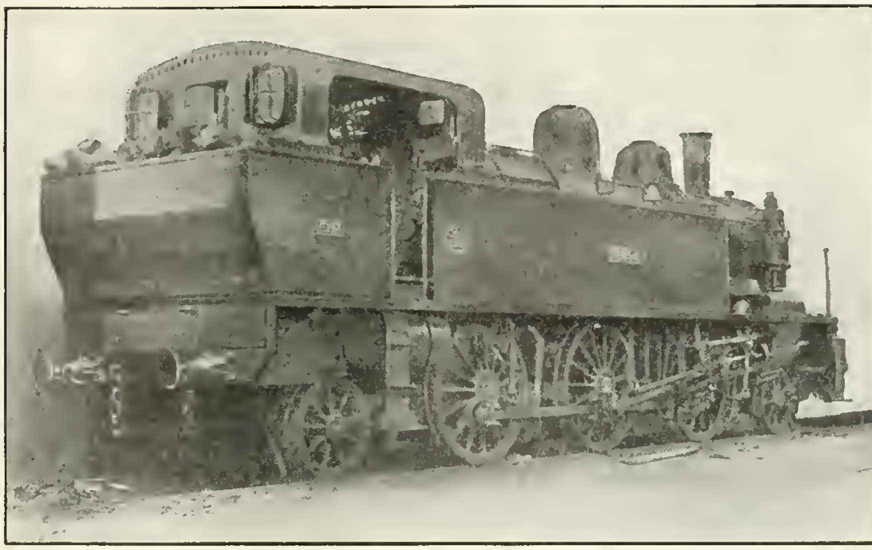
Revise His Diploma.

Henry Mandslay, the inventor, used to boast that his diploma as a mechanic was an antiquated vise. He went to take a job as a machinist in the shop of Bramah, a famous lock maker and he looked so young that the workmen protested that he could not have learned the trade. There was a worn out vise on a bench in the shop and he requested that they judge of his skill by the manner in which he would repair vise and bench. They agreed and he set to work with the result that in four hours he re-steeled the vise jaws, build up, recut all the parts, hardened the jaws and brought them to proper temper and made the old bench look as smart as when new. The men gladly voted that Mandslay was a first-class mechanic.

In the year 1709 when Newcomen's steam engine, the first to use a piston, was put to work the art of iron working was so backward in England that the frames for cotton spinning machinery was made of wood.

Bulletin No. 1008.

The American Locomotive Company have just issued Bulletin No. 1008, presenting in seven pages a complete classification, analysis and the comparative heating values of different grades of coal. It is rare, indeed, that so much information is presented in such concrete form. Locomotives burn at the present time about 100 million tons a year, or one-fifth of the total amount of coal mined annually in the United States. The Geological Survey, under the auspices of the general government, suggests that coal may be graded on the basis of the ultimate analysis, which establishes the ratio of hydrogen to carbon. This ratio is the quotient of C, carbon, divided by the percentage of H, hydrogen; or R, ratio, equals carbon divided by hydrogen, and is generally expressed in the mathematical form, $R = \frac{C}{H}$. A careful analysis on this basis shows the following rating of the various kinds of coal in general use: Anthracite, 26 to 30; semi-anthracite, 23 to 26; semi-bituminous, 20 to 23; bituminous, 11 to 20; lignite, black or brown, 9 to 11. Interesting tables are added in the bulletin showing the various States where the different kinds of coal are largely found, and the publication as a whole is of much value to all who are interested in the use of coal as a generator of heat in the production of steam. Copies of the bulletin may be had on application at the company's office, New York.



FRENCH 2-6-2 FOR HEAVY SUBURBAN TRAFFIC.

A Wise Brakeman.

An Irishman had received a job as brakeman on a railroad in a mountainous section of Pennsylvania, and was to be paid a certain amount per mile as wages.

On one of the first trips the engineer lost control of his train, and at a dangerous rate it went speeding down the steep gradients.

Suddenly the conductor saw his companion, who had been clinging to the running board for dear life, make a move as though to rise, and, fearful that he intended to jump, the conductor said: "Don't jump; you'll be killed."

The greenhorn shouted back: "An' do you think Oi'm fool enough to jump when Oi'm makin' money as fast as Oi am now?"—*Ideals.*

Electricity in the Hoosac Tunnel.

The electrification of the Hoosac tunnel is being steadily carried on. But there are many difficulties, the overcoming of which shows much skill and ability. The overhead contact line brackets have to be fastened to the roof of the tunnel, and for this purpose holes have to be drilled in the rock. If the tunnel was not constantly used, this would be quite easy, but trains are passing through the tunnel at relatively frequent intervals.

To protect the workmen from the smoke of passing engines the men are placed in tents which are set up on the roofs of the cars of their work train. These tents are supplied with air taken from a point near the floor of the tunnel and brought up to the tents by means of air compressors. There are two tracks throughout the length of the tunnel, which is 4¼ miles long. The work train occupies one track while the regular trains use the other. Work was begun at the North Adams end and it has now proceeded over a mile.

Improvements on the Pennsylvania.

Some idea of the magnitude of the work which has been undertaken by the Pennsylvania Lines to provide additional facilities for handling traffic on their Indianapolis division, is shown by the fact that they are making improvements by constructing 25.9 miles of second track. No less than twenty-five street and highway and two railroad grade crossings are to be eliminated. This will entail the building of four overhead and sixteen undergrade crossings and the vacation of five highways formerly crossing the railroad at grade.

The division, extending from Columbus to Indianapolis, carries the heavy through freight and passenger business of the Pennsylvania system between points on the eastern lines and Indianapolis and St. Louis.

The double tracking authorized is in two sections, 17.6 miles from Richmond to Dublin and 8.3 miles from Dunreith to Knightstown. In connection with the double track work it was decided to reduce the maximum grade from 1.1 per cent. to 0.7 per cent., or about 35 ft. to the mile. This necessitates changing the grade on 21.3 miles of line, but when completed it will enable the company to operate much heavier trains over this division with the same locomotives as are now in use.

Transforming Metal.

For centuries the philosophers who were carrying out what they regarded as scientific experiments devoted much unrequited labor to what was called the transmutation of metals. They hoped to convert copper and other base metals into gold. It was an idle fancy and was abandoned only with the increase of knowledge. That is, the quest was abandoned by most chemists, but some lingering belief in the possibility of changing one metal into another must have persisted, for we find that Sir William Ramsey, one of the most eminent chemists in the world, has been working on the transmutation of metals, and claims that he has succeeded in converting copper into lithium and potassium. The substance produced was more costly than diamond, so the process is not likely to be of any commercial value.

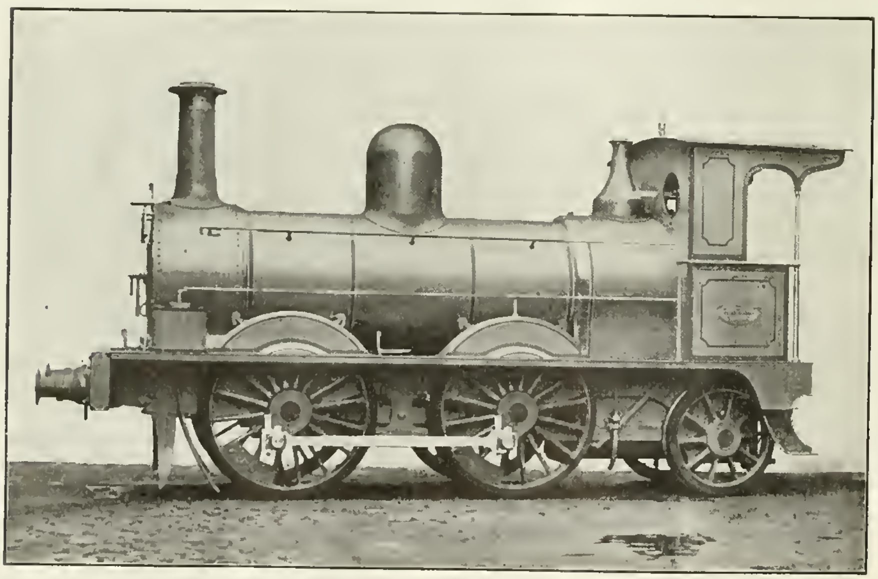
Oath Prevented Flattery.

Senator Theodore E. Burton, of Ohio, who is a bachelor and has never been ensnared by the wiles of women, tells a story of a young lady and a judge of his acquaintance. The former was a witness in the latter's court. The prosecuting attorney had repeatedly put to her questions which she persistently evaded under the plea that she did not comprehend his meaning. Whereupon his honor undertook to bring out the proper responses. Leaning over, he said in a kindly and fatherly manner, "Young woman, why is it that you insist in refusing to understand the questions of counsel? You are a person of charm, grace, beauty and more than average intelligence, and——"

"Thank you, Your Honor," interrupted the young woman; "if it were not for the fact, judge, that I am under oath I would return the compliment."
—*National Monthly.*

Boiler Explosions.

There are two popular explanations of boiler explosions, one is that it was a mysterious dispensation of Providence, the other is that the water was low and permitted the sheets to get burned. We know that boiler explosions are never due to the first of these causes, though they occasionally occur from the second. We have a theory of our own, which is that through deterioration, what were originally good boilers have become so weakened that they no longer could withstand the steam pressure and so went to pieces. There is nothing in the whole range of railroad practice more important than careful boiler inspection.



AN OLD TIMER OF THE ATLAS WORKS, MANCHESTER.

Time Used in Change of Power.

The Pennsylvania Railroad Company have compiled a series of records of the time consumed in changing from electric to steam motive power, and vice versa, at Manhattan transfer station, near Harrison, N. J. The records show that 98 per cent. of the trains now go through the transfer in the time allotted for the change of power. From 106 to 109 trains pass through on weekdays. Nowhere else is a rapid change from steam to electric engines made on so large a volume of traffic. The time allowed for uncoupling, switching, and coupling is four minutes. Owing to the difficulty of detaching the steam hose from the engine during cold weather, it has not been thought advisable to make a shorter time allowance during the winter months, but with the warm weather it may be cut down. Thus far the record for the change is one minute and thirty seconds.

Taking the trains passing through the transfer during the last week, in which detailed charts were made, 108 went through the first day, of which 99 trains, or 92 per cent., made the change in four minutes or less. On the second day there were 109 trains, with 101, or 92 per cent., making the scheduled change 106 went through the third day with a perfect record. 92 per cent. was scored on the fourth day, Sunday, when 86 out of 88 made the schedule of four minutes. On the next day 105 out of 106 made a score of 99 per cent. perfect; and for the last two days the percentages were 94 and 98, with 101 out of 108, and 107 out of 108 trains passing through the transfer in the allotted time.

Squelched Him.

In a suit tried in a Virginia town a young lawyer was addressing the jury on a point of law when good naturedly he turned to opposing counsel, a man of much experience, and asked:

"That's right, I believe, Col. Hopkins?"

Whereupon Hopkins, with a smile of conscious superiority, replied:

"Sir, I have an office in Richmond where I shall be delighted to enlighten you on any point of law for a consideration."

The youthful attorney, not in the least abashed, took from his pocket a half dollar piece, which he offered to Col. Hopkins with this remark:

"No time like the present. Take this, sir; tell us what you know and give me the change."

Catechism on D. C. Apparatus.

Under the above title, Messrs. Fairbanks, Morse & Co., of Chicago, Ill., have published a very interesting booklet giving, in simple language, definitions of electrical terms and describing the construction and uses of different electrical machines. As the title indicates, this treatise is prepared in the form of a series of questions and answers. It was originally prepared for the use of salesmen only, but there has been a considerable demand for it by others. The booklet is well illustrated and printed on enameled paper. The insight which it gives to the products of Fairbanks, Morse & Co., makes it very interesting to engineers, and it is in this way practically a fine type of catalogue of their specialties. To one who is not familiar with electrical machinery, this pamphlet will be of great assistance. It will be sent on request to those interested. Electricity is becoming more and more popular in railroad shops, and this little pamphlet is well worth getting. Write direct to the company in Chicago, and ask for the copy mentioned in RAILWAY AND LOCOMOTIVE ENGINEERING.

Air Brake Repair Work.

Repair work on brake valves and feed valves is now of more consequence than it has ever been and there are no special tools required for any part of the work; of course, if a valve and rotary seat of a brake valve are worn badly a light cut across the seats on a lathe will render the task of facing off somewhat easier than if filing or scraping was resorted to, but the term "grinding in the valve" is often misunderstood.

The matter of using lead or any preparation to find the bearing of the valve on its seat is mostly a habit, something really unnecessary, and it is well known that "grinding the rotary valve" is merely an expression, as grinding alone would never get one air-tight.

In trueing up and facing off a rotary valve and seat in the H 6 brake valve where there is no pin in the valve to hold it in place on the seat, a very convenient way of holding the valve in position while rubbing it on its seat to find the bearing is to use a metal band bored to fit snugly around the valve seat and to extend about one-fourth of an inch above it. About the most important tool in connection with brake valve repairs is the preliminary exhaust-port gauge, and it is not found in every railroad shop, which indicates that the most important tools are sometimes neglected while insignificant ones receive attention, and again the important tool is not always an expensive one, as this gauge could constitute nothing more than a piece of 5/64-in. wire or a 5/64-in. drill.

Locomotive building in Scotland is said to have been far from active during the past year. Some of the works have been kept going with difficulty, while about 1,000 fewer hands have been employed than during the previous year.

Safety Their Boast.

The Harriman lines, it is stated, carried 10 per cent. of the estimated 1910 passenger traffic of the United States, or 49,491,000 persons, without fatal accident to any of the number. This result is ascribed to the installation of safety devices. The report containing this information has just been compiled in the office of Mr. Julius Kruttschnitt, director of maintenance and operation of the system, including the Southern Pacific and Union Pacific railroads, which totals 17,960 miles.

We cannot help feeling that although the equipment and operation of this road leaves little to be desired, yet the excellent results which have attracted widespread attention are in large measure due to the steady team-play of the railroad employees on these lines. A record like this means that the men have "made good."

The Caddie's Advice.

The caddie followed him around the course silently, solemnly, but not unobservant. Their wake behind was marked by scars and gashes in the turf. At length he ventured on a tentative remark, "Ye'll be a stranger to these parts maybe?"

"Well, not exactly a stranger." Whirr-whirr-swish! And one more gash appeared as a lump of turf soared aloft and came down fifty yards away. "You see," the golfer concluded, "I was born here, but I have been away many years now. All my folks are buried hereabout."

"I doot ye'll no' go deep eno' with your driver," remarked the caddie; "ye'd better tak' your iron."

Aluminum Coins.

The use of aluminum for coins has received some attention in France, but the authorities have condemned it. A 5 centime piece (halfpenny) made of aluminum weighed only 1.9 grams, as against 5 grams in bronze, and it is thought that a coin so light would slip through the fingers, especially the rough fingers of a workman. Tests are now to be made in bronze containing 10 per cent. of aluminum, which, if adopted, will reduce the weight by one-half. This combination of metals possesses a fine golden yellow color, and the coins made of it will therefore be perforated so that they may not be mistaken for 20 franc pieces.

Business Anomalies.

There are some curious anomalies in the working of trust-regulated prices. Certain grades of petroleum are pumped out of the earth and subjected to an expensive refining process, then the product, kerosene, is retailed for 10 cents a gallon. Certain grades of mineral water flow out of springs and are collected and bottled without going through any manufacturing process, then the bottled water is sold at the rate of one dollar a gallon. Yet the dollar is paid cheerfully and the ten cents are given with growls about heartless monopolies.

A Low Speed Foreman on a High Speed Road.

By A. O. Brookside.

Once upon a time there was a locomotive foreman who was a plodder. His friends said he was a fool to plod but he thought he was right at the time he plodded. He had charge of a station on a road where things went fast, sometimes. This man did not know it all and was willing to admit it, but no one thought any more of him for that reason—he was right more often than he was wrong, but no one loved him for that reason.

He had some pretty good car inspectors on his staff and they tried to earn their wages, but one of them did not catch on one dark night and trouble was his portion. A foreign road delivered a train to the Finditout & Pressithome Railway one dark and dismal night. This was the road the plodder worked for. As the train came round a sharp curve from the foreign road the front wheels of the front truck on one of the leading cars disagreed with a frog as to which was the right course to take and the result was that the frog got it in the throat and the car left the track. Only one car got off, but two couplers were broken. The car, the disagreeing wheels and the broken couplers all belonged to a private line car loaded to the roof with no capacity stencilled on the sides.

The ground was soft and the derailed truck made as much havoc as it could, while the town clock chimed 1:00 a. m. The car was pushed and pulled and jerked and jacked back on to the rails and new couplers were applied, and the car went forward, while the town clock aforesaid made 2.30 a. m., with the wind in the east.

Next morning when the plodder talked it all over with the inspector the latter assured him that the wheels were all right and fully to gauge and that he had tried them, but that the track was a one-horse creation of the maintenance of way department, but the plodder did not agree to this in its entirety. He made out his report, but said nothing about the track being one-horse, though he did not praise it beyond measure.

The following day when the train mail was distributed the plodder got one of those letters where the writer (his superior officer of course), who had had years and years of the most extensive and varied experience in every known branch of railroad activity, yet failed to understand how he, the poor plodder, could possibly have said that the condition of the track must have been the cause of the derailment, when 500 miles further along the road this same car had got off the track where it had to go into a siding, and the foreman of that far distant station had found the wheel to be loose on the axle.

The poor plodder was up against it, for the far distant foreman had rubbed it in hard about certain kinds of car inspection and all the rest of it and the superior officer of experienced years had joined in the hunt for the plodder's scalp. Now it so happened that when the plodder thought it all over, and examined the track and again questioned his inspector, who was honest enough, and when the plodder had worked on the case with his good but slow-going brains, he discovered that in the act of getting the car on the track the loose wheel had been pushed, or pulled or jacked or jerked back into its proper place on the wheel seat and that when on the track on a straight piece of road it gauged all right while the track, wide to gauge on the curve anyway, looked pretty bad after the heavy car had been yanked on in a great and overmatering hurry.

The inspector finding his wheels apparently all right, having left no mark of having shifted on the axle, and the track looking bad at 2:30 a. m. on the dark and windy morning aforesaid, concluded the track was to blame and said so.

The plodder and all his men were greatly called down and nothing was said to any one else on the road, though others handled the same car at various inspection points and the far distant foreman put in a new and tight pair of wheels and gave them free to the private line, because he did not know enough to bill the owners, and the master mechanic was so busy making the plodder suffer that he never got on to the far distant foreman's presentation of the car wheels and the Finditout & Presithome Railroad were out one pair of wheels.

Moral:—If you are a plodder do the best you can and be careful and earnest, but do not expect any mercy from anybody, for the oftener you are right the more is laid up against you and the happier everybody who loves you dearly will be when some one, somewhere, somehow puts one over home plate for you.

Train Robbery in Sardinia.

Sardinia is an island in the Mediterranean for which nature has done much and human industry little. The island is infested by brigands who have lately tried a new line of industry. They have taken to train robbing and display savagery that the worst western robbers have seldom equalled. The Sardinian brigands, numbering about thirty, held up the trainmen at the point of revolvers, and compelled the conductor to give them a box containing a large sum of money. Not contented with the booty secured the ruffians practically wrecked the train before leaving it.

Steam Superheating in Great Britain.

Locomotive superintendents of the British Isles are noted for their conservative tendencies which have frequently made them slow in adopting genuine improvements. Using superheated steam has advanced very slowly, but the tentative period now seems passed.

According to the London *Times*, the superheater has at last obtained favor with British railway managers, and it is destined to effect a remarkable saving. In October last, Professor Sauvage was able to put in evidence the fact that the Great Western Railway had now 150 locomotives so fitted, and that 100 more were under construction, and he was able to point to the success of the superheater trials on the Lancashire and Yorkshire Railway, and to the increase to 475 superheaters for locomotives of the Canadian Pacific Railway. The Schmidt system of superheating has been applied to British-built locomotives in sufficient numbers to justify the conclusion that superheating for locomotives in this country is emerging from the stage of experiment into that of tolerable certainty as a means towards economy. It is also satisfactory to observe that the Phœnix superheater has been successfully applied by the Furness Railway Company. With these it was found, in one set of tests made last year, that the average saving of fuel in "ordinary every day running," over a distance of 24,000 miles, was 23.5 per cent. In the case of a Phœnix superheater applied to a locomotive at Barrow, there was an average saving of 18.7 per cent., and the same engine tested at Carnforth showed a saving of 17.5 per cent. in fuel.

Old Adage Still True.

"It's a fact," sighed the impoverished horse dealer, as the cruel wind blew his cotton trousers against his thinning limbs. "It's a fact that my business is getting worse and worse. There's no demand for horses any more. If people get hold of money now they buy automobiles and let their horses go."

"Yes," commented a grizzled old bookworm, "and how vividly the present state of the horse market, so disheartening to you, is explained by the adage, 'Money makes the mare go.'"

English Oil Companies in Mexico.

It is reported that some new oil wells are being developed at Juan Casiano, Mexico, and that two more companies will begin operations in the near future. The new wells are producing 35,000 barrels of oil per day, and oil is being pumped through the pipe line to Tampico at the rate of about 20,000 barrels a day. It is proposed to build two large storage reservoirs, and it is believed that a new refinery will be erected in the neighborhood of Tampico.

Apples and Drought.

The eating of raw apples as a cure for the drink habit was confidently recommended by a learned doctor at a recent State convention of Iowa horticulturists at Des Moines. He told the delegates that eating apples will not abate the appetite for liquor, but will cure the most confirmed drunkard if the drunkard eats enough of them. This recalls to a contemporary the story of an apostle of the apple cure who maintained his contention stoutly in a public meeting. "How do you know raw apples are a cure?" shouted a doubter in the audience. "How do I know?" came the withering rejoinder. "Haven't I been cured eight times?"

The London *Times* makes the assertion that Great Britain is losing the business of making steel casting because the molders are opposed to piece work. Belgium, where piece work is universal, is taking possession of the business.

INDEX TO ADVERTISEMENTS.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, April, 1911. No. 4

New Railway in China.

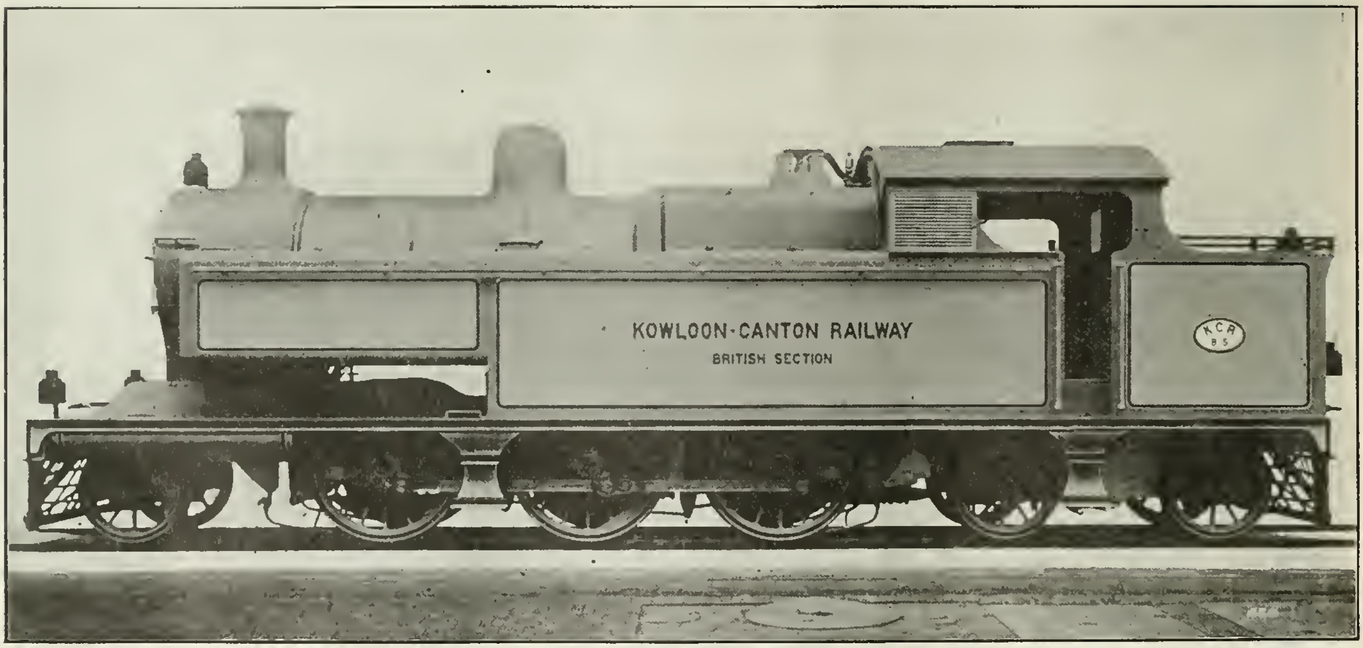
The Kowloon-Canton Railway (British section) which has recently been completed is 23 miles long. Work was begun towards the end of 1905, and the first through train to run over the completed section made the journey on July 28, 1910. There are five tunnels of which one running under the Beacon Hill is 7,212 feet long. A picture of the portal of this tunnel forms the subject of our frontispiece this month. This tunnel was begun in January, 1907, and the headings met in May, 1909. The five tunnels together represent 10 per cent. of the total length of the line. There are 49 bridges, the longest of which is 200 ft. situated at Taipo having two spans of 60 ft. and two of 40 ft. long. Considerable difficulty was experienced in the construction of the bridges, especially in the foundation work, owing to the fact that the railway skirts the seashore for many miles. Several of the bridges had to be built on "well" foundations. There are eight intermediate stations on the section, and at one time there were no fewer than between 4,000 and 5,000 men and women at work on the railway.

The rolling stock at present consists of four locomotives, two of these are of the type shown in our illustration. These engines have been supplied by Messrs. Kitson & Co., of Leeds, England. The following are the leading dimensions: Cylinders, 19 ins. diameter by 26 ins. stroke; diameter of wheels, leading 3 ft. 7 ins., six coupled drivers, 5 ft. 1½ ins., and trailing bogie, 3 ft. 7 ins. The boiler

PORTAL OF TUNNEL DRIVEN THROUGH BEACON HILL. NEW CHINESE RAILWAY.

has its center line 8 ft. 11½ ins. above rail level, and carries a working pressure of 180 lbs. per sq. in. It has a total heating surface of 1,810 sq. ft., of which the tubes contribute 1,623 sq. ft., and the firebox 187 sq. ft. The grate area is 32 sq. ft. The tank capacity for water is 2,500 Imperial gallons, of which 1,960 gallons are carried in the side tanks, and 540 in the bunker tank over the trailing bogie. In working order the engine weighs a total of 89 tons 15 cwt., of which 50 tons 18 cwt. are carried by the driving wheels. The other two locomotives are also six-wheel coupled, but of a much smaller type.

There are six open and six covered bogie wagons for dealing with the goods traffic, each with a carrying capacity of 30 tons and each 33 ft. in length. There are also 16 four-wheel covered and 10 open wagons of about 15-ton capacity and two brake vans ballasted to 15 tons each. The passenger coaches are of the bogie type, with corridor, and fitted throughout with electric light and all modern improvements. There are altogether eight passenger coaches. The completion of this line will no doubt prove to be of great importance to British and other interests in China. These facts show also the small beginnings from which railway enterprises often begin. China is awakening, and in a few years it is probable that the whole country will be covered with the modern steel highways of commerce.



TANK LOCOMOTIVE FOR THE KOWLOON-CANTON RAILWAY OF CHINA.

Old-Time Railroad Reminiscences.

By S. J. Kidder.

I believe a somewhat general impression prevails among the railroad laymen that a man who gets into the air brake business has his time pretty fully occupied in looking after such things as pertain to that particular occupation. Well, that is true so far as it goes, but when he is called upon by a railroad as a witness in a damage suit wherein it is alleged that the air brake through some defect failed to work and contributed to an accident, thus making the company responsible and he is turned over to the tender mercies of a critical, well posted and quick witted attorney for cross-examination, whose whole aim seems to be to confuse the witness, it makes the air brake man feel that there are other vocations much more congenial to his tastes. Indeed, he is quite apt to recall the time when he could with far greater facility hold his own in a discussion before the Ananias Club, as in the latter event conditions would permit of strengthening his argument by more or less perversions of the truth, while in the hands of a shrewd attorney he is subjected to all manner of importunities to side-step or distort facts already stated.

I have been called upon quite a number of times to appear as a witness on behalf of railroads, but fortunately was able to get off with but slight cross-examination by resorting to some of the intricacies of the air brake art and in my answers utilizing such knowledge in a way to frustrate the attorney while he was endeavoring with his blandishments of cold-blooded effrontery to place me in that position.

Perhaps the most astute disciple of Blackstone I ever came in contact with was an attorney in the "Hoosier" State. He was a very short, slim, nervous and energetic sort of fellow, full of fire, as would be surmised by his name, Coloric, and whose whole soul seemed to be wrapped up in winning the case for the plaintiff. The defendant was one of the trunk lines running out of Chicago, and the suit was based on an alleged air brake failure.

A night train was descending the grade into a division station where a change of engines was to be made. As the train approached the station it was not under full control and the engineer, evidently in fear of striking the engine waiting to relieve him, jumped off and was killed. The suit was promptly instituted against the railroad company and long after, I with numerous others, were notified to appear at the court house of a pretty little Indiana city, on a certain date. The court convened in due time, a jury was drawn and after a number of preliminaries, among which was a supply of cuspidors for the granger jurymen, all of whom were vigorously chewing plug tobacco, and occasionally expectorating at the nearest cuspidor with almost the precision of a projectile fired from a gun, the trial began. For some reason not apparent I was retained as the last witness and as a consequence I sat for several days in the court room a silent observer of the proceedings. One after another of the witnesses were called and when those for the defence were cross-questioned by Mr. Coloric he catechised them most unmercifully until they were in an almost hopeless state of confusion, all of which was, of course, intended to impress upon the jurors the questionable veracity of the witness.

One of the witnesses for the plaintiff was the fireman of the locomotive hauling the train and among other things he testified that the brakes worked perfectly in making all stops after leaving Chicago up to the time of the alleged failure. There was also an abundance of evidence to prove that following the change of engines the brakes were found in proper condition and the train had proceeded on its way. The fireman further stated that just before the engineer attempted to apply the brakes in descending the grade he, the fireman, had looked at the brake pipe air gauge, which registered 70 lbs., and it appeared to be largely on this that the attorney was to base his contention that the railroad had been negligent as with this normal brake pipe pressure, if everything pertaining to the equipment had been in first-class condition, the train should have stopped at the depot.

At last the critical moment arrived and I was called to the witness chair. The railroad attorney questioned me for a couple of hours, his efforts being to produce proof that the failure to stop the train was not a result of any defect in the brake apparatus but, rather, a lack of sufficient air pressure and which supply was under the control of the engineer.

While stopping at the hotel I had become well acquainted with attorney Coloric and had found him a most congenial gentleman, but during our banterings regarding the trial he had laughingly told me to look out for a grilling when he got me where he wanted me, i. e., on the witness stand, and to which I replied that the fellow who throws a boomerang sometimes gets hit with it himself. The cross-examination began with a number of irrelevent questions regarding my residence, experience with air brakes and all that sort of thing, then the lawyer propounded a long hypercritical question in substance as follows:

Suppose we have a train of eight cars composed of a locomotive, two baggage, four coaches and two Pullman cars. The engine and train is fully equipped with the latest and most approved form of Westinghouse automatic air brakes. The air brake apparatus throughout the train is in perfect condition, the hose properly coupled up, the angle cocks and cut-out cocks all open, excepting the angle cock at the rear of the train which is closed, thus giving free communication for the air to flow from the brake valve to the triple valves and auxiliary reservoirs.

The train has run eighteen miles since making the last brake application and as it descends the grade approaching the station the engineer endeavors to make a light application, but not feeling the brakes apply immediately moves the brake valve handle to emergency position. Just prior to the attempt to apply the brakes the fireman looked at the air gauge and observed that it registered 70 lbs. Now, considering all the conditions recited, I will ask the witness if it would be possible for these brakes to fail to apply with nearly or quite their maximum efficiency. "Yes, they might apply only lightly or not at all," I answered. That my reply was quite contrary to what the attorney anticipated was evident. He looked in a most bewildered way at the witness, then at the jury and followed by jumping to his feet and in an excited manner exclaimed "possibly the witness did not understand my question and I will state it again." He did so and as he resumed his seat and looked in my direction I emphatically repeated my answer. For some seconds the lawyer sat in a deep quandary, then turning to the judge remarked, "Your honor, I would like to retire to the ante-room with my associate counsel." They did so and after a conference of some ten or fifteen minutes' duration returned to the courtroom when the cross-examiner again addressed the Court by saying, "We have no further questions to ask the witness," and I was excused.

About five o'clock the following evening I repaired to the railroad station to take a train for Chicago. I had boarded the train and ensconced myself comfortably in a seat when, a minute or so before the train started, my inquisitor entered the car. He walked down the aisle, set his grip on the floor and took a seat beside me, remarking as he did so, "I want to say that you gave me the worst knockout I have ever had in this law business, but I would like to know what you were driving at in answering that question the way you did." "Why didn't you pursue your inquiries and find out?" I replied.

"Well," said he, "I have been in this business a long time and for years have frequently conducted damage suits against railroads. Many of them were on matters pertaining to air brakes and I have made a special study of that subject and thought I was quite an expert regarding it, but when you answered my question in the emphatic manner you did I concluded you knew exactly what you were talking about. In fact I know enough about human nature to let a buzz-saw alone and after consulting with my associates the conclusion was reached to drop a further examination, for fear that while I was trying to put you in a hole, I might find myself deposited there." Continuing he said, "But I would like to know on what hypothesis you could truthfully answer that question the way you did." "That's easy," I replied, "You know it requires compressed air in the auxiliary reservoirs as well as in the brake pipe, to apply brakes. Now assuming that after making the stop eighteen miles away and releasing the brakes the engineer had inadvertently placed the brake valve handle a little past the running position notch and thus lapping the valve—as has been known to occur at night—and in making the 18-mile run the brake pipe and auxiliary reservoir air gradually leaked away, though not sufficiently fast to apply the brakes, but to seriously deplete the pressure in them. Then just before the attempt to apply the brakes on the grade the brake valve handle had been moved to full release position, which quickly charged the brake pipe, and back to application position, as engineers sometimes do, and at the same moment the fireman observed the air gauge registering 70 lbs. brake pipe pressure. This action while very quickly charging the brake pipe would in the very short time have little effect in charging the depleted auxiliary reservoirs and as a consequence when the air was discharged from the brake pipe there might have been a low pressure in the auxiliary reservoirs with which to apply the brakes." "Well, I will be d——! Well, that's a bran new one on me," and I can see now that a perfect air brake apparatus without the requisite compressed air is the same as the perfect locomotive without steam, in both of which cases it devolves on the engineer to see that the motive power is in the proper receptacles to operate the machinery.

It is not to be assumed, however, that my testimony contributed to winning the case for the railroad. Far from it for the jurors, after a brief consultation in the juryroom, brought in a verdict for $15,000 damages, but which was promptly set aside by the judge as excessive. A year later I was again called upon to appear at a retrial of the case and in conversation with the railroad attorney asked him what show he would have to win a suit against a railroad, regardless of the merits of the case, before a granger jury. He hesitated a moment, then replied, "Not much." Whether my query had any effect I know not, but some two weeks later he 'phoned me my services would not be required.

"How's that," I asked.

"We have settled," said he.

"What sort of a settlement did you make?"

"Two thousand dollars," he replied, as he hung up the receiver.

New Bettendorf Steel Car Plant.

The Steel Car Works at Bettendorf, Ia., were built in 1902. In the past two years these works have been enlarged to such an extent that the plant of 1908, which was then by no means small, is only a small corner of the present one. The original tract for the old plant covered 40 acres, while the factory grounds now cover an area of 100 acres, and the buildings have an aggregate area of 800,000 sq. ft., or 18 acres under roof. Our engraving gives a very good idea of the size and arrangement of the plant as it now stands.

The original shop, which was erected in 1902, is a brick structure 700 ft. x 240 ft., and in the recent improvements there have been added to this original structure, the main fabricating and erecting shop which is of steel frame and brick construction, and is 1,400 ft. x 255 ft. x 60 ft. high, thus making one building 2,100 ft. x 255 ft. In addition to this there has been erected, a steel foundry of which the dimensions are 540 ft. x 440 ft., arranged in wings on bays. This set of buildings covers 160,000 sq. ft., and lies directly east of the main shop. We show it on next page.

The main shop is equipped with fifteen electric traveling cranes of from 3 to 10-ton capacity and approximately 60 ft. and 70 ft. spans. The old part of this building, or original shop, is divided into five bays, the two south bays being devoted to the manufacture of bolsters, the two north bays being used for the manufacture of small car parts and truck springs. At the west end of this part of the shop and connecting it to the new addition is a transfer bay equipped with cranes, magnets, etc., for distributing material from the old shop into the four bays of the new addition. There are 39 hydraulic presses in this shop designed and built by the Bettendorf Axle Co., ranging in capacity from 50 to 2,500 tons and specially designed for the peculiarity of Bettendorf construction. Near the centre of these two north bays are located series of sub-ways for assembling and riveting the underframes, which is done by means of powerful compression gap riveters above which are placed electric or air hoists suspended from small overhead cranes or trolleys for handling heavy sills, etc. Numerous Bettendorf low pressure air-furnaces serve to heat rivets and other materials. Running through this shop longitudinally are eight standard gauge tracks connecting with the various yard tracks running between different parts of the plant and yards on which are employed two locomotives and three locomotive cranes; the tracks at this plant have a total length of eight miles, the heating of this shop is supplied by the Evan-Almiral hot water system, having 75,000 sq. ft. of radiation surface which is found to comfortably warm this immense shop.

Complete cars are manufactured in this shop, such as gondola, flat and tank cars, which are designed in the same careful manner as the underframes, their respective members transmitting load from member to member directly. The Bettendorf I-beam bolsters are also made here and like other Bettendorf products are made from commercial rolled beams shaped cold in specially designed hydraulic presses and to which after shaping, are riveted the necessary cover plates, side bearings, column guides, centre plates, etc. It might be stated that there are over half a million of these bolsters in service.

Aside from these specialties this concern is gradually going into the manufacture of cars in their entirety. An all steel box car was designed by this company and is now being tried in service.

Sills, etc. are shaped cold in hydraulic presses to prevent internal forging stresses and punched and sheared in such a manner that one sill is completed in two strokes of the press which insures perfect alignment of all holes, etc., thereby eliminating the necessity of drifting and reaming to make rivet holes match and prevent the fracture of metal in drawing up and insure good riveting, making all sills interchangeable with no variation in the spacing of holes. These sills are handled between machines by powerful lifting magnets and are fed into the presses by compressed air handling, turning and feeding trucks specially designed by the company. The main machine shop which is devoted entirely to the building and repair of the hydraulic presses, machines and the elaborate dies used in the presses throughout the plant, is a well equipped, up-to-date and strictly modern shop equipped with motor driven tools.

The blasksmith shop used exclusively for the making and trimming of shop tools is a well equipped modern shop with the necessary forges, hammers, press and hardening furnaces with electric pyrometers as well as a bolt and rivet heading machine.

The steel foundry located directly east of the main shop is a steel and brick structure divided into wings or bays and designed to permit of enlargement, was commenced in 1909 with the first heats being taken from the furnaces in the summer of 1910. There are now regularly produced castings of various descriptions and largely of a very difficult nature; principally truck frames and centre sill ends. The furnace bay 70 ft. x 440 ft. is equipped with two 5-ton 70 ft. span electric traveling cranes, for handling molds and castings, one 3-ton electric traveling wall crane, one 35-ton 70 ft. span ladle crane with 35-ton main hoist and 5-ton auxiliary hoist and two 3-ton jib cranes for handling the furnace spouts. Through this department is a continuous sand conveyor for handling sand and conveying it to the sand mixers in the sand room. The two molding rooms, each 260 ft. x 50 ft., are equipped with two 5-ton 48 ft. span electric traveling cranes and miscellaneous jib cranes, pneumatic ramming tools, Bettendorf molding machines and core machines, and a continuous sand conveyor delivering sand at the various machines from the sand mixer. The sand room, 240 ft. x 50 ft., is equipped with concrete bins for sand storage, one 5-ton 48 ft. span electric crane with ½-yard grab bucket, two 25-ton continuous heavy sand mixers and two 15-ton facing sand machines. The annealing and chipping rooms arranged in two bays, each 400 ft. x 50 ft., are equipped with two continuous annealing ovens of the Bettendorf design, which greatly expedite the process and render castings of a uniform quality. A Bettendorf hydraulic press of 775-tons capacity and specially designed for this service is used to straighten and test truck frames to insure reliability and perfect alignment. Five-ton 48 ft. span electric traveling cranes serve to transport castings to the various parts of these departments and for loading castings. In another building, 140 ft. x 50 ft., among the foundry bays is the wood pattern shop on the upper floor, equipped with motor driven auto-start and stop planer, jointer, pattern grinder, saw tables, band saw, lathe, revolving oil stone, etc. On the ground floor of this building is a well arranged locker room, lavatory and swimming pool for the convenience of the employees.

VIEW OF THE BETTENDORF NEW STEEL FOUNDRY AT BETTENDORF, IOWA.

In this foundry are produced Bettendorf one-piece cast steel truck frames, of which there are now about 250,000 in service, with the arch bars, columns and journal boxes cast in one piece, thereby producing a truck with very low cost of maintenance, light weight due to reduction in number of parts, great strength, and flexibility due to the method of tieing the two frames of the truck together by means of a spring plank with pivoted connections at the side frames, which renders the truck free to adjust itself to track irregularities. The Bettendorf cast steel centre sill ends are also produced here and have the Bettendorf peculiarity, viz: reduction in the number of parts and weight, together with great strength. This is the characteristic Bettendorf idea.

General Correspondence

Second-Hand Switchers Wanted.

We are informed by Mr. James E. Bough, manager of the Pennsylvania Equipment Co., of Philadelphia, Pa., that they are in the market for two second-hand, standard gauge, six-driver switching engines, for prompt delivery, to have from 50 to 75 tons on the drivers, and the heavier the engines are, the better.

Defective Tender Brake.

Editor:

I wish to relate a recent experience with a strange combination of air brake defects, thinking that it might possibly be of some assistance to other air brake men.

On an engine equipped with the No. 6 E. T. brake, the P. R. R. standard brake valve cut-out cock with a quick action triple valve on the tender cut in, and the distributing valve also connected with the tender brake cylinder by means of the double check valve the following trouble was found to exist. After a 20-lb. reduction in brake pipe pressure the equalizing discharge valve would intermittently discharge brake pipe air, but the air gauge showed no fall in brake pipe pressure.

This indicated some leakage into the brake pipe, and as the rotary valve of the brake valve appeared to be tight the brake valve cut-out cock was tested for leakage by disconnecting its brake pipe connection, but the cock also appeared to be free from leakage.

With a view of continuing the investigation the tender brake triple valve was cut out, whereupon the trouble disappeared and upon a further examination of the tender brake the double check valve was found stuck against the automatic side with the distributing valve operating the tender brake and the triple valve piston packing ring was found to be stuck nearly all the way around in the piston groove.

Thus the stuck check valve prevented a fall in auxiliary reservoir pressure and the stuck packing ring permitted the higher auxiliary reservoir pressure to flow back into the brake pipe, causing a discharge of air from the brake valve exhaust port.

Never having encountered any trouble similar to this, I submit it, hoping it may be of interest to others, and I would be pleased to have other readers of Railway and Locomotive Engineering say if they ever had such a thing happen to them.

Oliver S. Sprout,.

Harrisburg, Pa.

Two Kinds of Indicators.

Edtior:

I am sending you two indicator diagrams taken from the same engine, but each pair was taken with a different indicator. In doing this I simply want to point out that in buying a steam engine indicator, like everything else it pays in the long run to buy a good article.

Fig. 1 shows a diagram with the expansion curve in very pronounced steps and only a suggestion of late admission. The compression line was also jagged, showing

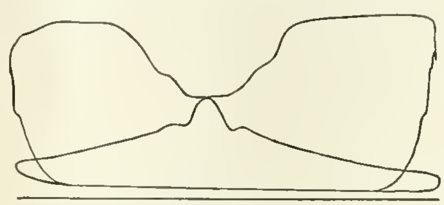


FIG. 1.

more the defect of the instrument than of the engine.

Fig. 2 was taken with the better indicator, and although the expansion line is slightly wavy the compression curve is

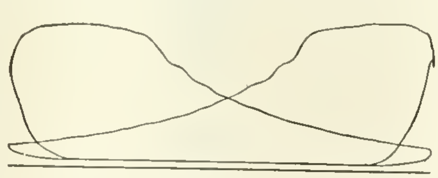


FIG. 2.

firmly drawn and the late admission, which was the defect of the engine, is clearly brought out. It is needless to say the defect was remedied as soon as possible after it had been discovered. P. D. Q.

New York, N. Y.

Proper Method of Disconnecting.

Editor:

In this month's number (February, 1911) of your paper a question is asked concerning the course to pursue in disconnecting an engine with eccentrics on one axle and the main rod connected to another and different axle. See April, 1905, number, page 160, that will tell him exactly what he wants.

Fred Nihoof.

White Sulphur Springs, W. Va.

[This is not all that can be said on the subject. We wish our readers would look back to page 60 of our February issue and write us their views of how this disconnecting may be properly done.—Editor.]

Officials Read it.

Editor:

I am quite sure you have an excellent list of premiums and while I know the magazine is well worth the money, perhaps others do not and as to the value of the premiums I guess the strongest argument would be to "show them." I am sure an examination of the premiums will be a surprise to anyone, and as one of my friends said, "I would not take $2 for your book 'The Railroad Men's Catechism.'"

Personally I do not know how much value to place upon my Railway and Locomotive Engineering. I began taking it in 1895; not very long after I had been promoted and I was surprised when I came to realize how little I really knew and how much there was to learn, and your magazine pointed out the correct way. That is what made it so valuable and getting the experience of others and those others dependable men, practical men, and "getting next" to the best way to overcome many disagreeable and perplexing situations and conditions, without the disagreeable experience attending the trials leading up to the "best way."

Only those who have received the benefits for years can realize the true value of Railway and Locomotive Engineering. I guess that is also why the officials and the best posted engineers and shop men are the easiest to secure subscriptions from and it always seemed to me if they could get $2 worth in a year, others in the business and learning the business could find no better recommendation for a $2 investment. Geo. E. Willacy

Denver, Colo.

Cleaning Front Ends.

Editor:

Referring to question in column 1, page 58, in your February issue, on front end filling up, the statement of the case as given by your correspondents is indefinite and unsatisfactory. The front end fills up with so-called "cinders," in reality unconsumed coal, from which only the volatile matter has been extracted, leaving a piece of almost pure fixed carbon jerked into the front end by the intermittent action of the exhaust steam on that most elastic of all bodies, the air, a portion of which is impelled through the stack.

The petticoat pipe and diaphragm plate are for the equalization of this movement, so that it will make a steady pull on the fire. The M. M. front end has not given satisfactory results, under the most favorable circumstances. There is an enormous waste of fuel, but it can be made to clean the front end, or rather burn the coal in the firebox to such an extent that what cinders are drawn into it will pass through.

First pay no attention to the nozzle, but set the petticoat pipe as high above the table plate as it will go, and still clean the plate, it will do so with 8 or 9 ins. opening measuring from edge of flare to the plate at the top. Set it level with the extension of stack-saddle, then lower the slide on diaphragm till it cleans absolutely.

The practice of raising the plate to stop tearing the fire is a mistake. With a very large opening the draft will tear holes in the fire all over the box, lowering the plate a little at a time will cause this to go to the front end firebox, but if lowered enough, will stop it entirely and pull even over the whole surface. The maximum opening should not exceed the area of opening at smallest opening of the stack. If the engine does not pull strong enough on the fire, bush the nozzle rather than put a split in it.

Referring to article I, page 69 of same issue, fitting a smoke stack is a very good article, but with the nozzle in use at the present time on most engines, the exhaust is thrown across against the side of stack crossing at the nozzle tip, and not going up the centre of stack as it should. You can find stacks all over the western country, cut out at the base from this cause, not the stack being out of line.

The article on back pressure, pages 78-79-80, leads me to ask, is it any great wonder that our engines only have an efficiency of 66⅔ per cent. working against such a back pressure as this. There are engines today of 100 tons, running double nozzles very little larger than we ran on little 14x22, 28-ton engines 30 years ago. It seems to me about time this evil was recognized, and an effort made to remedy it. It is a very easy matter to put a pipe into the exhaust channel and run it to the cab with a gauge on it and see what back pressure you really have, as most of these engines are doing worse with the single than with the double nozzles. J. A. Eson.

Denver, Col.

[The article on back pressure, which appeared on pages 78, 79 and 80 of our February issue, was on "Air Pump Back Pressure." Perhaps our correspondent has temporarily overlooked the fact that the pages mentioned are the Air Brake Department.—Editor.]

Trying to Make Flues Tight.

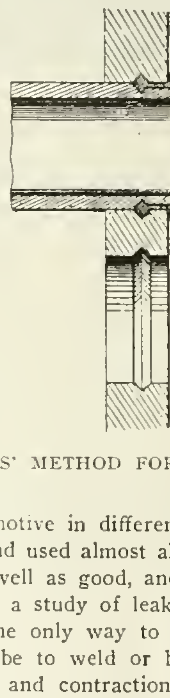
Editor:

Referring to the editorial in your February number with regard to flue failures, I will say that flue failures will not be stopped until they weld or braze them in. This can be done now with the oxy-acetylene process. I believe they can and will be put in this way just as sure as they are using air pumps and injectors on engines today. It was said for years that air pumps and injectors could not be used, so it has been said that flues could not be welded or brazed in. There is no reason why it will not work if the weld can be made, and this welding is now being done. The flue can be reamed out and the spout will be just as good or better than new.

One great cause of flue failures now, is that they are not only about half expanded or rolled when put in, as I have seen flues leak when engines came out of the shop, after having new ones put in.

One cause of cracked bridges is that they are cracked when trying to expand the flues, when it has become loose after being used awhile. If you weld or braze flues in, they can use a thicker flue, which will make them last longer where treated water is used.

Having had over 35 years' experience



HINES' METHOD FOR FLUES.

on a locomotive in different parts of the country, and used almost all kinds of bad water, as well as good, and for 30 years have made a study of leaky flues, I will say that the only way to stop flue failures, will be to weld or braze them in. Expansion and contraction has very little, if anything, to do with making flues leak. After having watched leaky flues for over 30 years, I might be able to tell or say something about them. It is a great study and problem.

It is a stand off now, between inferior iron and cheap work in putting flues in, The extra cost of failures would more than pay for good iron and having them put in properly. D. B. Hines,

Loco. Engr., U. P. Ry.

Norfolk, Neb.

More About the "Shakopee."

Editor:

In your issue of February, 1911,, relative to the car named the "Shakopee." This car was designed by Mr. L. C. Timm, engineer and one of the oldest engineers on the C. I. & S. railroad and is still in the employ of that railroad, together with his assistant, Max Kettle, another engineer built the Minnesota Valley car and engine named "Shakopee" in 1865. P. M. Miller,

Gibson, Ind. Sec. Y. M. C. A.

The Old Shakopee Again.

Editor:

I think I can furnish you and Mr. Herbert Fisher, of Taunton, Mass., the desired information concerning the car and engine combination "Shakopee," or the Minnesota Valley's first passenger train, between Mendota and Shakopee, Minnesota. This road now is the Sioux City division of the Chicago, St. Paul, Minneapolis & Omaha. The engine was built in Columbus, Ohio, by Mr. Romaine, a master mechanic, on the, at that time, Bellfontaine Railroad. It was bought and brought to Minnesota by Mr. J. B. Lincoln, the superintendent of the Minnesota Valley. I knew the engine first in 1866, with Mr. Anson Messer as engineer, doing the passenger work at that time on the 20 miles of road.

A year after this, after the road was built from Mendota to West St. Paul, the engine did the work between Minneapolis and St. Paul jointly on the Minnesota Central, now a division of the Chicago, Milwaukee & St. Paul, and the Minnesota Valley, this being the first short line train between the Twin Cities. The distance via Fort Snelling and Mendota is one hour, the mileage fifteen, fare 50 cents. The conductor that ran this train most of the time was Mr. George Huusacker, and the engineer Mr. Reed Bracken.

Most of us engineers had a chance at this short line work whenever the regular engineer was off. I know I ran the engine for a week once, and I can now recall the beauty of the little machine's work and the convenience and comfort for the engineer and fireman. I know of nothing to compare the little engine and car to except our finest automobiles of this day.

If my memory serves me right, her dimensions were 9 x 18 ins., 50-in. drivers, link motion, large wagon-top and dome for dry steam space. (Note scape pipe in roof of car.) Nothing could be devised to ride any smoother or easier than this combination. The car would seat about thirty passengers; the wood and water was taken in through the side door at engine end.

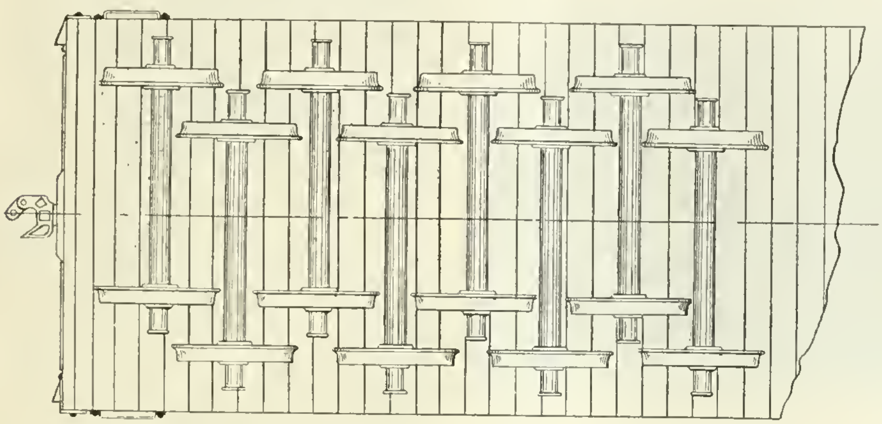
We engineers never found any excuse when called to run the "Shakopee," especially in winter time, as you may conclude by observation the engine crew took about as much comfort as the passengers. Mr. James Waters, master mechanic of the Minnesota Central, rebuilt an old Harkness engine, 12 x 18 ins., about same dimensions as the "Shakopee" in 1867, and Mr. D. C. Shepherd, superintendent, used it for a business car, until the Milwaukee Railroad took possession, and in the early 70's the careers of the Little Dummys were ended. I am very much pleased to get this photo of the old "Shakopee." I shall place it with my collection of old-time engines that I have gathered the past fifty years.

Minneapolis, Minn. B. N. Lewis,
Conductor Soo Line.

Right and Wrong Way.

Editor:

The attached print shows our method of loading car, and tender wheels for shipment to prevent damage to journals by the rolling and bumping motions caused in transit. Before all concerned were given one of these prints as to the proper way to load wheels, we often got a full car load that was improperly loaded and every journal would be badly damaged and have to be turned up again. If the wheels are loaded as shown they cannot be damaged in transit.



RIGHT WAY TO LOAD WHEELS JOURNALS CLEAR OF FLANGES.

Clinton, Ia. Chas Markel,
Shop Foreman, C. & N. W. Ry.

Which Is More Economical?

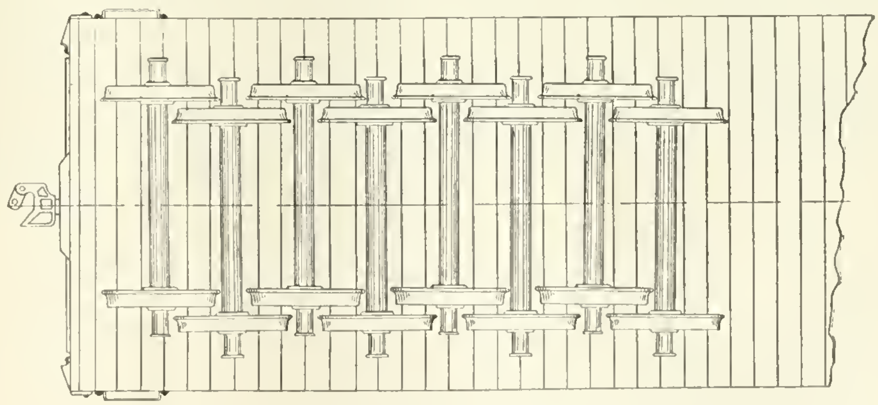
Editor:

Being a reader and subscriber to your valuable paper, I would feel obliged to have the following question answered: Two engines, same in every respect, leave a given point, B. On either side of which are two points, viz., A and C, on same level as B, distances between each point 80 miles; from B to C is level track, and from B to A has many gradients, the longest being five miles, vertical height 100 feet. I would like to know which of the two engines would be the more economical, the time allowed for each engine to do the journey being 105 minutes the load in each case being 250 tons and tractive effort of each 22,000 lbs., no curves to be taken into account.

Wm. Collis.

New York, N. Y.

[When you ask which engine is the more economical of the two you must remember that simply burning less coal does not entitle the engine running between B and C to be considered as the more economical. This engine is not worked as hard as the one on the hilly division, but it does not do as much work while pulling equal tonnage. As far as the railway is concerned it burns less coal and probably uses less stores and is in that respect economical. It is quite within the bounds of possibility that the engine on the hilly division may do its work per mile or per hour on less coal and so be more economical than the first engine. Your question does not give all the data necessary to completely answer the question. If you did not run the engine at all it would cost nothing, but that would not be economy. Try the ton-mile-per-hour on the problem and see how it looks. If any others of our readers can throw any light on the subject we will be happy to hear from them, and the columns of Railway and Locomotive Engineering are open to them.—Editor.]



WRONG WAY OF LOADING WHEELS; FLANGES STRIKE JOURNALS.

What Is Negative Lead?

Editor:

Kindly state what negative lead is? The method of valve setting by Mr. Chas. Markel in the February issue of Railway and Locomotive Engineering prompts the question. You should know the travel of eccentric and be guided by same regardless of axle diameter. About 1889 you published a treatise on same. I have read behind Mr. Sinclair, Mr. Meyer, Mr. Hobart and Mr. Hemenway, while running the *American Machinist.* I find all folks working today as described by Chordal. "Negative" is the term I am anxious to grasp.

Arthur K. Marks.

New York.

[The term negative lead, though a common one is not a very good term. Lead or positive lead is the opening of the port at the beginning of the stroke, negative lead is a covering of the port at the beginning of the stroke. Mr. Markel refers (page 83 of the February issue) to 1/8 in. negative lead. This means that the port is closed at the beginning of the stroke and that the valve extender over it to the length of 1/8 in. The valve will have to travel 1/8 in. before valve and port come line and line, after which the port will be opened by the continued motion of the valve. It should be borne in mind that the lap of a valve is a property of the valve itself due to its construction and that lead is not dependent on the construction of the valve. Lead is due to the setting, and if instead of giving the valve lead, which means opening at the beginning of the stroke, you alter the setting so that there is not only no lead but a slight overlap you give the valve what is called negative lead or set it, say 1/8 in. blind.—Editor.]

The Longitudinal Railway of Chile.

Editor:

As its name implies, this railway will run practically the length of Chile from north to south, the terminals being at Arica in the north and Osorno in the south. The southern section, the first to be undertaken, presented considerable engineering difficulties, but the northern section, which is now in course of construction, and will extend from Pueblo Hundido to Lagunas, a distance of 719 km., for the most part traverses desert country, crossing the nitrate deposits of Taltal, Aguas Blancas, Antofagasta and Tocopilla, a route which allows the permanent works to be of a comparatively simple character. There are no tunnels, and only one bridge; the maximum gradient is 1 in 33, and the sharpest curve is of 100-m. radius, which is not excessive for a metre-gauge track. The rails weigh 50 lbs. a yard, and are laid on sleepers of native wood.

The engine illustrated is one of two supplied by the Hunslet Engine Company of Leeds. It has the following leading dimensions: Cylinders, 15 in. diameter by 18 in. stroke; diameter of the driving wheels, 2 ft. 10 ins., and of bogie wheels, 31 ft. 11 ins.; driving wheelbase, 7 ft.; total wheelbase, 17 ft. 9 ins.; boiler barrel, length, 10 ft. 7 ins., diameter, 3 ft. 7 ins., containing 117 tubes of 1⅞ in. diameter; working pressure, 160 lbs. per sq. in.; heating surface, firebox, 57 sq. ft., tubes 631 sq. ft., total, 688 sq. ft.; grate area, 12½ sq. ft.; capacity of tanks, 930 Imperial gallons, and of bunker, 97 cu. ft. The weight in working order is 35 tons, 3 cwt. of which 27 tons rest on the coupled wheels.

A. R. B.

Chesham, Eng.

TANK ENGINE ON THE LONGITUDINAL OF CHILE.

A Little Pipe Bending Kink.

Editor:

There are many little kinks in shop practice, the most simple of which are often the most valuable. A hyperbole is usually something that is, while it is not. A hyperbola is a certain kind of curve. A kink is also a curve to a workman, and the kink which is mentioned below is a kink to avoid a kink, and therefore a hyperbole, although it is not. In bending pipe to some desired form or curve, it is universally desirable to have the work free from kinks or blemishes, and even in some cases, cracks.

A piece of lead pipe is easily and neatly bent by inserting a coil spring, which can be withdrawn after the pipe is bent. An iron pipe can be smoothly bent by laying it in a fitted groove of the block over which it is turned, and if the bending pressure is applied by means of a grooved roller, so much the better. The above are only mentioned in passing, but the bending of a brass pipe neatly is the snare of the unsuspecting and joy of the good workman, when successfully accomplished.

The usual way to bend a brass pipe is to fill it with dry sand or resin (not quite full), close both ends and pour out the contents after the operation. The best way, however, and the one of which this article treats, is to prepare a metal according to the following formula: Bismuth, 8 parts; tin, 3 parts; lead, 5 parts, by weight. This metal melts below 212 degs. F., and therefore will flow in boiling water.

Set the pipe to be bent upon end, resting it on a board or upon sand, pour it full of this metal, previously heated in a ladle, and allow to cool. Now bend the pipe to any desired shape, and then immerse in boiling water, which melts the "core" and leaves the pipe free. The pipe may be turned about in the water, if there are any "pockets" which would hold the filling. Should it be necessary to bend any quantity of pieces, it will pay to provide a boiling tank with a mold at the bottom, to catch the metal, which can be used over and over without limit.

ALLEN G. WOOD.

New York.

The Cast Iron Microbe.

Editor:

The word microbe has been shot at us so often with alarm guns and missed, that we had become proof to that kind of missile, but at last some enterprising microbist has hit us with the announcement that a certain kind of ferocious microbe has proceeded to feed on cast iron.

We had become accustomed to hearing that all sorts of food and things that yield comfort to mankind were devoured by microbes, but they left enough food to go round; now if the pests have turned their attention to materials we depend upon for safety, verily we are undone. Think of car wheels for instance having their inwards devoured by microbes till they become in the condition of a maggot-eaten cheese. The train is speeding along, and all at once the microbe's work overcomes the resistance of the metal, when unexpected disaster overtakes the train.

Alarmed by contemplation of these horrible possibilities, we consulted a well known microbist in New York, and he comforted us by saying that the influence and activity of these organisms, as agents of destruction of health and life, have been absurdly exaggerated. Generally speaking, he substantially states, there is no need to worry about them. This sounds like common sense, because the vast majority of people know nothing whatever about microbes and therefore don't worry about them. And such people live and move and have their being, and are, as a rule, a sturdy, healthy lot. According to modern discoveries there are microbes everywhere. There are millions of them on every bank note, on every trolley car strap, on all lips, however kissable, on every tongue, in every part of every human system, in the streets, in the houses—in fact there's no space or place that hasn't its microbes.

D. A. S.

Labor and Intellect.

Editor:

I want to give you this quotation from the great art critic and writer who exercised in his day a powerful influence, not only in the realm of art, but upon men's minds and consciences.

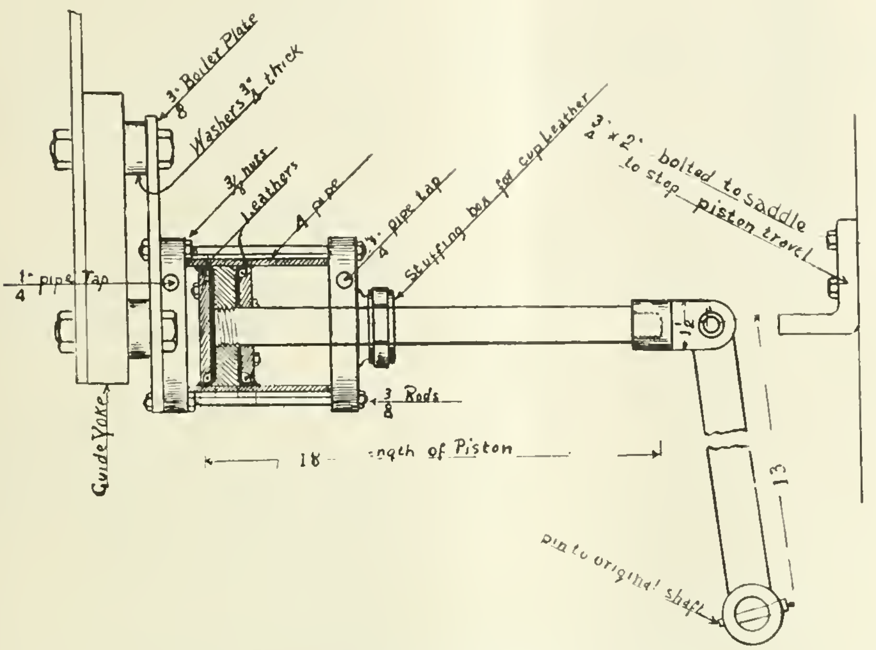
Ruskin, the philosopher, says that it is no less fatal error to despise labor, when regulated by intellect than to value it for its own sake. We are always in these days trying to separate the two; we want one man to be always thinking and another to be always working, and we call one a gentleman and the other our operative; whereas the workman ought often to be thinking and the thinker often to be working and both should be gentlemen in the best sense. As it is we make both ungently, the one envying and the other despising his brother, and the mass of society is made up of morbid thinkers and miserable workers. Now it is only by labor that thought can be made happy; and the professions should be liberal and there should be less pride felt in peculiarity of employment and more in excellence of achievement.

G. J. S. H.

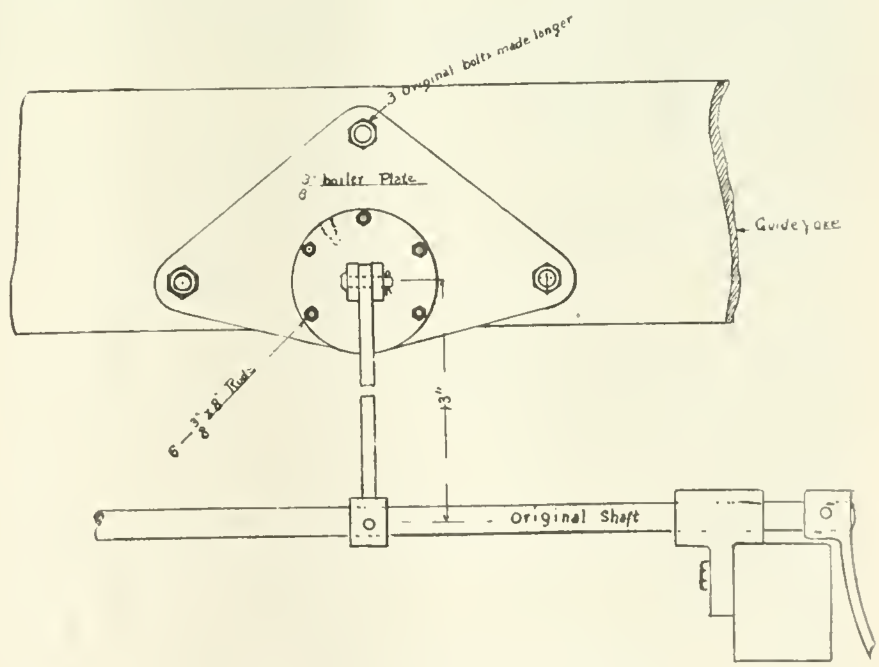
Cylinder Cock Opener.

Editor:

The engraving shows a cylinder cock opener operated by air, which was designed by Mr. F. G. Benjamin, at one time master mechanic of the Clinton division of the C. N.-W. Ry. This arrangement was applied to an Atlantic type of engine during 1904 and is still in use and has cost but a trifle for repairs. The cylinder is made from 4-in. pipe. It is bolted to guide yoke as shown. The piston has leather on both sides and air is admitted at cylinder heads by a four-way cock. This cock is located on boiler head in close reach of engineman. To operate the opener the handle on four-way cock is turned one-quarter turn which admits air to cylinder and opens the cocks and holds them open until handle is brought back to release position, which exhausts the air in one end of cylinder and admits it to the other end, thus securing the closed position.



SECTION OF CYLINDER OF CYLINDER COCK OPENER.



FRONT VIEW OF CYLINDER COCK OPENER.

CHARLES MARKEL,
Shop foreman, C. & N. W. Ry.
Clinton, Ia.

Heavy Mallets for the B. & O.

The Baltimore & Ohio Railroad, were, not long ago, notified that five of the largest railroad locomotives ever constructed, of the Mallet articulated compound type, have been completed at the Schenectady shops of the American Locomotive Company. Ten of these huge locomotives were contracted for by the Baltimore & Ohio several months ago, the present installment being the first delivery to be made under the contract. The weight of the new engines is 461,000 lbs., or 51,000 lbs. in excess of any motive power heretofore built; the tender weighs 181,000 lbs., making the combined weight of the engine and tender 642,000 lbs. The new locomotives will be placed in service to haul freight trains over the mountain divisions of the B. & O.

This railroad was the first American road to purchase a Mallet engine, which is a French design, and after exhibiting one as a part of the company's display at the World's Fair at St. Louis, in 1904, it was put in use as a helper engine in freight service over the Allegheny mountains This engine, which is still in use on the Connellsville division, weighed 334,500 lbs. It was the heaviest engine in the world at the time it was built. This type is especially adapted to American railroading, where large tonnage is handled, still larger locomotives of the same type were purchased by other lines for use as helpers on freight trains.

The new B. & O. Mallet locomotives are 93 ft. 3¼ ins. long from the pilot to the drawbar on the tender, having 16 driving wheels arranged in sets of four pairs. The engine also has two sets of cylinders, those forward being low-pressure and those in the rear high-pressure cylinders. The steam pressure of the new engines is 210 lbs. to the sq. in. These Mallet engines were included in the contracts for new equipment placed early last year with a view to equipping the road in order to expeditiously handle the business offered and to provide for increased business. At the same time, it will be remembered, the Baltimore & Ohio management began the construction of a third track across the mountains in West Virginia, which work is progressing satisfactorily. We hope to be able to illustrate and describe these engines in the near future for the benefit of our raders.

Paint Like Enamel.

To make white paint look like real enamel, take a piece of caustic soda the size of a marble and dissolve throughly in half a wineglassful of spirits of turpentine, and add this to a 2-lb. tin of white zinc paint; stir well, and it is ready for use. When dry, it will be found to have a fine glossy surface which almost equals enamel.

I have encountered some fine ladies and gentlemen who might as well have been born caterpillars.—*David Copperfield.*

Catechism of Railroad Operation

By Angus Sinclair

Second Series.

1. Has there been any obstacles in the way that prevented you from obtaining the information that would enable you to pass this examination?

A. The answer would be based on the experience of the candidate.

2. Have there been any signals introduced during the year or any changes on the old ones?

A. The answer to this question will be a test of the candidate's knowledge of signals.

3. Have you made any improvement in your methods of firing during the past year? Have you been able to reduce the amount of smoke?

A. Answers to these questions will be based on the candidate's experience.

4. Are you sufficiently familiar with the rules of the road to take an engine or train over the road without the help of a conductor?

A. I am.

5. What is a Train under the rules?

A. One or more engines coupled with or without cars, displaying markers.

6. What is a Regular Train?

A. A train represented on the time table. It may consist of sections.

7. What is a Section of a train?

A. One of two or more trains running on the same schedule displaying signals or for which signals are displayed.

8. What is an Extra train?

A. A train not represented on the time table.

9. What is a Superior Train?

A. A train having preference over other trains.

10. What makes a train superior to others?

A. Right, class or direction. Right is conferred by train order. Class and direction by time table. Superiority of direction is limited to single track.

11. What is meant by a train having Superior Right?

A. A right given by train order.

12. What is meant by a train being of Superior Class?

A. A train given precedence over others by time table.

13. What is a train of Superior Direction?

A. A train given precedence in the direction specified in the time table as between trains of the same class.

14. What is a time table?

A. The authority over the movement of regular trains subject to the rules. It contains the classified schedules of trains with instructions relating thereto.

15. What is a schedule?

A. That part of a time table which prescribes the class, direction, number and movement of trains.

16. What is the main track?

A. The principal track on which trains are operated.

17. What is a fixed signal?

A. A signal having location established for the protection of trains.

18. What is the origin of power?

A. Most of the power used in the vast variety of industrial operations we are familiar with, from the operating of a sewing machine to the propelling of a huge steamship, is derived from combustion of fuel. All the power energy, whether derived from combustion, from water-wheels, wind mills or solar engines is utilizing energy that originally came from the sun's rays.

19. What is heat supposed to be?

A. Heat is supposed to be a condition of violent motion in the molecules composing any substance. Heat was long supposed to be a subtle fluid without weight that passed from a fire or other source of heat and gave out the sensation of heat. The investigations of scientists last century demonstrated that heat is created by the chemical combustion of certain substances, as in combustion and from friction.

20. Give examples of heat produced by friction.

A. The heating of a car axle and the heat produced by a tool cutting metal.

21. What is mechanical heat?

A. The heat produced by friction or by impact of two bodies, such as the heating of a piece of iron by hammering.

22. What is combustion?

A. Combustion is the combination at a high temperature of oxygen and carbon or other combustible substance.

23. What are the most common characteristics of a fire burning in a furnace.

A. Carbon, which is the fuel, and oxygen, which is the supporter of combustion, come together at a certain temperature, the two elements combine, producing intense light and heat. Combustion results from a strong natural tendency that oxygen and carbon have for each other; but they cannot combine freely until a certain temperature is reached, known as the igniting temperature.

There are other forms of combustion besides that known as burning. The rusting of iron and the explosion of dynamite are examples of very slow and very rapid combustion.

24. From whence comes the oxygen that supports combustion?

A. From the atmosphere which consists of a mixture of one pound of oxygen to 3.35 pounds of nitrogen; or by volume, one cubic foot of oxygen to 3.76 cubic feet of nitrogen.

25. What function does nitrogen gas perform in combustion?

A. Nitrogen merely dilutes the oxygen preventing that gas from being too strong, for pure oxygen would burn up almost any substance it came in contact with.

26. What is common bituminous coal?

A. Bituminous coal consists of a mixture of fixed carbon and of volatile gases mostly inflammable hydro-carbons. The amount of fixed carbon varies from 37 to 70 per cent., while the volatile matter averages from 25 to 35 per cent.

27. What is anthracite coal?

A. A coal that had undergone a sort of cooking process sometime in the earth's history which drove out most of the volatile gases. Good anthracite contains about 83 per cent. of fixed carbon and 4 per cent. of volatile matter.

28. What is a heat unit?

A. It is an expression of value used in measuring heat just as a pound is used in weighing. One heat unit, generally called a British thermal unit or B. T. U. is the quantity of heat required to raise the temperature of 1 lb. of water 1 deg. Fahr. at its greatest density, which is 39.2 degs. Fahr., or 4 degs. C.

29. How many heat units are produced in burning each pound of coal or other combustible under the most favorable conditions?

A. One pound of hydrogen gas combining in combustion with hydrogen produces about 62,000 heat units.

One pound of solid hydrogen of the density forming a constituent of coal, liberates about 50,000 heat units.

One pound of gaseous carbon on combining with 2⅔ pounds of oxygen forming carbon dioxide liberates almost 20,000 heat units.

One pound of solid carbon on combining with 2⅔ pounds of oxygen to form carbon dioxide produces about 15,000 heat units.

One pound of solid carbon combining with 1⅓ pounds of oxygen to form carbon monoxide generates about 4,500 units of heat.

30. Is there anything particularly worthy of notice in the two last acts of combustion?

A. Yes. One pound of carbon is burned in both cases, but in one case where a full supply of oxygen is used the heat produced is more than three times the volume of heat produced when this supply of oxygen is restricted. This means that a fire burning coal into carbon dioxide is three times more efficient than where the fuel is burned to carbon monoxide. The lesson taught is let the fuel have all the air needed.

31. What is the effect of admitting less than sufficient air to the fire?

A. The act of combustion produces a gas deficient in heat.

32. What is the effect of admitting an excessive supply of air to the fire?

A. The volume of air in excess of that needed to supply oxygen to form carbon dioxide absorbs part of the heat that ought to be used for steam making. It also tends to depress the fire below the ignition temperature.

33. What is the ignition temperature of fuel?

A. The degree of heat at which any kind of fuel begins to burn is called its ignition temperature. Different kinds of fuel have different igniting points. If one takes a piece of iron heated to a dim red and applies it to a gas jet, the gas will not ignite. Increase the temperature of the iron until it reaches a cherry red and it will ignite the gas jet. From this experiment it may be inferred that this ignition temperature of hydrogen gas is about the same as the cherry heat of iron which is about 1,600 degs. Fahr. As carbon requires still greater heat for ignition, it may safely be inferred that the heat of a fire-box performing active duty is considerably higher than the cherry heat of iron.

Why an Engine Moves.

We have had several enquiries which involve the question, Why does an engine move? and for the sake of our correspondents we will endeavor to briefly give the reasons. Let us confine our attention to one side of an ordinary locomotive, with 20 x 24 ins. cylinders and 56 ins. driving wheels, and a boiler pressure of 200 lbs. The master mechanics' rule for the mean effective pressure in the cylinders is 85 per cent. of the boiler pressure, and in this case it amounts to 170 lbs.

This engine has a piston area of 314.16 sq. ins. and 170 lbs on each square inch imparts a total pressure to the piston of 53,407.2 lbs. but for the sake of facilitating the calculation, let us say 53,400 lbs. M. E. P. With piston at the back end of the cylinder and crank pin on back quarter, or just above it, the pull of the piston on rod, crosshead and main rod reaches the pin. The wheel is a lever with fulcrum on the rail. This fulcrum changes from moment to moment as the wheel rolls along, and the point of contact between wheel and rail is called the instantaneous fulcrum, as the length of the lever or the operating part of the wheel above it changes momentarily. It is easy to see that if the crank pin is ever so little above the center line of the axle the pull of the main rod will turn the wheel and the engine will move forward. The effective pull, as we have seen, was 53,400 lbs., and this is applied to the wheel lever of maximum length when the crank pin is on the top quarter, for this is 40 ins. above the rail.

The force of 53,400 lbs. is therefore applied to the crank pin pulling it forward, but at the same time exactly this pressure is applied to the back cylinder cover, and the cylinders bolted to the frame carries this same force back to the axle box and tends to push box, axle, and indeed the whole engine backward. The center of the axle is, however, only 28 ins. above the rail. We have therefore the same force, viz., 53,400 lbs., applied to two levers of different lengths, one 40 ins. long and the other 28; that is in the proportion of 10 to 7. The moment of the force at the crank pin, about the instantaneous fulcrum at the rail is $53,400 \times 40 = 2,136,000$, and that at the axle is $53,400 \times 28 = 1,495,200$. The difference between these two moments is 640,800, in favor of the crank pin, and the engine moves forward.

On the back stroke the pressure on the piston and front cylinder cover is 53,400 lbs., and the moment of the force at the crank pin when on the lower quarter or 16 ins. above the rail, is 854,400. The moment of the force at the axle-center about the fulcrum on the rail, is 1,495,200. The thrusts on the pin tends to drive the pin, wheel and engine backward, while the pressure on the front cylinder-cover, frame and axle, tends to drive the engine ahead. The difference between these two moments is 640,800; the same as in the previous case, and the engine continues to move ahead.

On the back stroke the steam practically pulls the cylinder over the piston a distance of 2 ft., but the half circumference of the wheel is 7.33 ft., which is the distance the engine moves ahead. On the forward stroke the piston is pushed through the cylinder 2 ft., while the engine moves ahead 7.33 ft.

To picture the push of the piston as it acts on the crank pin when below the center line of the axle, let us suppose we have an ordinary wheelbarrow with wheel at the left hand side of the observer. Suppose that the two legs of the barrow have small wheels so that the whole can easily be pulled along without anyone touching the handles. Now tie a string to the vertical spoke on the lower half of the wheel. This is the one standing between the hub and the ground. If this string leading forward from the barrow be pulled, one would almost expect that the wheel would move in the direction of the hands of a clock, and that the wheelbarrow would move backward, and one would almost expect the spoke with the string attached would swing to the left.

As a matter of fact, neither wheel nor spoke move in this way, and any one who cares to prove it can easily do so with a toy cart or other small vehicle. If there is sufficient weight on the wheelbarrow to prevent slipping, a pull straight ahead on the string attached near the rim to the vertical spoke, will actually produce a motion of the wheel in a counter-clockwise direction, and the pull on the string becomes stronger in consequence, and the wheelbarrow will roll forward toward the man who is pulling on the string. This action is exactly opposite what occurs on the engine. Similar action to what takes place on an engine would be secured if the man got on the wheelbarrow and applied force to the vertical spoke below the centre line of the wheel.

Establishing the H. P. Measurement.

When engineers were first becoming familiar with the methods of measuring mechanical power, they frequently speculated on where the breed of horses could be found which would keep at work raising 33,000 pounds one foot per minute, or the equivalent familiar to men accustomed to pile driving by horse power of raising 330 pounds 100 feet per minute. Since 33,000 pounds raised one foot per minute was called one horse power, it was natural for people to suppose that the engineers who established that unit of measurement based it upon the actual work performed by horses. But that was not the case. The method of fixing the unit is a testimony to the shrewd business methods of James Watt.

Towards the end of the eighteenth century Boulton & Watt were the principal engine builders in Great Britain, and it became necessary to establish a unit of power. Watt in his usual careful manner proceeded to find out the average work which the horses in his district could perform. After careful investigation he found that the raising of 22,000 pounds one foot per minute was about an actual horse power. Business was dull at the time and customers hard to find, so he decided that artificial encouragement was necessary to induce power users to buy steam engines. As a method of encouraging business, Watt offered to sell engines reckoning 33,000 pounds to a horse power. This was intended as a temporary arrangement, but that kind of horse power became popular with power users, and the engine builders had to abide by the false unit.

Heavy Pacific Passenger Engine for the New York Central Lines

Heavy Locomotive for the N.Y.C. Lines.

The requirements of heavy through traffic between New York and Chicago over the N. Y. C. Lines has for a long time necessitated the use of the heaviest and most powerful high speed passenger locomotives that it has been possible to obtain under existing conditions. These circumstances have done much to bring the Pacific type engine to its present high state of development. The excellent example of this class here illustrated, represents the latest type of standard heavy passenger engine on the N. Y. C. Lines.

In the early part of 1907 the American Locomotive Company built for the L. S. & M. S. division of the N. Y. C. Lines some very heavy and very powerful Pacific type passenger engines, which were at that time, and with few exceptions still are the heaviest passenger engines in actual service. These engines proved to be very successful in operation on the heaviest trains and immediately became the standard heavy type passenger engines on the N. Y. C. Lines, practically no change of importance having been made in the general design up to the present time, successive orders to the builders differing only in minor details.

As the boilers of the Pacific type engines already built and in service on the N. Y. C. Lines had nearly reached the maximum size permitted on engines of this type, the railroad company's attention was directed toward the use of superheated steam as a possible means of increasing the boiler capacity of these engines. After successfully experimenting with individual engines of this class it was finally decided to apply superheaters to the latest engines and to otherwise retain the standard design, thus obtaining a substantial increase in boiler power without adding a new type to the railway's classification. The engines here illustrated were then equipped with the latest approved type of Schmidt fire tube superheaters as adopted for the particular service required.

In general, the Schmidt standard type with top header is used, the application being made in the regular way. Particular attention should be called to the arrangement of steam pipes connecting the superheater header with the cylinders.

In order to obtain the maximum free area in the smoke box under the table plate for the waste gases, the steam pipes are led out through the side of the smoke box to the cylinders instead of being jointed to them on the inside and at the bottom of the smoke box in the regular way. This arrangement provides a very open smoke box, giving correspondingly easy access to superheater and general smoke box fittings. This arrangement of steam pipes has the additional advantage of greatly simplifying and strengthening the coring of the cylinder castings. Owing to the greater size and simplicity of the lightening cores, the danger of shifted cores causing thin walls or restricted passages is reduced to a minimum and taken as a whole provides for the simplest and most direct passage of steam from the superheater header to steam chest and one open to inspection in its entire length.

The general design as a whole presents no unusual features in addition to steam pipe application as already noted, but is of interest on account of its general symmetrical appearance, large size and as representing the highest development of the Pacific type engine for heavy fast passenger service on a road whose profile permits the use of 79-in. drivers for its entire length and on which speed, in accordance with this size wheel is of daily occurrence.

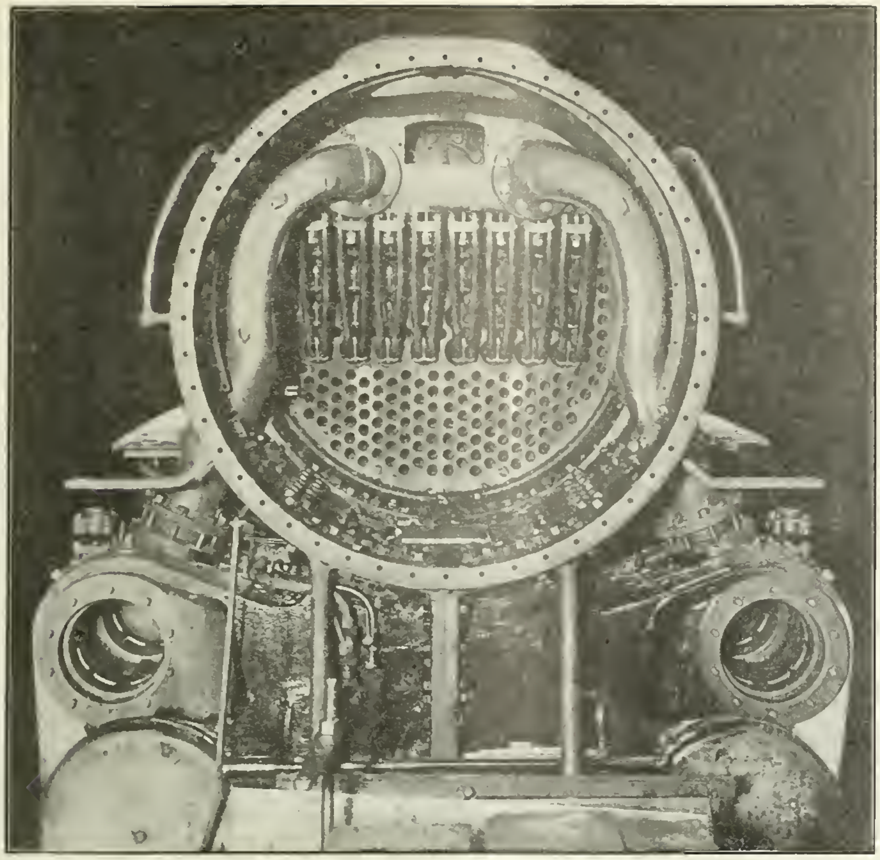
In order to best utilize steam of a high degree of superheat in high speed passenger engines it was deemed advisable to change the cylinder dimensions on these engines from 22 x 28 to 23½ x 26; this has resulted in a slightly increased starting tractive power, the boiler pressure remaining the same, but owing to the lower resulting piston speed and the use of superheated steam, the experience so far obtained with these engines has shown a very satisfactory increase in power at the higher operating speeds required by the regular train schedules.

Attention should be called to the use of the builders' latest type of Walschaerts valve gear crosshead and guide; this arrangement insures absolute alignment of the crosshead and valve, the guide being secured to the valve head and centered by the bore of the valve chamber as well as giving free access for inspection and repairs. It will be interesting to note that other details of the valve gear remain substantially as on the original design, a simple straight line motion. The builders' latest type of radial outside bearing trailing truck with single bar frame and construction substantially as applied by them to many recent Pacific type engines, is used in this design, differing from previous engines in that they were built with the double bar frame construction. On account of lightness and accessability for repairs it was deemed advisable to apply the latest type of truck to these engines. Another feature which, while common abroad, is a novelty in American practice, is the use of a single U-shaped heavy pressed steel plate bumper instead of the conventional steel casting or heavy wooden beam with plate backing.

A table giving the general engine characteristics is given below, showing the difference in dimensions between the original

FAST PASSENGER, 4-6-2, FOR THE NEW YORK CENTRAL LINES.

J. F. Deems, General Superintendent of Motive Power. American Locomotive Company, Builders.



FRONT OF N. Y. C. 4-6-2 SHOWING SUPERHEATER.

engines and of those here illustrated as the latest N. Y. C. Lines standard engines.

LATEST DESIGN AS ILLUSTRATED.

Type, 4-6-2.
Service, passenger.
Cylinders, 23½ x 26 ins.
Boiler—Type, conical connection; diameter, 72 ins.; working pressure, 200 lbs.
Firebox—Length, 108 ins.; width, 75¼ ins.; grate area, 56.4 sq. ft.; fuel, soft coal.
Tubes—Number, 32, 5½ ins., and 175, 2¼ ins.; length, 21 ft. 6 ins.
Heating Surface—Arch tubes, 28 sq. ft.; tubes, 3,192 sq. ft.; firebox, 200 sq. ft.; total, 3,420 sq. ft.
Superheating Surface, 765 sq. ft.
Driving Wheels—Diameter, 79 ins.; journals, 10½ x 12 ins.
Truck Wheels—Front, diameter, 36 ins.; journals, 6½ x 12 ins.; trailing, diameter, 50 ins.; journals, 8 x 14 ins.
Wheel Base—Driving, 14 ft.; total engine, 36 ft. 6 ins.; total engine and tender, 68 ft.
Weight—On driving wheels, 171,500 lbs.; total engine, 269,000 lbs.; total engine and tender, about 424,000 lbs.
Tender—Wheels, diameter, 36 ins.; journals, 5½ x 10 ins.; capacity, water, 7,500 gals.; coal, 12 tons.

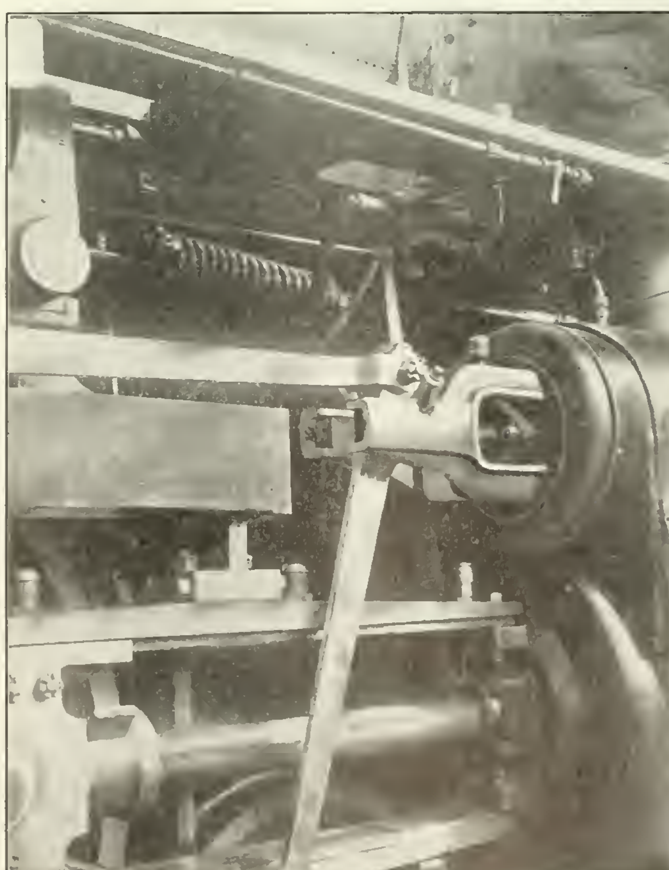
Boiling Airless Water.

When water freezes solid in very cold weather the particles of air which are normally held in solution by the water, are forced out, and the mass of ice contains practically nothing but pure water in the solid state. A very interesting experiment was years ago made by Michael Faraday in order to demonstrate the peculiar effects which could be produced when such water was boiled. Under the conditions he secured in the laboratory, steam was not formed in a continuous flow of bubbles, but came off all at once.

Faraday took some clear Norwegian ice and placed it in a test tube. He surrounded it with oil of turpentine, and melted it very slowly and carefully. As the water formed in the bottom of the tube the oil of turpentine floated on the top, and the water was therefore prevented from absorbing any air from the atmosphere above. This isolated water was gradually heated, and the temperature rose above the normal boiling point, viz., 212 degs. F. All at once the water burst into steam so suddenly that the contents of the tube were violently thrown out.

Another similar experiment in superheating water was performed by Donny in 1844. He succeeded in raising water, without exposing it to pressure, to a temperature of 279 degs. F. This temperature would normally correspond to a pressure of 33 lbs. to the square inch.

These experiments are interesting as showing what may be done under suitable conditions, and in a laboratory where the greatest care may be taken, and where time is no object. In any case they are very difficult to perform. They also show that peculiar characteristics may be found in even the most familar substance with which we come in contact in daily life.



VALVE GEAR CROSSHEAD, N. Y. C.

Technical Education of Railway Foremen.

When Mr. Ogden sent us the article which here follows on the technical education of railway mechanical foremen, he requested Dr. Sinclair for an expression of opinion on the subject. At the end of the article we print Dr. Sinclair's letter and would invite as many of our friends who desire to add something to the discussion of this important matter, to write to Railway and Locomotive Engineering and give their views.

Technical Education of Railway Mechanical Foremen.

BY T. H. OGDEN.

A question that is vital in the operation of the locomotive department of today and the future is, "How can the foreman promote greater shop efficiency?" In connection with this progress and development, because of its radical character and great extent, the development of men has been allowed to take care of itself until it must be said the most vital problem of the mechanical foreman of today is that of men. The locomotive operating situation on large railway systems is in advance of its men in this capacity and in many ways has outgrown the individual foreman and methods of dealing with individuals, and especially has it outstripped methods of preparing men for such work. These suggestions are prompted from close observation with a desire to present a possible, simple and consistent solution of the problem for the men of today and the future.

The plan begins with a careful selection of recruits, this must be followed by a scheme of education carried on by the railroads themselves, beginning at the recruiting, and consistently followed with a view of raising each individual to the limit of his capacity. The results to be looked for being to secure as a broad base, a well qualified man who will apply knowledge and thought to his work, appreciating his responsibilities and obligations to his employer and his fellow workmen with whom he is directly associated in the performance of his duties. From among the men it should be easy for a superior officer to discover who are capable of subordinate responsibility to meet the present needs of leadership, among the many strenuous conditions on which depend the efficiency of the shops of today. Few of the many railway mechanical foremen are doing anything to assure a staple, definite system and self-sustaining policy when conducting operations, and few appear to appreciate the needs of the present or of the future. The great need lies in the motive power department and the efficiency of its shops depends most entirely with the men in charge of supervision. Foremen need preparation, educating themselves for positions of responsibility. They need to be men of character, and of executive ability to produce the methods of operation which bring greater efficiency to the shops.

With the general progress of the present generation, the motive power problem is an example which has grown to such an extent as to be only appreciated by those who have observed closely. It has not been long ago that an engine dispatcher, or a hostler, or a locomotive engineer filled the position of foreman, and sometimes of master mechanic. It was a comparatively easy matter to step from shop or locomotive to a position as head of the mechanical department. At the present day the building of heavy locomotives and large capacity cars, the strenuous operation required to run large shops, and the intricate labor problems, renders such a step an exceedingly long one. The sort of man who successfully directed large railway shops a few years ago would find his ability overtaxed to properly supervise a single busy roundhouse today. A different kind of ability is required now to direct the affairs of back shop and roundhouse on a single progressive road, and as great roads combine into systems still another kind of men are needed. Men must prepare for this work for it is now waiting. There is evidence this is not appreciated by mechanical foremen and that they are not preparing for the emergency.

The locomotive foreman problem incidental to handling the up-to-date locomotives placed in their charge for care, good performance, and reasonable cost requires the careful thought and application of the foreman to show the efficiency of his system of organization under conditions surrounding him. Some foremen have large up-to-date shops equipped with modern and expensive labor saving machinery. Their superiors look to them for valuable assistance in the successful and economical operation of the department. It is no small task to properly direct and maintain the "large traveling power stations," such as modern locomotives have become and to organize a system for such an undertaking.

The problem has grown perceptibly in five years and enormously in ten. The problem is also that of the selection of men, their preparation and training. If this is provided for the rest is easy. It has been said that it was less difficult to secure a new president than to secure a good shop or roundhouse foreman. This of course is not true, but it certainly is sufficiently difficult to secure the right kind of men from the ranks. Men are not essentially different from those of generations ago but conditions are certainly different. To improve conditions it is necessary we become familiar with all the conditions and changes that come to us daily and be prepared to meet any emergency.

A few years ago railroad mileage was numbered in hundreds, now in tens of thousands. Heads of the departments once knew all their subordinates because they were few and changes were not frequent. Their men all knew them because they were personally close to them in their work. All this has changed as railroads became greater, and as systems great in themselves combine into greater systems, heads of the departments have, as by a powerful current, been carried from their men and far even from their subordinate officials. From personal friends, men have become to them as mere figures and are known only by their work.

From a simple business the administration of mechanical affairs of great systems has become like the direction of an army. But armies do not suffer weakness of organization because of increasing size. An army becomes larger by aggregation of units which of themselves become no larger as numbers increase. Officers are added. Commanding officers do not know all their men but the captain does know them. From this standpoint, great railway systems require mechanical foremen with a greater talent for leadership so they may know their men and be able to show the required efficiency for up-to-date methods of operation. Such men will bring out the results that the heads of the locomotive departments of this country are striving to obtain with the assistance of those they have chosen as their subordinates in back shop and roundhouse work. If our information is correct, it is the judgment of men at the head of the great railway systems, that back shop and roundhouse foremen are not preparing themselves with the knowledge necessary for the great work before. Back shop and roundhouse foremen are always required to show results, and such responsibilities of obligations require thought and application, for upon their talent and ability depends the success of the many strenuous undertakings in the operation of their different departments.

Economical methods is another part of the efficiency problem which is vital to the mechanical foreman. It is absolutely impossible for their superiors alone to organize a system to obtain best results without their subordinates giving every assistance in order to succeed in the economical handling of the great locomotives which are placed under their care. Foremen must strive to obtain good performance of power at a reasonable cost of handling and maintenance, combining quality of work with rapidity of handling, most especially in roundhouse work. This assistance is needed for the success of the department. Foremen should give much thought to organization. This will regulate nearly the entire problem. They must learn the character of their men, the disposition and ability of each, so it will be easy to determine as to whether their men can do the work assigned to them in a workman-like manner.

The floating element, workmen coming to our shops if received in a manner which will make them feel at home and make them feel as though their work was appreciated, will result in increasing shop efficiency. It is the judgment of the writer that too many men holding subordinate positions do not practice such methods, and do not realize workmen stand in the same relation to the foreman as the foreman stands to his superiors.

Mr. T. H. Ogden, Gen. Foreman,
A. T. & S. F. R. R., Emporia, Kans.
Dear Mr. Ogden:

The article which you sent me on "The Technical Education of Railway Mechanical Foreman" has been received and very carefully considered. I thoroughly agree with your views on the increasing necessity for the better training of the men to whom the responsibility of supervising the shop operations must be given, and I am keenly interested in every movement in that direction. The most promising movement that I have come in contact with, intended to educate shop men, is the system of apprentice schools insituted by several railway companies.

I hold the position of Special Instructor on the Erie Railroad, which requires that I should periodically inspect the apprentice schools. In doing the duties involved, I find that the apprentices are obtaining instruction in technical education that imparts all the scientific knowledge which a general foreman requires to possess. The graduates of the apprentice schools are already becoming available to fill the position of foreman, and several of the young men who have been promoted are proving decided successes.

The faculty of handling men and that of executive ability cannot be taught, but the technically trained men are as likely to develop those attributes as others. The mechanic ambitious for promotion ought to devote time and energy in acquiring technical knowledge concerning his art. If he acquires that and displays executive ability which embraces the proper handling of men, he is certain to "arrive."

The railroad official you mention as saying that he was in charge of 2,200 men and could not find one capable of filling a higher position, is a disgrace to his class. The percentage of capable men is about the same in all callings, and when an official fails to recognize men suitable for promotion, he is to blame, not the people upon whom he casts a slum.

In my experience I have frequently found railway officials who followed the policy of keeping no men about them who displayed ability worthy of attention. That policy proceeds from weak jealousy. A man having that weakness is unworthy to be the head of any department, and is necessarily an expensive official for any company to employ.

Yours sincerely,
Angus Sinclair.

ANNUAL BANQUET OF THE NEW ENGLAND RAILROAD CLUB AT BOSTON.

The problem does not end there. Those who have supervision at terminal stations in many cases have overlooked their duty to their superiors in their relation to those with whom they are directly concerned. It is essential for good organization that harmony and co-operation exist.

Recently the writer discussed this subject with a railroad official who, with a gesture toward his shop, said, "I have 2.200 men and not one of them can I promote to take charge of a roundhouse that is badly in need of a foreman." It cannot be true that out of that number not one was worthy and prepared for advancement, but that official believed it to be so, which is nearly as bad. Men looking for advancement need to be reminded that many are sure to rise if they qualify themselves for a higher position on the staff, by putting forth every effort to improve their talent for leadership. The opportunity is now before us to reach the root of the mechanical foreman problem which has been allowed to wait too long.

An Expensive Blunder.

Once upon a time the pattern maker of a certain railroad shop found a better job, and a carpenter of the car shop was appointed to fill his place. One of the first jobs the carpenter pattern maker was called upon to do was making the pattern for the throttle valve of an engine that was in the shop. The engine was undergoing a general repair. When put to work that engine appeared to be suffering from paralysis. After about six months wrestling with the same useless engine it was discovered that the carpenter pattern maker had attempted to strengthen the throttle valve by making it solid instead of ribbed.

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The Era of Co-operation.

The railroad systems of this country have, like every other institution, passed through and are passing through a period of evolution in which, though the progress made in any one period may appear slow, it is nevertheless substantial. Perhaps three stages in the process of evolution toward better things stand out more clearly than some of the others which have gone before. First, we may say, we had the period marked by the buying of good equipment without much thought of maintenance. Second, good equipment with efficient maintenance, and third, the period of instruction and co-operation.

The salient feature in the first stage was the purchase by railway companies of costly equipment, such as the air brake, and other appliances, to which very little thought was given, after it had been installed and proved by the builders to be in good working order. Several years elapsed before railway companies turned their attention seriously to the efficient maintenance of the equipment. Air brake repair plants, test racks, special air brake repairmen began to make their appearance. In the operating department it came to be recognized that an expensive installation of block and interlocking signals did not of themselves carry the guarantee of safety as long as discipline was lax, and the Chancetaker was permitted to exist.

The later stage of evolution, the one we have now arrived at, is marked by the desire of the railways for the co-operation of the men to make railway travel as safe as it is cheap. With that end in view we now have the traveling air brake instruction car, equipped with other forms of railway apparatus, upon the functions and operation of which, free lectures are delivered by an officer or officers of the company. The idea of instruction has been carried forward and extended, by the formation of evening schools and apprentice classes, which have become a necessity if technical skill is to keep pace with the march of invention.

It was urged at first by some that if one railroad went to the expense of educating their men, another road would reap the benefit if any of the men left or were discharged. The refutation of this argument lies in the fact that the benefits to the pioneer roads in increased efficiency due to educational methods, were so marked that others were compelled to follow. We may even believe that an apprentice of the future may seriously consider the relative educational advantages offered by the several roads in his locality before he decides which one he will apply to for work.

A very gratifying phase of this part of railway evolution in which practical instruction plays such a prominent part, is the direct bid for co-operation put forth by several of the large railways in the best and kindliest spirit. We mean the desire of the responsible officers to work hand in hand with their men for the promotion of safety in every branch of railway operation. This most desirable state of affairs—hearty co-operation—has a three-fold effect. It saves money, for accidents are costly affairs, but it does more, it promotes a feeling of greater security among the men who do the hard outdoor work of railroading, and it almost automatically reduces the severity of discipline.

We have repeatedly insisted in these columns that a careless or incompetent man on a railway may, by his recklessness or folly, cause the death or lifelong injury to half-a-dozen good men; and reparation is impossible. A logical result of co-operation will be the elimination of the Chancetaker. The officers will not have to proscribe him or point him out. He will be forced to go, by the weight of opinion and practice of the men on the road who "play the game squarely, according to the rules."

As an evidence of the fact that the desire for co-operation is growing, we may mention the Santa Fe "safety button." It was devised by Mr. J. D. M. Hamilton, the claims agent of that road at Topeka.

It is said to have done more to minimize accidents and to reduce the number of casualties on the Santa Fe than any one thing since the introduction of block signals. It is just a button bearing the words "Get the Safety Habit," and these words surround the monogram of the road. The button is worn conspicuously by the employees. Every man on duty is reminded by his own or his co-worker's button to be careful. Like a caution signal it is always a warning of danger and puts every man on his mettle.

The Chicago & North-Western Railway has adopted another plan with the same end in view, co-operation for safety. Their plan provides for what are known as safety committees made up of a locomotive engineer, fireman, conductor, brakeman, trackman, station agent and switchman, who are enlisted for the work of promoting safety, and from whom suggestions are invited for the object in view. These committees meet every month and the members are paid for the time required for their attendance. There is free discussion of matters relating to safer operation and the attention of division officers is directed to specific cases of disregard of rules, dangerous places and customs. At present about 250 officers and employees of the Chicago & North-Western are serving on these committees.

The work is not limited to the employees committee; there is a "division safety committee," composed of a superintendent, a master mechanic and a track engineer. At joint meetings matters local to the division are considered, while other matters common to the entire system are referred to what is known as the central safety committees whose members are two general superintendents, an engineer of maintenance of way, also the superintendent of motive power and machinery, trainmaster of freight terminals and assistant superintendent of the car department. Safety bulletins are issued once a month calling attention of employes to the large number of preventable accidents and how they may be avoided.

The effect of taking the men into the railway company's confidence has shown beneficial results on the Santa Fe and on the Chicago & North-Western. The Pennsylvania Railroad officials are considering the application of latter plan, modified to suit their conditions. Other roads may be expected to follow suit, and when they do, the various safety committees composed of officers and men doing their work conscientiously and well, will usher in the dawn of good feeling and co-operation, and with this dawn, comes the handwriting on the wall, for the Chancetaker, with a fate less hard, perhaps, but not less sure than that which overtook the King of the Chaldeans, when it was written of him, "Thou art weighed in the balances and art found wanting."

The Centre of Percussion.

It is a safe guess to make, that a very large proportion of our readers have at some time in their lives, played baseball. In that game what is usually called the bat is in reality a club with a large or heavy end, the shaft tapering or sloping down to convenient size for the hands of the player to grasp. No doubt everyone who has wielded this club or bat, has found that there is a point out on the striking end where the driving power of the bat seems to be at the maximum. If the player can succeed in striking the ball squarely at this point on the bat, taking care to make a safe hit, he is reasonably certain to make first base and may even get to second. If the stroke be made so that any other point on the bat comes in contact with the ball, the full force of the blow will be divided, the greater part occupied in driving the ball and the other to cause the bat to slightly shiver or sting the hands.

Cricket players have also probably found a similar condition exists when the ball is not struck at the point giving the maximum drive. Under these conditions, even with the built up, spliced handle made of cane, with strips of whalebone or rubber between the sections of cane, the hands may yet be severely sting. This point of maximum driving power in baseball and cricket bats may be altered by the player by changing the position of his hands. A point on the handle between the hands becomes practically the point of suspension, just as if the bat was a pendulum. The point on the bats which seems to give the maximum driving power is called by mathematicians and engineers the centre of percussion, and its distance from the point of suspension, is called the radius of percussion. The centre of percussion is also the centre of oscillation for the body under consideration, and the radius of oscillation is identical with the radius of percussion.

The centre if percussion is defined in engineers' pocket books as the point in a body oscillating about a fixed axis, at which, if a blow be struck by the oscillating body, the percussive action is the same as if the whole mass of the body was concentrated at that point. The center of oscillation of a pendulum or other body rotating about a fixed center (which is not the center of gravity) is that point at which the action is the same as if all the weight of the body was concentrated at that point. The use of these centers and radii when found may not at first be apparent, but it is well to remember that they are mathematical expressions useful in various formulas. For example the radius of percussion or oscillation is used in calculations dealing with rotating ball governors for steam engines, fly-wheels, etc. They also furnish the conception of the ideal or simple pendulum, which is that of weight concentrated at a single point supposed to swing from a fixed point of suspension by a string having no weight. The pendulum principle has many applications. The force of gravity may be ascertained at any place, if this ideal or simple pendulum, vibrating seconds, be found for the locality in question. The length of the simple pendulum for New York is 39.1017 ins. while that for London is 39.1393 ins. The acceleration due to the attraction of gravity at New York is therefore 32.16 ft. per second, and at London it is close to 32.165 ft. per second.

A bar of iron 1 in. in diameter and 9 ft. long suspended at one end, with friction reduced to a minimum at the point of suspension, the whole swinging as a pendulum (without extra weight at the lower end) would have its centre of percussion 3 ft. from the lower end, or in other words ⅔ of its length from the point of suspension, that is 6 ft. and would be the radius of percussion or oscillation. Measured from the bottom the centre of percussion is ⅓ of its length or 3 ft. up. Other forms give other proportions. In the case of the baseball bat the centre of percussion would be somewhat nearer the large end as the bat tapers, and a player could practically move it out further toward the end by holding bat further down the handle. The compromise point between hands, becoming for all practical purposes the point of suspension. In the cricket bat the same alternation could be effected by the grasp of the player. The object of the cane and whalebone handle spliced in a tightly fitted V, into the body of the bat is to prevent as far as possible the stinging of the hands by reason of the various points on the bat at which the ball is struck. Golf clubs are made with long, slender, yielding handles for the same reason. The heavy ends are for the purpose of balance and to bring the centre of percussion down near, if not entirely within the head of the club.

At the request of a subscriber we endeavored to give what may be considered as a popular explanation of the mathematical expression, the Moment of Inertia. It appeared on page 70 of our February, 1911, issue and a similar article appeared in our March, 1911, issue, page 112, dealing with the Radius of Gyration, and in order to make our present subject as clear as we can, the explanation of a simple little experiment will afford the reader a means of roughly finding the centre of percussion, and for that matter, the centre of oscillation of a walking stick or other like body.

Suppose for sake of illustration that our experimentor takes a broom handle or other piece of wood or iron of the same diameter throughout its length, and grasping it firmly in one hand strikes upon the edge of a table or other firm heavy body. Let him strike with his stick so that he hits the edge of the table a few inches from the end of the stick. He will find the stick vibrate and if the blow be smart enough the stick will sting his hand. The stinging is caused by the stick trying to rock or oscillate on the edge of the table. The few inches of stick beyond the edge of the table try to go down toward the floor and they feebly tend to swing the long end of the stick upward. The blow, however, brought the long end down, and that more powerfully tends to throw the short end up. The stick vibrates unequally about the edge of the table and that point becomes a node or non-vibrating point and the stick seems to shiver in the hand.

If the next blow be struck so that a point much nearer the hand be made to hit the edge of the table a like unequal series of vibrations will be caused, with the sensation of stinging as before. The experimentor may now vary the point he brings down on the table's edge in several succeeding blows, until at last he finds a point where the stick does not shiver or sting the hand. The point so found is the centre of percussion for that stick, with hand remaining in one place and so giving a constant point of suspension during the series experiments. When the point of percussion is brought hard against the edge of the table, the down stroke of the longer handle-end moving more slowly exactly balances the upward effort of the shorter and quicker moving end beyond the table and vice versa so that the stick has no tendency to rock or oscillate on the edge of the table and produces practically no pressure up or down in the hand and the stinging sensation is entirely absent.

This experiment may be very practically applied by any one who has occasion to put a door-stop in the baseboard of a room to keep the handle of the door from punching a cup-like socket out of the plaster. If the stop be put in too near the hinge-edge of the door it will have a tendency to tear the door off the hinges or at least loosen the screws. If the stop be put too close to the handle-edge, the door will be thrust inward against the hinges and will tend to bend between stop and hinges, and in either case it will shiver when opened against the stop. If, however, the stop be placed exactly on the base of the vertical line which carries the centre of percussion, the door may be flung open with considerable violence without causing strain on the hinges or even a tremor in the frame work of the door itself.

Some Points Concerning Carbon Steel.

There are two words which look something like each other and sound something like each other, and they are used in connection with high carbon steel. These words are Decalescence and Recalescence. They indicate opposite states. When the mixture which will eventually become steel is being heated in the furnace the temperature of the whole mass goes up to a point somewhere about 1,400 degs. F. At that point a change of state takes place. This is the decalescent point.

At the decalescent point the heat of the whole mass which has been steadily rising becomes stationary or even experiences a slight drop while the molecular transformation is going on. This is very much like the behavior of melting ice which absorbs a large quantity of heat in order to produce the physical change from ice to cold water. In the case of the melting ice heat continues to be applied, but it is hidden from the thermometer being expended in shaking the molecules apart and is called latent. So it is in somewhat the same way with the steel, heat is absorbed, one might almost say, rendered latent by the act of shaking the molecules into a new crystaline form, and after the point of decalescence has been reached and passed the still further application of heat becomes apparent as the mass grows hotter.

The steel may be heated up to a temperature perhaps 100 degs. F. above the decalescent point and is then allowed to cool. The heat gradually disappears until at a point below that of decalescence by about 150 degs. F. the point called recalescence is reached. The use of a pyrometer will give these temperatures exactly, though we are here speaking of them only approximately more with a view of explaining the significance of the words and the relation to one another of the states they indicate.

This point of recalescence may be at about 1,250 degs. F. It indicates the point at which some change probably, again the form of crystallization, takes place. In the case of high carbon or what is often called 100 point carbon steel, the point of recalescence, or rather just below it, is the point where this steel should be quenched in order to make it very hard and to secure other desirable qualities. If the steel is cooled slowly so as to allow large crystals to form the steel is weak, but if cooled quickly small crystals are formed and the steel is strong and hard.

The expression 100 point carbon steel is somewhat misleading to those who are not familiar with steel makers and steel users' terms. Five point carbon .05 per cent. means that in 1,000 parts of steel there would be .005 parts of carbon or in the proportion of ½ mill to one dollar.

The Mechanical Stoker Up to Date.

Railway sentiment in favor of the introduction of mechanical stokers seems to make very small progress, but trains continue to be loaded heavier and the fireman's labor of handling the required supply of coal to the firebox is getting nearer and nearer to the limit of human ability and endurance. For some time after mechanical stokers were first tried on locomotives there was a strong spirit of opposition to the invention manifested among firemen, but that feeling has now almost entirely vanished. A mistaken impression prevails concerning the purpose of a mechanical stoker. It was looked upon by many as a contrivance that would dispense with the skillful fireman and permit the employing of an ignorant laborer in his place. We were at that time in a position to find out the inside views of railroad officials concerning mechanical stokers and it certainly was that the mechanical stoker would lighten the labor of the fireman and enable him to do his work more skillfully and with less effort.

Ingenious people readily receive the impression that devising a practical mechanical stoker for a locomotive would call for small inventive ability; but very many inventors have found out that the designing of such a stoker is one of the most difficult inventive problems ever undertaken. At first inventors thought that a device which would inject the coal over the fire-box from a hopper loaded by the fireman would be satisfactory, and several patented stokers were made in that manner and gave satisfaction as far as their work went. But familiarity with that type of stoker aroused the question why should it not have a conveyor that would bring the coal from the tender to the hopper? There is where the problem of this invention now rests. There are several mechanical stokers that perform their functions satisfactorily after the coal has been placed in the hopper; but there has been no combination of carrier and stoker brought out that receives an unmitigated verdict of approval.

Early Power Brakes.

Having the power to quickly work a passenger train into high velocity, and then be powerless to bring it quickly to rest, appeared to be a ridiculously one sided transaction. Several of the pioneer railroad inventors tried to invent practical steam brakes, but none succeeded until George Westinghouse applied air brakes.

In Great Britain there appears to have been prejudice against power brakes among train men as attempts to introduce this much needed improvement were rendered futile by the men who were first to profit by the increase of safety that continuous brakes afforded.

About 1850 a fairly efficient steam brake was introduced upon the Glasgow Southwestern Railway, the only difficulty with it being that the enginemen displayed want of judgment in the handling of the brake. They would approach a station at full speed to the point where a full application of the brake would stop the train at the platform. Then the flexible buffers, used on British cars, would react as violently that the passengers would be thrown against each other, a most embracing experience that was fiercely resented. In spite of that drawback the brake was slowly gaining favor, even in a land where invitations are not received with loving kindness; but an accident brought the career of the pioneer steam brake to a sudden stop, amidst undeserved continuous and passionate abuse. It happened at the time of the Ayr races.

Auld Ayr wham ne'ar a toon surpasses,
For honest men an' bonnie lasses.

Sandy Matthew, who was running the engine equipped with the steam brake, one day of the races was pulling the fast express. A train loaded with excursionists and race horses was stopped on the main line outside of Ayr and Sandy who had received due and timely notice of the obstruction, but being a Chancetaker, ran well up to the train, depending upon the steam brake to stop his train in time. His well laid scheme did not work for one of the brake levers broke on the first application and the express dashed into the excursion train with dire results, making a dreadful carnage of human beings and horses. The steam brake received the whole blame of the disaster and all that had been applied were thrown into the scrap heap without delay. The inventor, who had made a really good brake, instead of receiving thanks was soundly abused and ridiculed, charged with being a senseless crank who sought the opportunity of slaughtering people and horses by wholesale.

The Promotion of Safety.

Not a single passenger out of 136,000,000 carried on the Pennsylvania Railroad in 1910 was killed in a train accident. This is brought out in a report issued by the company giving accident statistics for the years 1908, 1909 and 1910, for the Pennsylvania Railroad Lines East of Pittsburgh and Erie. These include the Pennsylvania Railroad proper, the Philadelphia, Baltimore & Washington Railroad, the Northern Central Railway, the Cumberland Valley Railroad, the Maryland, Delaware & Virginia Railway, the Baltimore, Chesapeake & Atlantic Railway, the West Jersey & Seashore Railroad, and the Long Island Railroad.

Combining the statistics for 1908, 1909 and 1910, it is shown that in that time the number of passengers carried on the lines east of Pittsburgh and Erie was 371,858,277, that is more than four times as many people as there are in the United States, and only one passenger was killed as a result of a train wreck. In other words, the chance of a passenger losing his life in an accident on the Pennsylvania Railroad under these conditions was one out of about three hundred and seventy million. The fact that the millions of passengers carried on the Pennsylvania Railroad during the last three years were handled with such safety is made more significant by the fact that along with the passenger trains, freight trains were operated for some 112,945,045 train miles. The passenger trains traveled 123,587,745 miles.

During 1910 the lines of the Pennsylvania Railroad east of Pittsburgh carried 14,180,228 more passengers than in 1909, but the total number of passengers injured in train accidents was only 84, or a reduction of exactly 50 per cent. as compared with 1909. These figures include every case requiring surgical or medical attention, however trivial. It will thus appear that counting every personal injury due to accidents to trains only one person out of every 1,600,000 passengers carried was injured. The number of passengers traveling a distance of one mile during 1910 was practically three billion, so that for each passenger carried one mile the proportion was 35,000,000 carried in safety to one injured.

The Chancetaker.

Some very good comments are made by an anonymous writer in the March number of the *Locomotive Engineers' Journal,* under the heading, "Another Chancetaker." The writer in the *Journal* confesses that he in in that class but would like to get out. He believes that a good deal of the smaller sort of chancetaking is the result of the system under which the men work, rather than any recklessness of spirit.

He intimates that very often in order to rate the engines for a certain division a locomotive in good condition is used, and at a time when everything is favorable, a good man is put in charge, and the best performance of picked crew and engine is supposed to become the normal rating for all engines of the same class on the division. The men are expected to live up to this standard of excellence, and if they do not, explanations are demanded. This he thinks helps to produce the Chancetaker.

The expression, "chancetaker," was originally used by Railway and Locomotive Engineering for the purpose of designating a class of men who disobeyed orders or passed signals and often endangered their own and other people's lives because they simply objected to the checks and restraints of necessary discipline. Fire drills in schools inculcate a particularly orderly and even carefully restrained way of doing a supremely important act, and it imposes a restriction, and it requires obedience to rule and system, yet who would dare to advise his child to disobey?

We cannot help feeling some sympathy for the man who looks upon the unnecessary reprimand or official sarcasm as a thing to be avoided if possible, but is not the chancetaker substituting one kind of trouble for another? It seems to us that one of the wrong things about chancetaking is that if you are ordinarily a good square man, your fellow employees will not expect you to take chances, and relying upon one line of conduct from you, they get another. That is what constitutes a good deal of the danger. There is also the force of example which may encourage other chancetakers, but it does not and cannot make wrong right.

Our friend in the *Journal* suggests some remedies which shows that he is willing to lend a hand to have things set right. We do not believe that putting engineers and firemen under the mechanical department when out on the road, as he suggests, will do away with the chancetaker. The elimination of that individual may be helped along in various ways from outside, and his operations may be rendered difficult by the enforcement of rules, but when the men themselves decide that the chancetaker is out of date, he will very surely disappear. One of the good suggestions made by the *Journal's* correspondent practically amounts to this, that a man should do his very best, and actually go in the "hole" if necessary, sooner than take chances, relying upon the support of the majority of his square dealing, rule-obeying fellow employees, men who would have done the same thing that he did, under the same circumstances, and would have done it as he did it, in an honest, open, manly way, after every fair and safe method had been tried.

A manufacturer of metal products cannot afford to use wornout tools. A lathe which has passed its period of usefulness in hard work is beyond repairing, and its proper place is in the scrap heap.

Book Notices

Scientific American Cyclopedia of Formulas, by Albert A. Hopkins. Published by Munn & Co., Inc., 1911. Price, Cloth, $5.00; half Morocco, $6.50; net post paid.

This book is edited by the Query Editor of the *Scientific American,* and he has drawn material from what practically amounts to an unlimited source. The book is 6½ x 8¾ ins. in size, has 1,077 pages and over 200 illustrations. The book is not only a statement of receipts and formulas, it is also informative as to many processes which may be used not only in the factory, but in the home. For instance, under the heading of Maps, the method of backing them with muslin is described. How to mount them, etc., follows in natural sequence. There is, of course, a chapter on Alloys and Amalgams which contains information on every metal known to the arts. Heat treatment of metals deals with annealing, brazing, casehardening, hardening, softening, tempering, welding, etc., of metals There are over 15,000 formulas contained in this book, and we are told that this book has called for the work of a corps of specialists for more than two years, and nearly every branch of the useful arts is represented. The formulas are classified and arranged into chapters containing related subjects, while a complete index renders it easy to find any formula desired.

Our Home Railways, How They Began and How They Are Worked. By W. J. Gordon. Published by Fredk. Warne & Co., London and New York. Vol. I, 268 pages. Vol. II, 248 pages. Profusely illustrated, with colored plates and photographs. Ornamental Cloth binding. 2 vols. Price, $4.50.

Mr. Gordon's work is a valuable contribution to the railroad literature of our time. The interesting story of how the railway came about is charmingly told. Brief biographies of distinguished men, graphic descriptions of the dangers and difficulties overcome, together with luminous glances at the Parliamentary and other political measures often hampering and hindering the great work, and above all, the glory of triumph that crowns the period of trial, gives a spiritualizing interest to the work not common in books of an engineering kind.

While the work may justly be said to be purely British in scope and purpose, it is of world-wide interest. The story of the development of the locomotive naturally leads to the story of the creation of the leading British railways, and twelve of these great highways are described. The illustrations are the best.

General Foremen's Department

To All Members of The International Railway General Foremen's Association.

In the January issue of the RAILWAY AND LOCOMOTIVE ENGINEERING I told you I would keep in close touch with our secretary, Mr. Bryan, to see how many applications you would have sent in by March 1. Gentlemen, you have shown us that you are wide awake, and that you are looking forward to a big convention in July, but let us not stop at this station. If we should stop now, we might not be able to get to the Grand Central Station in Chicago when convention time is here, which would result in missing that big convention where we will face to face talk over our trials and tribulations experienced in the railroad field since our last convention in 1910, and where we will again enjoy the many good things which are always afforded at our conventions.

Members of our organization from all over the United States have shown activity in the past few months, and there is no doubt that we will have the largest attendance ever known at our convention in July. We all are very glad to hear this gratifying statement. But we must not slacken our pace, we must keep on getting new members, prepare ourselves for the convention, so that when the time comes to leave our homes for Chicago in July, you will be ready to meet your old and new friends while the band welcomes you to our seventh annual convention, which will be held at the Sherman Hotel, where ample arrangements have been made to satisfy the most elite.

In closing, I simply want to say, remember our object: "The largest attendance ever known in the history of our organization next July." The date of the convention is July 25 to 27, inclusive, at the Sherman Hotel, Chicago, Ill. "Keep up the good work—get all the new members you can." It will help the association and add to your credit. Sincerely and fraternally yours,

C. H. VOGES,

President the International Ry. Gen. Foremen's Assn.

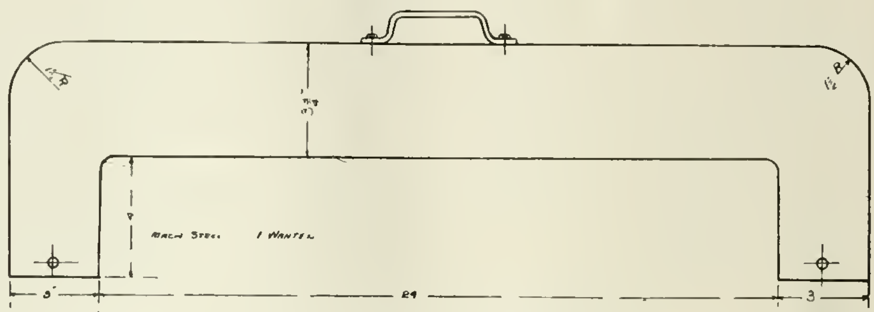
Device for Removing Driving Cellars.

BY CHARLES MARKEL.

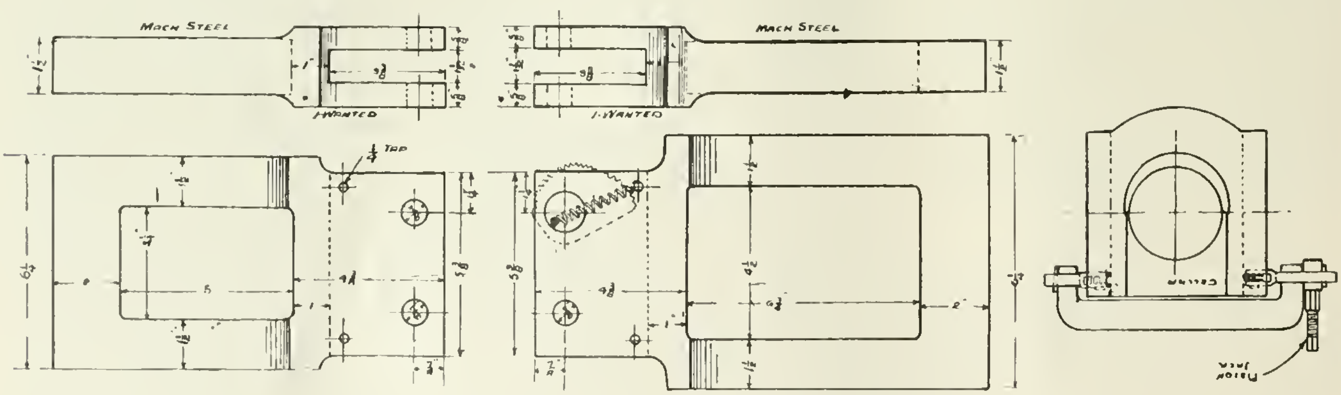
Shop Foreman C. & N. W. Ry., Clinton, Ia.

The drawing sent you shows an appliance recently designed and perfected by one of our machinists, Mr. Jas. Clark. It is intended to facilitate the removal of driving-box cellars on engines in the shop without the use of a sledge hammer, muscle or indeed of profanity. The cause of cellars being so hard to get out of boxes is on account of the brass being applied to the box at from ten to forty tons pressure, which pressure spreads the box slightly at cellar opening. In this slightly sprung opening the cellar is then fitted and after about six months' service the brass becomes loose in box and allows the pressure to come on the cellar.

Before this device was used it took from fifteen to twenty minutes of hard labor and possible damage to the box by sledging the box from the cellar. The collars are now removed in half the time and very light labor is required on the part of operator doing the work. The appliance is used as follows: Place driving-box upside down on the axle and place a screw jack under box to hold it while removing the cellar. The two pieces marked A and B with steel notched dogs in ends are placed between the flanges of the box, the coil springs holding the notched dogs against the flanges of the box. Then place the bar marked C over the bottom of driving-box, the two turned-down ends of bar fitting into openings of pieces A and B. The hydraulic piston rod jack is then placed between the end of bar and opening in A and by applying a wrench to the hydraulic jack the notched dogs embed themselves in flanges of driving-box and the power applied spreads the box, allowing the cellar to be removed sideways by hand. The notched dogs are fulcrumed in such manner that they will meet the different-sized flanges of various boxes.



DEVICE FOR SPREADING DRIVING BOX.

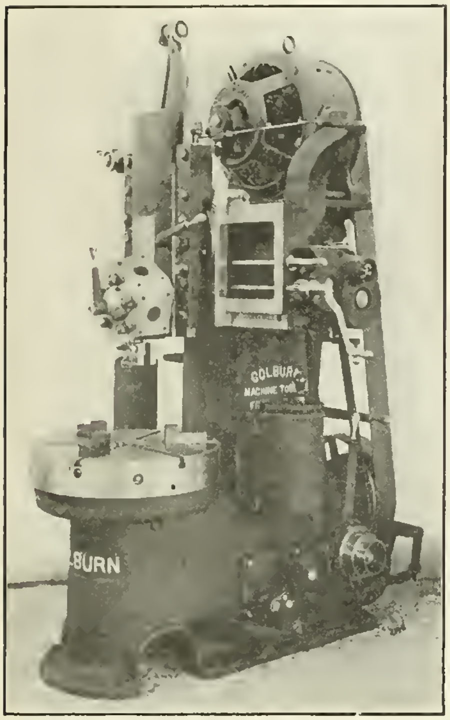


C. & N. W. RY. DEVICE FOR REMOVING CELLARS.

Individual Motor Drive on Boring Mill.

All manufacturers of machine tools have begun to modify their designs to include the individual electric motor as an integral part of the machine. Many manufacturers have made radical changes to secure the best results from the use of the motor. One of the latest designs that includes a motor is here illustrated. It is the 30-in. vertical boring mill, with a Westinghouse adjustable speed direct current motor.

The motor is mounted on a bracket



BORING MILL WITH MOTOR DRIVE.

at the top of the machine, thus raising it out of the way, so that there is no chance for metal chips to fall into the motor, as often happens when the motor is placed on the floor. The motor is belted to a friction clutch pulley which replaces the core pulley used with belt drive. The clutch is controlled by a lever, so that the machine itself may be shut down without stopping the motor if a short stop is to be made.

One 4 h. p. adjustable-speed Westinghouse type SA direct current motor, with a speed range of 400 to 1,600 r. p. m., is used, and its speed is controlled by a Westinghouse drum type machine tool controller with sixteen speed notches. The machine can take work 32 ins. in diameter and 16 ins. in height, where a chuck is used, and 17 ins. with the plain table. The table speed ranges in sixteen steps from 3 to 106 r. p. m. The turret slide has a vertical travel of 21 ins., and may be set at any angle up to 30 degs. on either side of the vertical. A graduated scale attached to the slide is provided to indicate the depth of holes, etc.

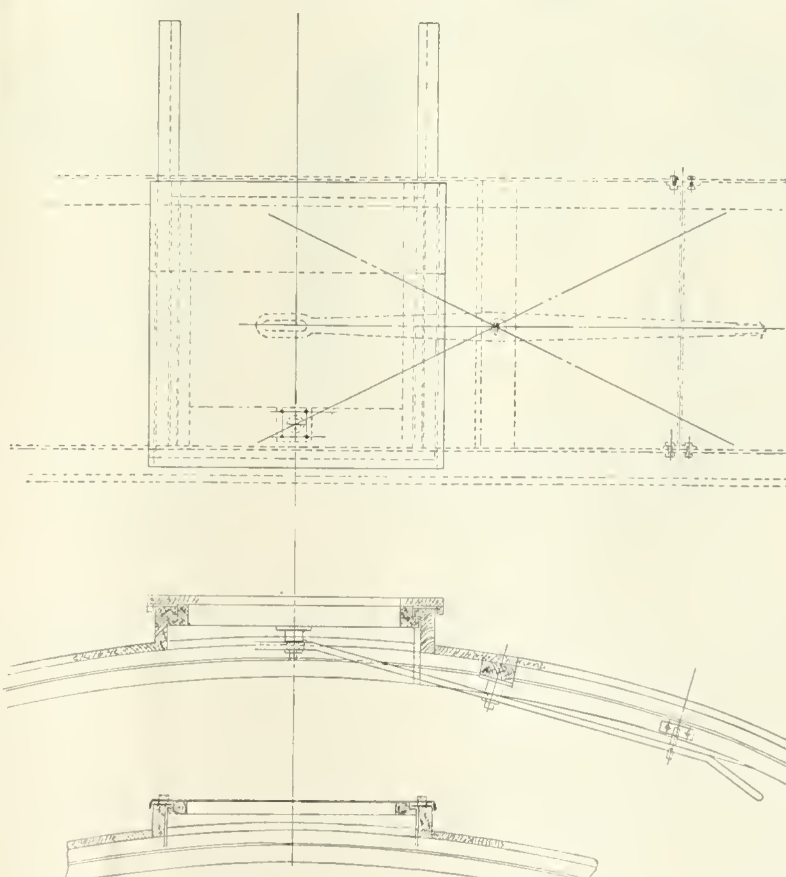
The five-sided turret has holes 2¼ ins. in diameter and also ⅝-in. tapped holes for attaching special tools. In addition to the regular clamping device for the tool holder shanks, special provision is made to keep the tool holders from twisting under heavy cuts. The lock bolt is of hardened steel ground perfectly true, and works in a hardened and ground steel index ring. Taper gibs of special design allow any wear in the lock nut to be easily and quickly taken up, thus keeping the turret holes in perfect alignment with the main spindle. A friction brake operated by foot power permits the ready stopping of the machine with the table in any desired position. The mill is made by the Colburn Machine Tool Company, Franklin, Pa.

Improved Cab Ventilator.

Locomotive cab ventilators generally consist of hinged covers located on the right and left sides of the cabs. These covers are raised and lowered by means of notched sectors, and may be torn off if they project beyond the clearance line. A more satisfactory apparatus for cab ventilation is in use on a number of locomotives of the C. R. R. of N. J. As shown in our illustration, the ventilator is placed in the roof of the cab. A square opening is cut in the roof, about two feet in either direction. A frame work surrounds the opening, the side members of the frame extend beyond the opening to form guides for the sliding door or ventilator. Two types of slide are shown, one of wood, ⅞ in. in thickness; the other of ⅛-in. steel plate. The latter design is more practicable, as it occupies less vertical height. The slide rests on four trunks or sash rollers, which are riveted to the same.

The operation of the slide is by a lever which is fulcrumed on the inside of the cab poof. One end of the lever rests on a guide with three notches, which hold the slide in either the closed, half-open, or full open positions. Rubber weather strips are attached to frame and ventilator. As will be seen in the drawing, the slides overlap the framework, and there is no possibility of water accumulating either on the slide or guides.

The engineers and firemen speak highly of the improved ventilator, and they are being rapidly installed. The device is the work of Mr. George W. Rink, mechanical engineer of the road, who has perfected a number of improvements in locomotives and car equipment.



CAB VENTILATOR ON THE C. R. R. OF N. J.

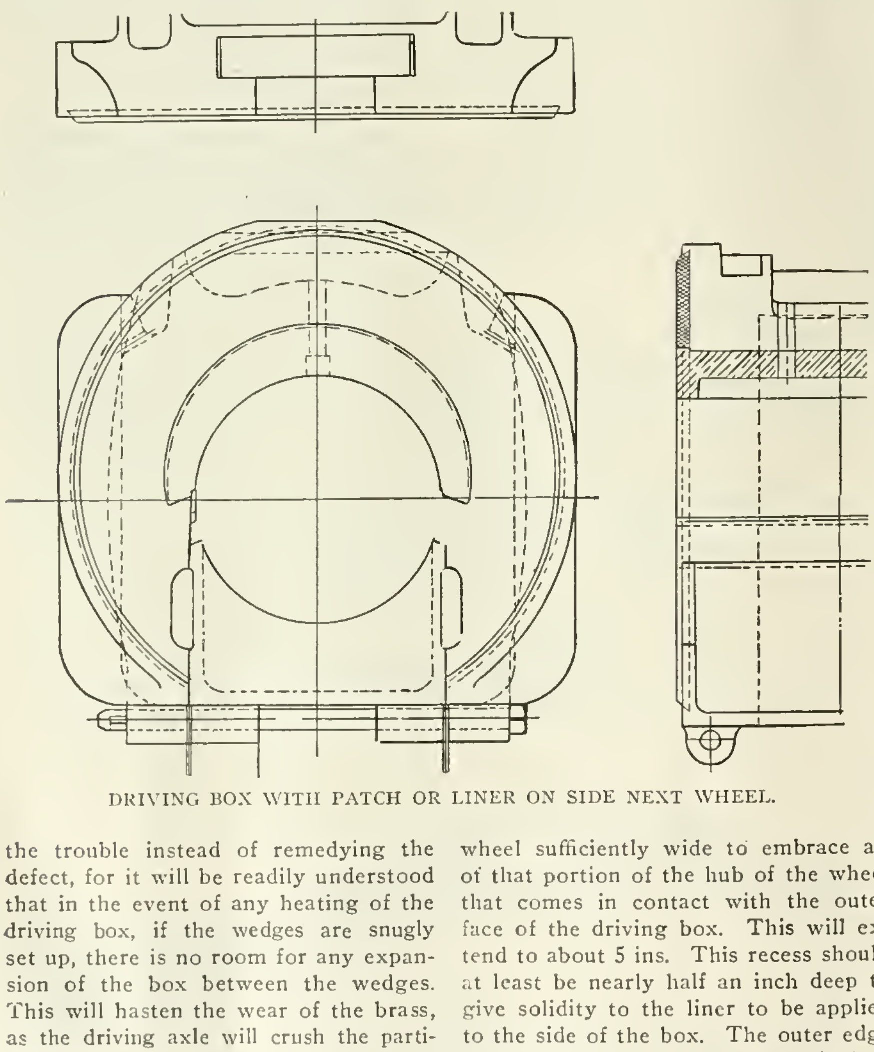
The most intelligently advertised article that we are acquainted with is Vim leather air-brake cup packing which is pushed through *The Houghton Line.* Every air brake man ought to read that interesting little magazine which will be sent free on application to E. F. Houghton & Co., Philadelphia, Pa.

Locomotive Running Repairs

XIV.—Refitting Driving Boxes.

The inevitable wear of the bearings of the axles of locomotives both as applied to the axle and also to the hubs of the driving wheels render the refitting and also the reinforcing of the driving boxes an occasional necessity. However carefully fitted, the driving boxes may have been, it will soon be found that there is lost motion in their relation to the axle and also in their lateral adjustment that calls for a refitting of the parts. The setting up of the wedges not unfrequently augments the trouble instead of remedying the defect, for it will be readily understood that in the event of any heating of the driving box, if the wedges are snugly set up, there is no room for any expansion of the box between the wedges. This will hasten the wear of the brass, as the driving axle will crush the particles of the softer metal in its revolving path, and it will frequently be seen after a driving box has been heated that a quantity of brass dust will be found in the cellar of the driving box. The box having assumed its normal condition, or nearly so, after cooling the line of curvature of the bearing will be in excess of that of the axle and hence a loosening of the bearing with an increase of pounding, and increased wear and tear in all of the other dependent parts.

When refitting has become absolutely necessary, the degree of looseness on the axle and the amount of lateral motion between the hubs of the wheels will determine the exact mode of procedure. If there is a sufficient quantity of metal remaining in the brass to bear a reboring and if the lateral wear is not excessive, it is good practice to cut a recess on the side of the box next the wheel sufficiently wide to embrace all of that portion of the hub of the wheel that comes in contact with the outer face of the driving box. This will extend to about 5 ins. This recess should at least be nearly half an inch deep to give solidity to the liner to be applied to the side of the box. The outer edge of the recess should be dovetailed at least one-sixteenth of an inch to prevent any loosening outwards of the liner. A still deeper recess should also be cut in the center of the larger recess, which should extend to at least one inch in width. This second or deeper recess to be dovetailed on both its outer and inner edges, in order to prevent any movement of the liner in either direction.



DRIVING BOX WITH PATCH OR LINER ON SIDE NEXT WHEEL.

In addition to these recesses two or three notches may be cut with a flat chisel on both sides of the inner recess, thereby preventing any tendency to revolve on the part of the liner. In applying the molten metal to the prepared recess on the side of the box there is usually a strong horse-shoe-shaped outer piece of iron, half an inch at least in thickness and one inch or more in width. This forms the outer or extreme edge of the proposed liner. An inner shell can readily be fitted into the bearing of the box, of an equal height or projection above the box. The two pieces are then covered and held together by a suitable flat attachment. Some mechanics apply a slight coat of crude or other inflammable oil to the surface of the recessed portion of the box, and when the molten metal is applied it will be found that the burning of the oil has the effect of preventing the formation of air cells in the applied metal. This is especially the case in the use of bronze or other alloys containing sulphur, these compounds generally having a coarse crust forming on their outer surfaces. This tough coating or scum frequently prevents the complete escape of the bubbles of oxygen or other gases that spontaneously coalesce and rush, unless prevented, to the outer air. It will be found that there is no need of tap bolts or other appliances to insure the fixity of the liners. Other methods and other materials are used in many of the leading railroad shops in dealing with the outer faces of the driving boxes as well as the inner hubs of the wheels.

In some shops the practice of applying babbitt liners to the boxes is approved. The best method of applying this metal, of which there are various kinds of mixtures, is after cutting the recess on the face of the box, to heat the box sufficiently to allow of the process of tinning the surface of the box where the babbitt is to be applied, the heating being speedily accomplished by a small portable, covered furnace. When the box is tinned in advance of the application of the molten babbitt, the babbitt rarely loosens.

It is also found that where babbitt is used on the box the application of a steel liner an the hub of the wheel makes a bearing of great durability and smoothness of running. The recess in the hub of the wheel need not extend over a quarter of an inch in depth. The disc when turned to the required size is cut into two equal pieces and held in the recess by three tap bolts in each piece, the tap bolts being carefully fitted to countersunk recesses in the semi-circular reinforcement plates.

It may be mentioned in relation to the subject of smoothness of running that there has been recently introduced some improvements in the construction of driving box brasses looking in this direction, which, although small in themselves, tend to aid in the approach to that degree of perfection essential to the modern locomotive. Among these the method of cutting the oil grooves in the crown or sides of the casting instead of having the recesses rough cast in the mold commends itself. The grooves cut after casting may be relied upon as not containing sand or other impurities, which is difficult to completely remove from castings where such grooves are roughly formed in the casting.

A simple method of securing the brass in the box may also be alluded to. In reducing the outer surface of the brass to the required size, a small collar may be left on the larger end of the brass. On the opposite side of the box a slight bevel or chamfer may be made by a few strokes of a rough file, and when the brass is pressed into place in the box, the projecting edge of the brass may be readily riveted over. This simple combination of a small collar on one side and a slight spreading of the metal on the other side precludes the necessity of drilling holes through the brass and box and fitting pins to hold the brass in place.

Coming to the fitting of the box, it will be seen that the most careful boring out of the box can at best only make a near approach to the exact fit required, and as there are not infrequently slight variations in the diameter of the axle at the different ends of the bearing, the proper fitting of the driving box, especially in the case of high-class passenger locomotives, is an operation requiring fine mechanical skill. The increasing weight of these boxes has now become so great that heavy appliances have been devised for raising or lowering them to and from the axles. Where it is not convenient for the traveling cranes to reach portable cranes are called into operation, and we have recently seen small cranes that may be readily moved from place to place by a traveling crane and deposited at the desired point. These were equipped with electric motors and pulleys slidably engaged on an extended arm which was counterbalanced by a heavy weight on the opposite side of a strong central structure resting on a heavy base, forming at once a very reliable and flexible means of moving the heavier kinds of driving boxes from place to place. With lighter boxes an improvised crane may readily be bolted by an adjustable strap to the center of the axle, and the box swung into the desired position by a chain running in a suitably grooved pulley, the arm supporting the pulley being furnished with a swivel joint on an upright arm attached, as we have stated, by a strap to the axle on which the boxes are being fitted.

Pieces of wood or corks should be fitted into the oil holes from the inside before beginning to use a file on the bearing . This obviates the necessity of hammering the box for the purpose of loosening the adhesive filings. There are very few evil practices so common in railroad shops as the hammering of driving boxes to jar the filings from their lurking places. Driving boxes of the smaller kind may be readily sprung by this practice until the box may be rendered unfit to admit of the cellar and the bearings on the box for the reception of the wedges are not parallel. A constant repetition of hard hammer blows upon the top of the box cannot fail also to affect the elasticity of the metal and hasten the crystallization of the part repeatedly struck, so that in time the metal will readily crack or break after a comparatively short period of service.

In this relation it should be remembered that all work on the top of the box, including the cutting of oil ways and fitting saddles should be done before the box is fitted to the axle. The fitting should be the last operation; as any other work that may be done upon the box after being fitted to the axle has a tendency to affect the exact relation of the bearing to the axle. The fit should be the best possible, and it is good practice to fit the bearing so that it bears lightly on the crown of the box, the fit being snug at both sides, special care being taken that there is something less than half a circle in the entire bearing. In regard to the oil ways the best practice is to have a deep oil way cut in the crown of the bearing from which grooves may be cut by hand or compressed air chisel leading angularly across the upper part of the entire bearing, so that the oil may reach every part of the axle bearing freely. In the case of the use of grease it is advisable to cut two grooves, at least one inch in depth. These grooves should be equidistant from the crown of the bearing and at sufficient distance to divide the bearing into three equal parts. The preference for two grooves when grease is used as a lubricant becomes apparent when it is borne in mind that grease possesses greater viscosity than oil, and even when partially heated does not flow so freely.

Questions Answered

LIFTING AIR PUMP.

26. W. O., Oakland, Calif., writes: Would it be safe to lift a No. 5 New York air pump with two eyebolts screwed into the holes on top of the air cylinders where the oil cups are attached?—A. If the eyebolts were made of a good grade of iron or soft steel it might be safe enough, but a quicker, safer, and consequently a better way is to lift the pump by the use of a chain sling made to go around the air cylinders.

STRENGTH OF BOILER JOINTS.

27. W. H. D., Catskill, N. Y., writes: will you please give me the rule for finding the strength and efficiency of a butt strap boiler joint.—A. This question cannot well be answered in the space at our disposal in the question and answer columns, but if you will turn to another column of the issue you will find the subject fully explained. You did not draw the form of joint correctly. There should be an outside and an inside welt.

CENTRE OF PERCUSSION.

28. B. O. A., of New York, writes: You have answered a correspondent on the moment of inertia on page 70 of your February issue and also have answered a correspondent regarding radius of gyration on page 112 of your March paper. Will you please tell me what is the Centre of Percussion.—A. You will find this subject discussed in another column of this issue.

BROKEN PIPE CONNECTION.

29. W. H. S., Baltimore, Md., writes: What would you do in the case of the pipe connections breaking between the automatic and independent brake valves, or between the brake valves and the distributing valve of the No. 6 E T brake? A.—Assuming that you wish to know what could be done to keep the engine brake operative if the application cylinder or the release pipe were to break off while out on the road or at some point where proper repairs could not be made, we would say that in the event of the application cylinder pipe breaking off, plug the end of the broken pipe toward the distributing valve and the operation of the automatic brake will not be affected, but the independent brake cannot be applied, nor can the brake be released with the independent valve while the automatic valve is on lap after an application. If the release pipe were broken, leave it open and the brake can be applied with the automatic valve, but the driver brake holding feature will be destroyed. If this was to occur in switching service and you wished to use the independent

brake in handling the engine, plug the broken end of the pipe toward the distributing valve. The brake can then be applied with either brake valve, but can be released with the independent valve only. If the release pipe branch between the brake valves was broken it would only interfere with the driver brake holding feature, and to regain this feature leave the pipe open and move the independent valve to lap position when the holding feature is desired, and move both valve handles to running position when the release of the engine brake is desired.

AIR PUMP STOPPING.

30. W. O., Oakland, Calif., writes: What will cause a No. 5 New York air pump, equipped with piston valves, to stop when the pump throttle is opened wide, but when the throttle is closed for a few seconds and opened part way the pump will start to work but will stop if throttle is opened wide?—A. This action of the pump is no doubt due to improperly fitted piston valve packing rings, that is, there are parts of the outside surface of the ring that do not touch the bushing and the ends of the rings are some distance apart, so that when the throttle is wide open the full head of steam entering the pump gets between the rings and the bushing and, so to speak, beats the rings down in the grooves and the effect, at this time, is the same as with broken or missing rings. The trouble might also be due to the rings being entirely worn out, or due to a badly worn piston valve bushing.

TEST FOR FLEXIBLE STAYBOLTS.

31. W. H. D., Catskill, N. Y., writes: Please inform through the pages of your valuable magazine how you would detect a broken flexible staybolt? A.—The recommended practice for inspecting flexible staybolts is to periodically remove the caps, and the bolts are tested under water pressure of not less than 50 lbs., by sounding with hammer on threaded end and holding on with light bar to the bolt head. This practice has been carried on once every year, but the present practice under the Public Service Commission rules has been extended to 16 months. The practice of hammer-testing the flexible stays without removing the caps and using light holding-on bar may eventually cause stripping of the threads in the fire sheet, and therefore caps should always be removed when inspecting flexible stays. Whenever a bolt is found broken clear across the diameter, by taking the cap off, it will allow the broken end of the stay to drop out; if the bolt is partially broken or fractured, the pressure used while testing is liable to separate the bolt completely, as sometimes a pressure of 100 lbs. is used. During the periodical inspec. - of rigid bolts, if such are found broke near flexible stays, it is advisable t .ke off the caps of the flexible stays and test each staybolt in close proximity. It is quite advantageous to use cylinder oil, mixed with graphite, in the threads of the caps to insure easy removal.

BRAKE STICKING.

32. K. N., Wheeling, W. Va., asks: Is it possible for the No. 6 E. T. brake to get into a conditon that would cause it to act in the following manner? On the lone engine the brake can be applied with either brake valve and after an application with the automatic brake valve the brake can be "kicked" off with the independent valve. Now when this engine is coupled to a train is it possible for the brake to apply in such a manner that it cannot be released with either brake valve? A.—We have never found a brake that was in this condition, and it would only occur through a combination of disorders that would indicate an alarming state of air brake affairs. It is well known that under ordinary circumstances the E. T. brake can be promptly released under any condition, therefore, the following is merely a possibility. Assuming that the equalizing valve packing ring leaked badly and that there was some leakage into the application cylinder of the distributing valve, and that in connecting up piping the application cylinder pipe was properly connected at the independent brake valve, but wrongly connected at the distributing valve and at the automatic brake valve and the release pipe connected at the remaining openings you would then have an arrangement whereby the application cylinder would be open to the atmosphere through the brake valves while the equalizing valve is in release position, and at the same time the wrongly connected release pipe would contain application cylinder pressure which could also escape while the equalizing valve is in release position. Now, if the equalizing valve, due to packing ring leakage, could not be moved during a service reduction the leakage into the application cylinder, previously mentioned, would apply the brake when the automatic valve handle was moved to lap or service position; placing the independent valve in release position would release the brake as the application cylinder pressure would escape through the exhaust cavity of the equalizing valve which has remained in release position and the brake could again be applied with the independent valve, and as both handles are returned to running position the brake will release. Now, when the engine is coupled to an uncharged brake pipe on a train of cars the pressure in the engine brake pipe might fall fast enough to move the equalizing valve to application position and the rise in brake pipe pressure would be entirely too slow to return the valve to release position, consequently the application cylinder would be cut off from the brake valves and the brake would likely remain applied until the distributing valve is cut out or until leakage from the application cylinder or pipe leaks the brake off or until the equalizing valve can be returned to release position. This is printed with a view of showing how improbable it is that the E. T. brake would get into the condition you describe rather than to convey the idea that the brake might have those disorders and be improperly piped at the same time.

CANDLE POWER OF HEADLIGHT.

33. E. J. H., Armourdale, Kan., writes: Will you please give me the formula for finding the candle power of a gas light? What I have in mind is an acetylene headlight applied to a locomotive, and I want to determine what candle power it is. Also have you the formula for figuring the candle power of an electric headlight?—A. We have not any empirical formula for calculating the candle power of these, but below we give the results of tests recently made by the Bureau of Standards on various sizes of acetylene burners:

Burner.	Distance from Photometer.	Declination from Axis.	Illumination on Screen.	Equivalent C. P.
¼ ft.	20 ft.	Axis	8.38	3,350
¼ ft.	50 ft.	"	1.00	2,500
¼ ft.	100 ft.	"	.22	2,200
½ ft.	20 ft.	"	22.3	8,920
½ ft.	30 ft.	"	8.55	7,695
¾ ft.	20 ft.	"	33.9	13,560

The electric headlight tests made by the Bureau of Standards show that the mean hemispherical candle power of the electric arc on the horizontal plane is 460 c.p. We believe that Mr. Young, of the Pennsylvania Railroad, figures that the intensification factor of the ordinary 18 in. parabolic reflector usually used for electric headlights is 560, thereby arriving at a projected candle power of 260,000 c.p.

Brick Arch Twenty-Six Years Ago.

As long ago as 1885 James N. Lauder, master mechanic of the Old Colony Railroad made a series of carefully conducted tests to find out the value of the brick arch in locomotive fire boxes and the conclusion arrived at was that the arch saved over 15 per cent. of coal. The Boston & Lowell Railroad people made tests of the brick arch about the same time and concluded that the arch saved 20 per cent. of fuel. Yet neither of these railroads adopted the arch. The objection was that it was something extra to look after.

Keep your temper, nobody else wants it!

Electrical Department

The Single Phase Alternating Current Motor.

By A. J. Manson.

The question has been asked, "Why is it that motors on the New York, New Haven & Hartford Railroad electric locomotives can run on both the alternating and direct current, whereas an electric fan for use on 110 volt alternating current lighting circuit will not run if connected to a 110 volt direct current lighting circuit, but will stand still and soon burn up?"

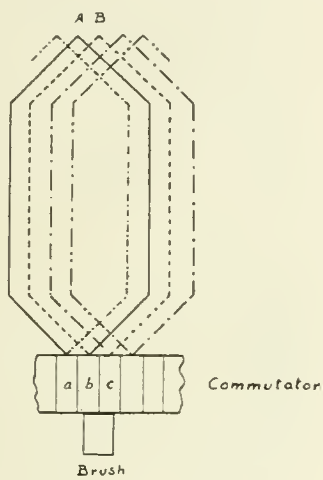


FIG. 1. D. C. ARMATURE WINDING.

In order to answer this question it is necessary to consider the two general types of single phase alternating current motors, namely, the series commutator type, and the induction type.

SERIES COMMUTATOR TYPE.

This type is that used on the N. Y., N. H. & H. R. R. electric locomotives, and is the one which will first be considered. We illustrated and explained in the February number a simple fact applying to a direct current motor, and pointed out that if either the pole of the magnet or the direction in flow of the current through the wire was changed, the direction of rotation of the motor would be reversed, but that if both were changed the rotation would be in the same direction. By this fact, it is therefore necessary, in order to reverse the direction of rotation of a direct current motor, to change either the leads to the armature or the leads to the fields. If the plus and minus leads at the terminals of the motor are changed, however, the rotation will, of course, remain the same, as this changes the flow of current in both the armature and the field coils.

Applying this to a direct current series motor, changing the connections at the terminals, say, by means of a switch, once a minute or oftener, would have no effect on the direction of rotation of the motor. We should, therefore, expect that if alternating current was connected to the direct current series motor that the motor would rotate in one direction and operate satisfactorily, for with alternating current it would be the same as changing the connections at the terminals with direct current several times a second, as in alternating current the current reverses its direction of flow several times a second. Theoretically this is true, and the motor will run in the same direction, but it is not practical as there are several conditions which exist in the direct current series motor, when connected to an alternating current circuit, which must be eliminated before the motor will work satisfactorily and can be of commercial use.

In order to understand what takes place it is necessary to know first about the winding of the armature of the direct current motor and the connections to the commutator. Fig. 1 shows the development of the most general method of winding used in railway work. From this sketch it is seen that starting with one end of the coil A, connected to the commutator bar *a*, the other end of the coil connects to bar *b*; the next coil B begins at bar *b* and ends at bar *c*, and so on around the armature until the last coil ends at bar *a*, thus connecting all the coils together. Note also that the carbon brush is wider than one of the commutator bars, so that the brush is at least in contact with two of the bars at all times. In the position shown this brush is in contact with bars *b* and *c*, and thus connects together the two ends of coil B. Therefore, during the rotation of the armature, as each commutator bar passes under the brush, there is a coil which has its two ends momentarily connected together or what we call short circuited. This condition of a closed or short circuited coil exists when the coil is directly under the pole where it gets the maximum effect of the field as the brush is set exactly in the middle of the pole face.

Having explained the construction and connections of the coils of the armature, let us see what takes place electrically in this direct current motor when connected to the alternating current. In order to fully appreciate this, the following fact, which can be shown easily by experiment, must be taken for granted. If a coil of wire is wound around a piece of iron and an alternating current is allowed to flow through this wire there will be a magnet formed, but instead of the pole of this magnet remaining fixed, as would be the case with direct current flowing through the wire, it changes from a north to a south and vice versa, due to the reversal of current which occurs with alternating current circuits. If a closed coil is brought up close to and in front of this alternating magnet or field there will be a current generated in this coil.

The above fact exists in the direct current series motor when connected to the alternating current circuits. There is the pole on which is wound the field coil and through which the alternating current is flowing, and there is also the coil directly in front of the pole which is closed by the carbon brush, as explained and illustrated by Fig. 1. There is then, set up in this coil by induction, a local current which will reach a high value, and which is entirely independent of the current taken from the supply circuit to do the work required of the motor. This current, together with the current from the power circuit, will be of such a value that the motor would soon get very hot and be damaged, and, moreover, the commutation would be very bad, due to the heavy flow of current at the brushes.

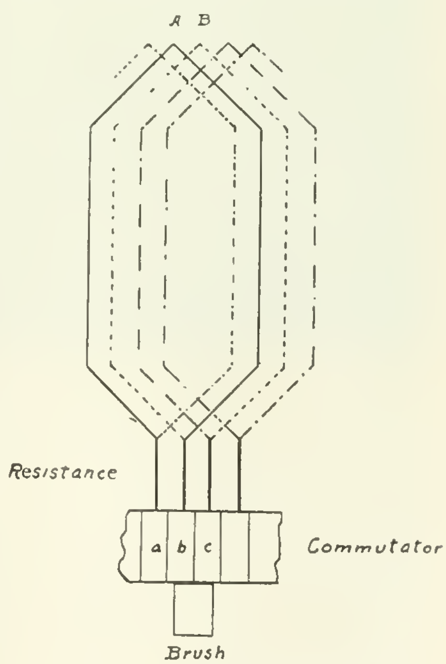


FIG. 2. A. C. ARMATURE WINDING.

Besides this condition there is set up

in the armature, due to the alternating current from the power supply passing through the coils, a series of alternating fields, which is called the self-induction of the armature and which must be eliminated.

It is therefore necessary in order to have the direct current series motor run satisfactorily and be of commercial use on alternating current, to provide means to prevent or else reduce to a minimum the two conditions which we have just mentioned, namely, the local current in the short circuited coils and the self-induction of the armature.

We will first explain how this is taken care of in the motors on the New Haven locomotives, which are running every day on both the direct current and single phase alternating current, and operating very satisfactorily on both systems. To overcome the first condition, namely, the large amount of current in the short circuited coil, there is placed in the same slot as each armature coil, and connected to the same, a strip of German silver, which has a high resistance to the flow of current. The connections are shown by Fig. 2. From this sketch it is seen that the coils are connected same as in Fig. 1, the only difference being that two adjacent coils are not connected together at the commutator but to one end of a resistance, the other end connecting to the commutator bar. When the brush is in contact with bars *b* and *c* as shown, coil B is short circuited and has connected in series with it two of the German silver resistance bars, which cuts down the local current (due to the alternating field and the closed coil) to a minimum and safe value, so that good commutation can be obtained. The current taken from the supply circuit passing through the brush also passes through two resistances and after reaching the armature coils it passes through them without flowing through any other resistances. When the armature is rotating the brushes only short circuit one coil momentarily, so that new resistances keep coming into the circuit and one set does not have the current flow through it continuously. The resistance therefore does not become overheated and does not interfere with the operation of the motor.

The second condition, namely the self-induction of the armature, is taken care of by placing a winding in slots distributed around the inside of the frame, these slots being so spaced that there is an alternating field opposite to that of the self-induction of the armature. The winding in these slots, called the auxiliary winding, is connected in series with the armature and thus the same current flows in each, and the field is not only opposite, but equal to the self-induction. Thus by the inserting of resistance in the armature coils and applying the auxiliary winding around the frame of the motor, the bad effects due to the alternating current are eliminated and the motor runs as satisfactorily as a direct current motor.

Fig. 3 shows one of the main fields and a part of the auxiliary winding. The arrows show the direction of the flow of current when operating on direct current and at a particular time when running on alternating current. Starting where the current enters the auxiliary winding, note that it passes around a center first, in a counter lock-wise direction and then in a clock-wise direction, but that instead of the windings being bunched together they are spaced over considerable distance. This sketch shows only one main field coil together with a section of the auxiliary winding, but the same windings continue all around the frame of the motor.

The general appearance of the armature, frame, etc., is the same as a direct-current motor and the relation of the torque, speed and current is identical with the D. C. series motor, so that this alternating current motor is just as satisfactory for railway operation.

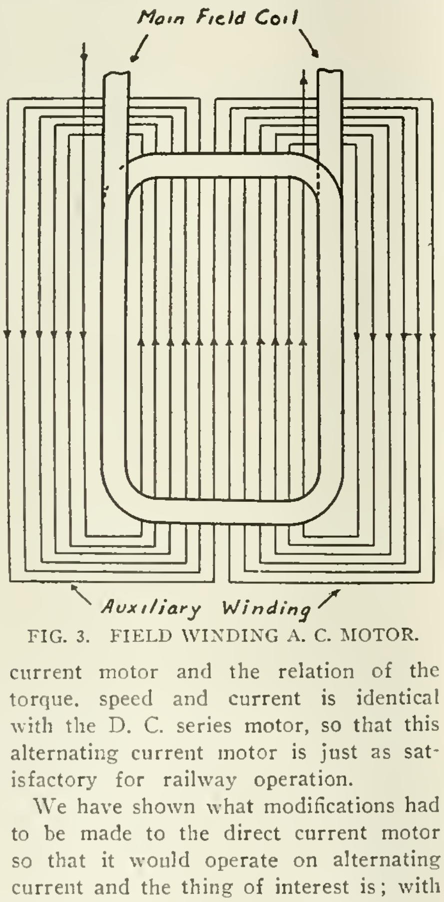


FIG. 3. FIELD WINDING A. C. MOTOR.

We have shown what modifications had to be made to the direct current motor so that it would operate on alternating current and the thing of interest is; with what success will this modified motor operate on direct current. The only changes made were the inserting of resistance in the armature coils, and the placing of an auxiliary winding around the frame of the motor, connected in series with the armature. This resistance in the armature does not effect the operation of the motor on direct current. The winding around the frame, or auxiliary winding, forms nothing more or less than interpoles, except that the poles are distributed instead of a coil on an iron pole. In our last issue we outlined what advantages were obtained by the use of interpoles so that this motor is an ideal direct current motor.

INDUCTION TYPE.

This type of motor is entirely different from the one just described, and. as implied by its name. it depends on the principle of induction for its rotation the same as the three-phase induction motor described fully in our March number. As in the three-phase motor, the single-phase induction motor has a stator, or field, composed of coils distributed in slots around the frame and a rotor, or armature, with no connection to the power circuit. Unlike the three-phase motor, however, the single-phase induction motor has no power to turn, as a single phase current does not give a rotating field in the winding of the stator, unless some means are provided to start this rotation. It is similar to a shaft with one crank, this crank always stopping on the dead center. The steam in the cylinder would then have no chance to rotate the shaft. If means were provided to get this crank off the dead-center and rotation of the shaft was obtained, then the single crank would be able to keep up the rotation.

In the single-phase induction motor, this rotation of the field in the stator winding is started by means of a small winding called the starting winding, placed at intervals around the stator, but occupying only a few slots compared with the main stator winding. The resistance of this winding to alternating current is different from the main winding, and due to the nature of alternating current will cause the current in this winding to lag behind that in the main stator winding, so that the maximum value will occur nearly ninety electrical degrees behind. Due to this there will be a rotating field in the stator dragging along the rotor. This is similar to fitting a smaller crank on the same shaft nearly 90 degrees from the main one which would rotate the shaft and get the crank off dead-center. After rotation of the single phase motor has once taken place it is not necessary to have this starting winding in the circuit, and same is cut out automatically by means of contacts which are fastened to the rotor, and which open the circuit when the motor reaches a certain speed due to the centrifugal force.

We have shown that the principle on which this motor works is induction and that a rotating field is necessary in the stator. What will be the effect if connected to the direct current, and will it be possible to obtain this rotating field? We explained that this rotating field in the stator was due to the reversal and change in value of the alternating current, and also that a starting winding is necessary to get rotation. With direct current there is no reversal of current or change in value, and the starting winding which causes a lag in the alternating current behind that in the main field, has no effect on the direct current. Therefore, there will be no rotating field and no means to cause rotation of the motor or armature. Moreover, with alternating current connected to the stator winding there will be only enough current flow to take care of the load, but with direct current connected to the windings there will be a rush of current, as it offers very little resistance to direct current, and the motor will burn up.

Counterbalancing Locomotive Wheels.

The problem of balancing the wheels of locomotives involves a calculation of the weight of cranks or crank-pins with their attached rods, crossheads and pistons, and applying a sufficient weight on the opposite side of the wheel from the crank to make up for the superincumbent weight of the crank attachments. Without such counterbalance a sort of eccentric motion would be given to the wheels, which all the acquired momentum of even the heaviest kind of locomotives could not completely overcome.

It would seem at the first glance that the problem would be simply to find out how much weight would be necessary to equalize the disturbing factors, but the fact is that it is the simplest part of the calculation. It must be remembered that the piston and the crosshead move in a straight line. The main and connecting rods describe varying paths. While the engine is running ahead the thrust of the main rods is downwards with the consequence that the weight upon the rails is somewhat increased, and when the thrust of the rods on the wheels is upwards, as is the case when the engine is running backwards, the tendency is to lift the wheels from the rails. Added to this is the centrifugal force of the side rods and the heavy end of the main rods, and in the case of locomotives equipped with the Stephenson valve gear, there is a small added disturbing factor in the weight of the eccentrics which lean toward their respective crank pins, increasing the amount of weight to be counterbalanced and which in an attempt at an exact adjustment should also be taken into consideration.

It will thus be seen that in the simplest forms there are several problems to be dealt with. The balancing of the sheer weight of the various attachments is simple enough. An extra weight conveniently placed near the rim of the wheel opposite to the location of the crank, as we have stated, can be so justly balanced as to counteract or make up for the eccentricity caused by the opposing weight. The other disturbing factors are not easily overcome. To understand clearly what takes place at each reversal of the stroke of the piston, we shall presume that the piston has reached the forward end of the stroke. The movement of the piston up to this point has been to move the engine forward. Now the piston has to be made to move backward with a velocity from nothing to twenty feet or more a second, the crank literally having to drag the piston out of its position. This disturbance cannot do other than make the engine move by jumps, and the movement is further involved by the location of the cranks which are generally set at right angles to each other, or at 90 degs. apart. Continued experiments have demonstrated the fact that these accumulated disturbances may be almost completely overcome by increasing the weight in the rim of the wheel opposite to the crank or crank pin.

Mr. Roger Atkinson, the well-known engineering writer, conducted extensive experiments several years ago and formulated methods for ascertaining the necessary amount of counterbalance for each class of locomotive. The Atkinson method may be briefly summarized as beginning with an exact weighing of the various connecting parts. The rods to be weighed centrally, that is, the rod should be balanced on its centre and each end weighed separately, care being taken to observe that the total of the weights of the separate ends agrees with the entire weight of the rod. With these weights carefully ascertained the crank and its hub may be counterbalanced separately by experimental loading of the wheel moving the wheel on level rails, and observing that the wheel ceases to move when the crank and counterbalance are at the forward and back centres respectively.

The following statement may be relied upon as a just estimate of weighing and counterbalancing a consolidation engine:

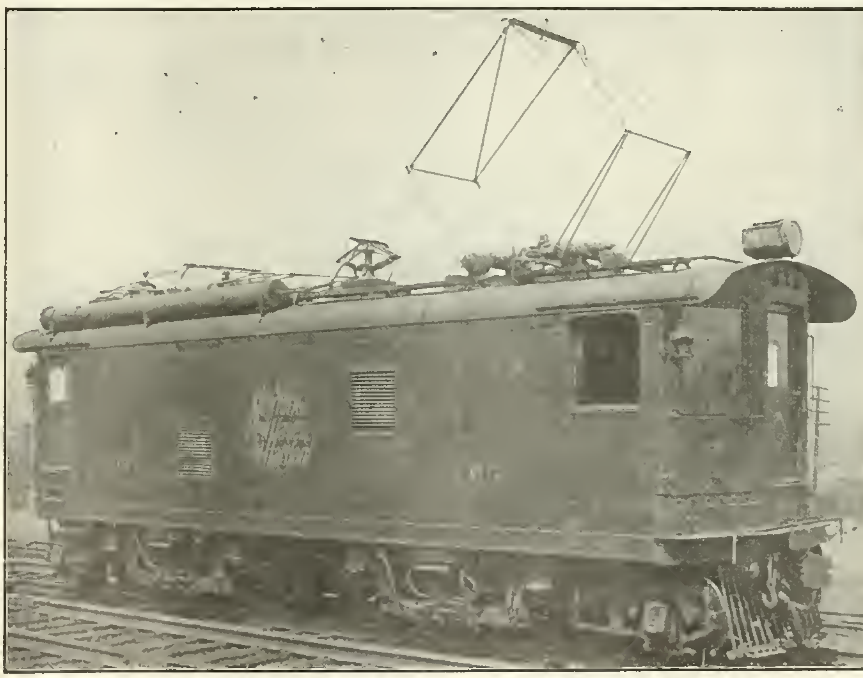
Piston and rod	525 lbs.
Crosshead and pin	232 "
Little end of main rod	239 "
Total	996 lbs.

Assuming that the ratio of the distance between the centre of the axle and the centre of the crank pin is as 2 is to 3, hence $996 \times 2 \div 3 = 664$ lbs.

Coming to the revolving weights the following are the exact amounts found on the engine referred to:

	Leading.	Intermediate.	Driving.	Trailing.
	lbs.	lbs.	lbs.	lbs.
Side rod	97	231	284	99
¼ of 664 lbs.	166	166	166	166
Big end	...	...	485	...
	263	397	935	265

Of the actual weights upon the engine on which Mr. Atkinson experimented the weights already attached to the wheels were found to have a shortage of counterbalancing of 750 lbs. on the right side and 756 lbs. on the left side, which were added on a ratio to the shortage on each wheel, with the result that the wheels were perfectly balanced.



N. Y., N. H. & H. ELECTRIC, RUNS WITH A. C. OVERHEAD, AND WITH D. C. ON THIRD RAIL.

Not the Whole Thing.

Ingenuity does not cover all mechanical shortcomings. There is King now who can do almost any job in the shop, but is the sort of man who when he wants a bradawl and hasn't any, instead of buying one, will go to work to make one by straightening out a corkscrew.

Air Brake Department

Conducted by G. W. Kiehm

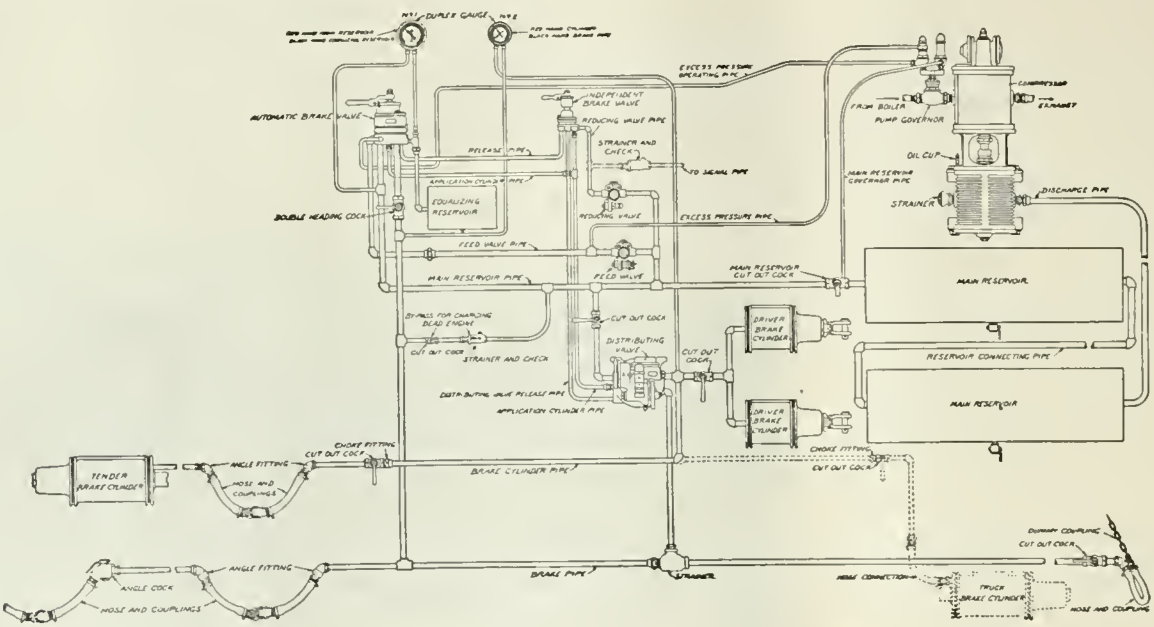
Blow at Brake Pipe Exhaust Port.

This subject of a blow of air from the brake pipe exhaust port of the H 6 brake valve is taken up with a view of making the series of articles on the H 6 brake more complete, rather than to present anything new on the subject. When a constant blow comes from the brake pipe exhaust port of the brake valve, it is owing to one of three things, the equalizing discharge valve is off its seat, due to sticking in the bushing, or due to an obstruction between the valve and seat, or there has been a variation in the pressure surrounding the equalizing piston and it has become unbalanced.

If the blow is found to exist when the brake valve is returned to lap position, after a brake pipe reduction, when coupled to a train, but where no leak exists when the handle is in running position, then it must be due either to a leak or lowering of equalizing reservoir pressure or to an increase of brake pipe pressure and as there is not likely to be an increase of brake pipe pressure after a 5, 10 or 15-lb. brake pipe reduction; therefore, if the valve handle is placed on lap position after such a reduction, and the equalizing piston refuses to seat properly and continues to discharge brake pipe pressure, it must be due to a leak in the equalizing reservoir volume which could occur at a number of different points.

The volume of air that is escaping will usually denote whether the reservoir or volume is defective, or whether there is some foreign substance on the valve seat, and if the equalizing reservoir pressure has escaped, or is escaping, the gauge hand will show it by falling, but if the valve failing to close is due to dirt on the seat, the gauge will register a pressure in the equalizing reservoir.

In case the blow is due to dirt or chipped-off pieces of pipe having lodged on the valve seat, it can generally be blown off if an attempt is made in the right manner. At the first opportunity, a full service reduction of brake pipe pressure should be made, and the brake valve cut-out cock closed, and the valve handle thrown to release position, and the violent rush of air to the under side of the piston will blow the dirt off the seat, if it can be done.



NO. 6 E. T. EQUIPMENT, INSTRUCTION DIAGRAM.

Under ordinary conditions, when the brake valve handle is placed in service position, the reduction of equalizing reservoir pressure permits brake pipe pressure to become stronger or of a higher pressure, and the valve becomes unseated and the resultant blow at the exhaust port is desired for the purpose of discharging brake pipe pressure, which is necessary to apply to brake. The blow, however, may occur when it is not desired, and this article has reference to a blow occurring at such a time.

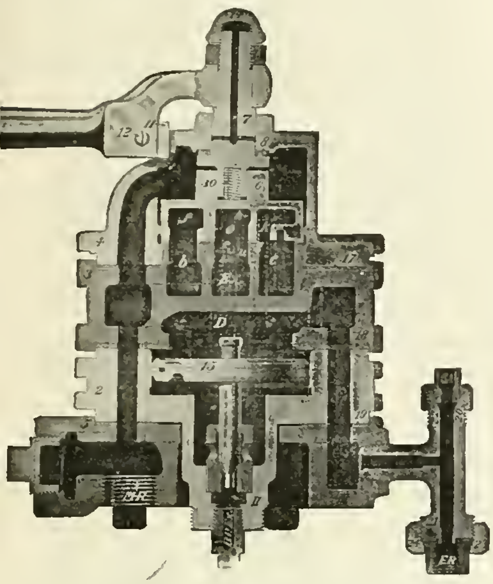
If a blow is found at this point, while the engine is in the roundhouse, the cause of the disorder can be found and removed in a very short time, but when out on the road, this is a different matter, as the brake valve can not be taken apart without causing a delay, even if it became necessary to do so.

If there was no unusual action of the brake valve after ordinary brake pipe reductions, but a blow did start at the exhaust port after a heavy reduction that had passed the point of equalization, and this blow existed only after such a reduction, it would indicate that it was the result of an increase of brake pipe pressure, presumably due to leaky check valves in some of the triple valves in the train.

Should a blow start at the point in question, after the ordinary brake pipe reduction and continue after the handle is returned to running position, it would mean that either the equalizing reservoir is disconnected, the pipe split or broken off, or there is some obstruction on the valve seat or under the piston that is holding the valve off its seat.

Under no circumstances should the handle be placed in emergency position for the purpose of removing any dirt at such a time, as this would quickly withdraw the brake pipe pressure under the piston and allow the pressure remaining in the equalizing reservoir to force the valve down hard on the seat, and if the obstruction on the seat was a piece of metal, it would be imbedded in the brass, and could not be removed without taking the valve apart, and even if it was to be removed, the valve or seat would probably be badly cut, at least enough to practically disable the brake valve for service operations.

The same thing would likely occur, if under the same circumstances, the cut-out cock was to be turned and the handle placed on lap position, while a high pressure was stored in the equalizing reservoir, as the leakage at the exhaust port



H-6 VALVE, VERTICAL SECTION.

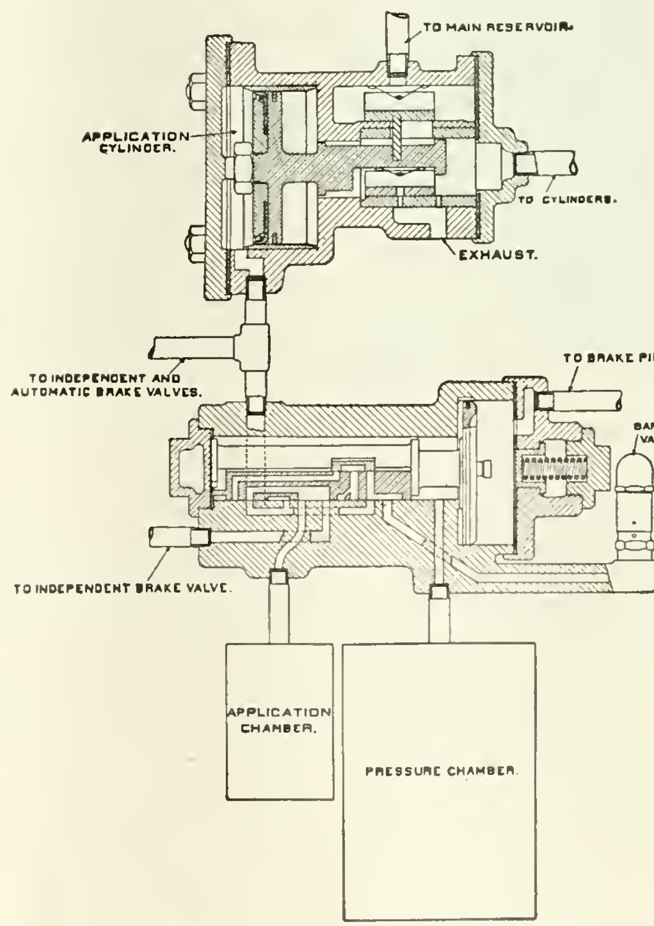
would quickly exhaust the brake pipe pressure under the piston. If such an action does occur at any time while out on the road, and the dirt cannot be removed in the manner described, it is best to close the brake valve cut-out cock as the opportunity presents itself, and the handle can be placed in lap position and the exhaust port plugged and the brake valve will be handled in the same manner as though the port was plugged to overcome a broken equalizing reservoir pipe. Taking a brake valve apart while out on the road is a thing of the past, and is no longer permitted.

If a blow should start at the exhaust port while running along and the brake valve handle has not been moved it might constitute a pretty severe test of a man's knowledge of the air brake. If this should occur, and if a man could think fast enough in a case of this kind, and realize at once that the piston cannot be unseated, save by a variation in pressure, and knowing that an increase of brake pipe pressure rapid enough to cause this is practically impossible, it would naturally follow that a reduction in equalizing reservoir pressure had taken place, likely due to a broken pipe, and if the brake valve handle is placed in release position within three or four seconds of the time the blow starts, the brake can be prevented from applying, after which the stop cock under the brake valve can be closed, and if brake pipe leakage on the cars is not sufficient to apply the brakes, there is no reason why the temporary repairs cannot be made while the engine and train are in motion.

The temporary repairs would consist of placing the handle on lap position, then disconnecting the equalizing reservoir pipe at the brake valve tee and plugging the tee and the brake pipe exhaust port which should require but a few seconds time, after which the valve would be placed in running position, and the stop cock under the brake valve opened. The brake would then be applied with a direct application, going slowly toward emergency position and returning slowly to lap position after the reduction.

This equalizing reservoir volume, which is used to operate the equalizing piston, must remain constant when the supply to it is cut off, if the brake pipe pressure on the opposite side of the piston is to remain unchanged, and if there is any decrease or increase in the equalizing reservoir while the valve handle is on lap, the brake pipe volume will also be affected.

In the event of a leaky equalizing piston packing ring, which is in the dividing line between the two pressures when the handle is on lap, brake pipe pressure would flow into the equalizing volume



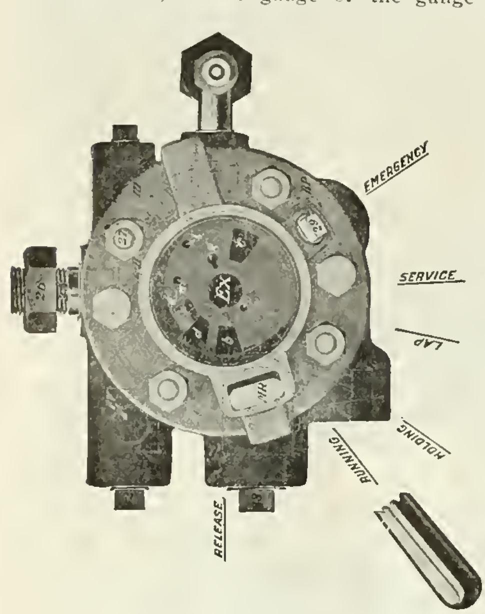
ELEMENTS OF NO. 6 DISTRIBUTING VALVE.

during a service reduction with the result that it would take longer than the specified time in which the reduction, as shown by the gauge hand, should be made, and if the ring leaked badly enough the piston could not be lifted at all by a movement to service position. A leak through the middle gasket would have the same effect of lengthening the time required to make a certain number of pounds reduction, and if the leakage is bad enough from either the brake pipe or main reservoir ports into the cavity above the equalizing piston, it will prevent the operation of the service features.

The piston is supposed to form a joint on the middle gasket when at its fullest lift, so that any slight leakage past the packing ring cannot enter the equalizing reservoir, should ring leakage, enough to be of any consequence, pass a defective gasket and enter the equalizing reservoir, it would have the effect of cutting down the amount of reduction as shown by the air gauge, that is, should a 10-lb. reduction be made in equalizing reservoir pressure and leakage from the brake pipe could enter the reservoir while the brake valve was discharging air from a long brake pipe, equalizing reservoir pressure would rise and the hand on the air gauge would indicate it, so that the reduction that was 10 lbs. initially might be but 7 or 8 lbs. when the exhaust of brake pipe pressure ceases. The difference in the amount of reduction would depend upon the volume of air in the brake pipe and the amount of leakage into the equalizing reservoir.

This reservoir volume is approximately 800 cu. ins. and will discharge from 70 lbs. pressure to 50 lbs. through the 5/64 in. opening, in from six to seven seconds, from 110 to 90 lbs. in from five to six seconds. If the time is any less than this it is likely to result in the undesired quick action, and is due to an enlarged preliminary exhaust port or to leakage from the reservoir or connections. Should it take longer than the time specified to make the reduction, it would be due to a restricted opening in the preliminary exhaust port or to leakage into the reservoir.

Whether leakage from the equalizing reservoir will cause the piston to lift and discharge brake pipe air when the valve handle is placed on lap position, depends upon the volume in the brake pipe and the condition of the packing ring. Leakage from the equalizing reservoir could occur in the reservoir itself or its pipe connections, in the gauge or the gauge



H-6 VALVE, HORIZONTAL SECTION.

pipes, from the middle gasket of the brake valve, to the atmosphere, from the pipe bracket gasket, from the bolt holes past the bolt heads under the lower case, or it might be caused by a cut on the rotary valve or seat, and with the G 6 brake valve, the leak could be past the threads of the stud on which the holding nut is screwed. Leakage into the reservoir might be from the middle gasket of the brake valve as explained, either main reservoir or brake pipe pressure could enter, or it might occur through leaks from port to port, on the face of the rotary valve and seat, and it might be due to a defective pipe bracket gasket.

It should always be borne in mind that the action of the equalizing feature of the brake valve is such that, the equalizing piston cannot be lifted, a differentiial in pressure surrounding it cannot be obtained. If it does lift the differential in pressure has been created, but there is a possibility of the piston being lifted without resulting in a discharge of brake pipe pressure should the exhaust port have been plugged for any reason and the removal of the plug had been neglected.

In view of the series of articles on the H 6 brake, it is unnecessary to call attention to the points from which air could enter the brake pipe from some other portion of the equipment and under certain conditions lift the equalizing discharge valve.

The Luminator.

A very interesting paper was recently read by Mr. T. R. Duggan before the Society of Chemical Industry in New York. Among other things the speaker said:

"After a long period of experimenting and after many trials, an inventor, a German scientist, Herr Brandes, was able to construct an apparatus which gave to ordinary water, after simply flowing over it, certain properties. For instance, when used in steam boilers, much less scale was deposited, old scale was softened and detached from the plates, especially the flues, steam was dryer, and less coal was required in steam-raising, and generally the salts were found as a powder in the bottom of the boiler, whereas otherwise they would have formed hard scale.

"This apparatus was studied in all its applications; it was simplified, and finally this scientific method of treating water has been patented throughout the world. The invention is a remarkable one in patent history, and in view of the simplicity and novelty of the means by which it effects results. I should hesitate to offer this for the serious consideration of practical men if I were not able to refer them to many of the principal British railways and British and German engineers, works' managers, industrial comporations and government officials of the highest repute and undoubted integrity.

"The action of the Luminator, for that is the name of the apparatus, is that, by the passage of water over the metal channels at certain speeds, a current of electricity is induced, the water being negative and plates positive, ionization of the salts takes place and they do not take a crystalline form, but become amorphous; at the same time a new and particular action goes on, that is, aluminum is by friction and electrical action abraded from the surface, which after a period undergoes change in the water. This action was investigated by Professor Donnan at the Liverpool University, who found that aluminum hydroxide was not present in water treated by the apparatus, to any extent, but on turning to the ultramicroscope he was enabled to see that the aluminum was in the colloidal form mixed with hydroxide and remained so for several days.

"When storage tanks and mains are far from the boiler, it is necessary that they be coated with a non-conducting composition, any bituminous varnish will do, and that water reach the boiler as soon after treatment as possible. In any case, to get maximum effect, the water must be used within seven days of its treatment; hence storage tanks should not be too large. Where water is passing continuously night and day, it may be found necessary to give the apparatus rest on about one day per week, as the plates under certain conditions become polarized. This only happens under very unfavorable conditions, and in most cases may be neglected altogether."

Reclaiming Oil.

A very legitimate economy is being sought by experimenters on the Pennsylvania in the reclaiming of oil for lubricating the journal boxes of cars. It is said that at the present time it takes 30 gallons a year for each box, with 5 lbs. of waste to absorb it. Already it has shown that 7¼ gallons of oil can be extracted from 60 lbs. of waste removed from the boxes. It is estimated that by a squeezing process 8 gallons can be taken from every 100. This is worth while with oil costing 33⅓ cents a gallon. Great quantities are used on a system like the Pennsylvania.

Statistics show 10,249,462 car wheels are in service on railroads in the United States and 307,483,860 gallons are used in the course of a year, and to 51,247,310 lbs. of waste 8 gallons of oil saved from every 100 lbs. of waste would mean the recovery of 4,097,734 gallons and this reduced to dollars and cents presents the neat sum of $1,366,595.

Strength of Riveted Joints.

A correspondent has written us for the rule for finding the strength and efficiency of a butt joint which he has not drawn in accordance with modern practice, but we will endeavor to answer the question intended. The rivets are 1-in. in diameter and the plate is given as ⅜-in. thick. We may say that one-inch rivets are generally used with ⅝-in. plate. The pitch of rivets given is 3 ins., and there is a welt inside and out. See Fig. 1.

The first thing to do is to find the relative value of the punched sheet as compared with the solid sheet. This has nothing to do with the tensile strength of either sheet or rivet. The value of the solid sheet is taken at 100, and the punched sheet has, of course, only some percentage of solid sheet strength. The holes are 1 1/16 in., for the 1-in. rivets, and from outside to outside of rivet holes there is a space of 1 15/16 in. The strength of the sheet for one pitch length of 3 ins. is in the proportion as 3 : 1 15/16 : : 100 : X. This works out to 64.4 per cent.

Now according to our correspondent the plate has a tensile strength of 55,000 lbs. The full strength of the plate for one pitch length is 3 × ⅜ × 55,000 = 61,875 lbs. If the rivets are iron assuming 40,000 lbs. shearing strength, we have in one pitch length one whole and two half rivets in double shear. That is equal to double shear on two rivets. A

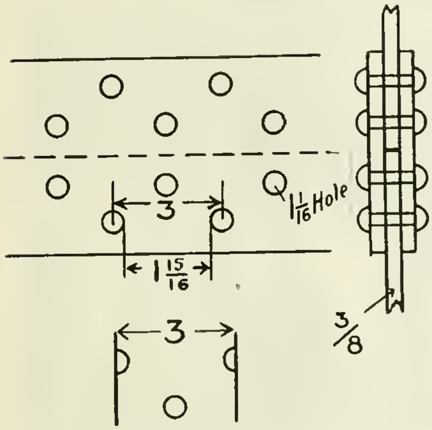


FIG. 1. BOILER JOINT ⅜-IN PLATE.

rivet in double shear being equal to 1¾ times a rivet in single shear. The two rivets in double shear are thus equal to 1¾ + 1¾ or 3½ rivets in single shear.

We found the full strength of the plate for one pitch length to be 61,875 lbs. The strength of the rivets is therefore 3½ × area a hole 1 1/16 diameter × 40,000 or 3½ × .8866 × 40,000 = 124,124, this is a little over twice the full strength of the plate to shear. The plate with rivet holes is only 64.4 per cent. or .664 of the full strength of the plate. That is 61,875 × .664 = 41,085. This shows that for one pitch length the rivets in double shear are about three times as strong as the punched plate.

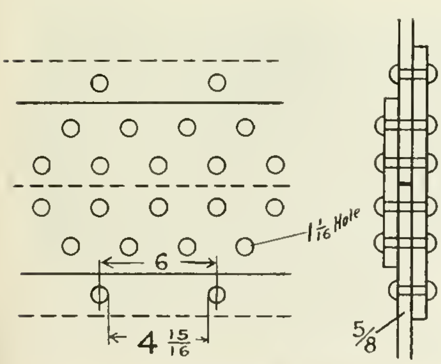
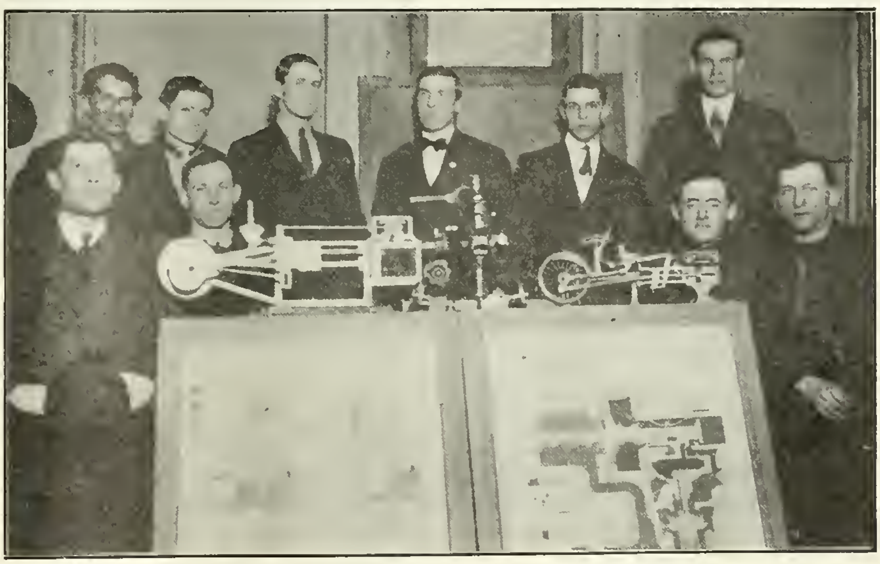


FIG. 2. BUTT STRAP JOINT ⅝-IN. PLATE.

The way this joint is generally made is with ⅝-in. plate and a row of rivets at double pitch are driven in an extension of the inner butt strap or welt. Fig. 2. Taking the outer row of rivets for pitch length, viz., 6 ins., we get as percentage of strength 6 : 4 15/16 : : 100 : × = 82.3 per cent., or .823 of the full strength of the plate for one pitch length. The plate strength is of course 6 × ⅝ × 55,000 = 206,250 lbs., while the riveting would show 4 rivets in double shear and one in single shear or equal to 8 rivets in single shear. This would give us the following: 8 × .8866 × 40,000 = 283,712 lbs., as the rivet strength. The full plate strength becomes 82.3 per cent. when punched and that amount is here 169,743 lbs. This means that the rivets are 1.67 stronger than the punched plate.

Railroad Y. M. C. A., Hoboken, N. J.

The Lackawanna Railroad Y. M. C. A., Hoboken, N. J., has added greatly to its membership during the winter season. The attendance at the classes of locomotive running and air brake department has been very large, and the work of the instructer, Mr. A. G. Secor, has been warmly appreciated. Mr. John G. Schroeder, the secretary of the association, has instituted an admirable feature which is worthy of imitation. It has enlisted the interest of the officials in the mechanical department and invitations have been extended to leading railway men in the East who have gladly helped along the good work by delivering addresses on special subjects. An invitation was recently extended to the editorial staff of RAILWAY AND LOCOMOTIVE ENGINEERING, which was responded to by Dr. Sinclair and Mr. James Kennedy. The class rooms have been fitted with models of mechanical appliances, the most recent addition being that of our Stephenson and Walschaerts valve gear models.



Y. M. C. A. ENGINE AND AIR BRAKE INSTRUCTION CLASS ON THE D., L. & W., WITH WALSCHAERTS AND STEPHENSON LINK MOTION MODELS, SUPPLIED BY RAILWAY AND LOCOMOTIVE ENGINEERING.

Detroit-Ann Arbor Section A. I. E. E.

A well attended meeting of the Detroit-Ann Arbor section of the A. I. E. E. was held on the evening of February 18 at the Whitney Hotel, Ann Arbor. The meeting was largely of a social nature; however, in addition a short paper was given by the chairman, Prof. G. L. de Muralt, on "Modern Tendencies in Railway Electrification."

Prof. de Muralt traced the development of electric locomotives especially with respect to the use of side rods, showing how the modern electric locomotive is finally coming to the side rod drive, as has been so successfully worked out by mechanical engineers for steam locomotives. He also pointed out that this construction was used in Europe many years ago.

Prof. de Muralt then outlined some of the salient features of the three phase system, a system which, in spite of its merits, is very little known in this country. The modern tendency to lighten the overhead line construction was also taken up and discussed, together with the ideal construction for light bow - type current - collectors, which make light overhead construction successful.

Prof. de Muralt accompanied his paper with numerous stereopticon views of locomotives and equipment, collected during his wide experience with electric trunk line installations, both in this country and in Europe.

Among those taking part in the discussion were Messrs. Hall, of the St. Clair Tunnel Company; Winslow, of the Detroit River Tunnel Company; Leamon, of the Michigan United Railway; Eddy and Woolfenden, of Detroit, and Prof. Sawyer, of the Michigan Agricultural College, Lansing.

An agent for steam engine indicators was recently confronted with an ancient gag of ignorance about indicators. He tried to sell an instrument to a superintendent of motive power, and was told that they built locomotives to haul cars not indicators.

Steel Post Office Cars.

The Pennsylvania Lines have recently received from the Pressed Steel Car Company, of Pittsburgh, Pa., some steel mail cars. These cars were built from the railroad company's designs and are in accordance with recent rulings made by the United States Government with reference to the use of all-steel cars for the carriage of mail matter.

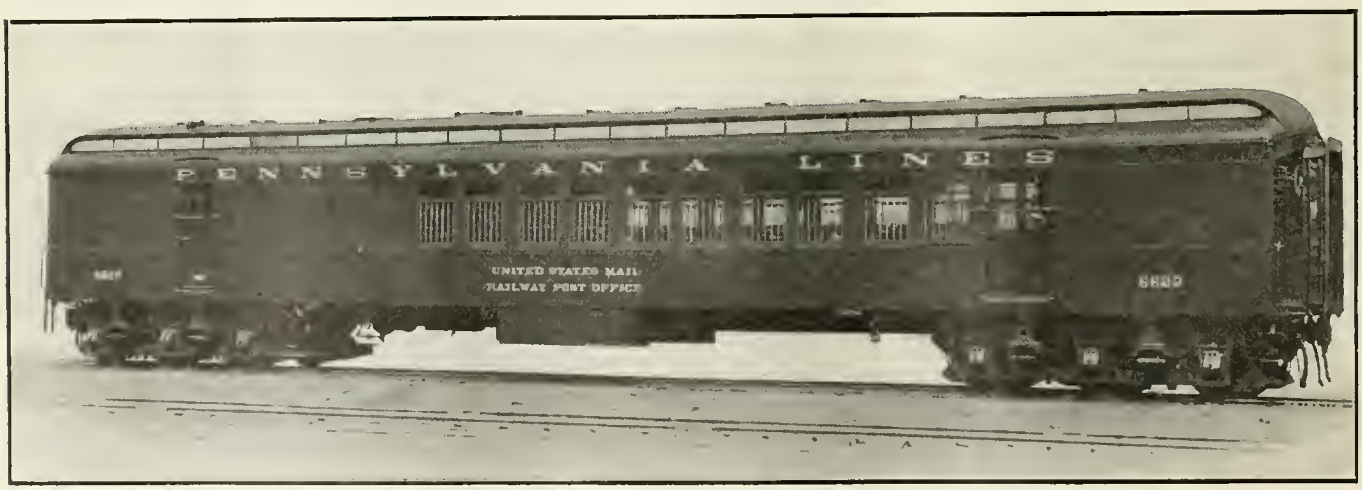
These cars are of the stub-end type with Monitor roofs, double steel sash windows, steel doors and six-wheel trucks. The principal dimensions are as follows: Length over buffers, 74 ft. 9¾ ins.; length over corner posts, 71 ft. 4⅜ ins.; distance from center to center of trucks, 54 ft. 9 ins.; width over side sheets at sills, 9 ft. 9¾ ins.; width over side sheets at belt rail, 9 ft. 10¾ ins.; maximum width of car, 9 ft. 11½ ins.; width at eaves lower deck, 9 ft. 11½ ins.; width at eaves upper deck, 7 ft. 7 ins.; height from rail to top of roof, 14 ft. ½ in.; height from rail to top of eaves lower deck, 12 ft. 2 ins.; height from rail to top of body center plate, 2 ft. 5 ins.; height from rail to center of drawbar, 2 ft. 10½ ins.; height from rail to top of floor, 4 ft. 4 ins.

The framing is composed of two 18-in. rolled channel center sills and two 5 x 3½ x 9/16 in. rolled channel side sills tied together by pressed steel cross bearers and 6-in. rolled channel diaphragms. Side posts are of pressed steel, channel shaped, and corner posts are 4-in. Z-bars with 3/16-in. cover plates. The belt rail is a 4-in. x ½ in. steel bar and the end door posts 12-in. I-beams. The outside sheathing is made of ⅛-in. steel. Carlines are pressed steel, channel shaped, the upper deck roof being made of .08 steel and lower deck of .062 steel. The inside lining is 1/16-in. steel with 3/16-in. Ceilinite glued to back of sheets. The ceiling or headlining being ⅜-in. composite board for the upper deck and ¼-in. composite board for lower deck. The flooring is of Carbolith, laid on No. 16 gauge corrugated steel, 1½ ins. thick throughout

All of the letter cases, paper cases, pouch racks, tables and fittings are steel, the tops of tables being covered with sheet rubber glued to Monolith.

The cars are heated with the vapor system and lighted by electricity, and are also equipped with a set of storage batteries. All cars are equipped with Westinghouse Air Brakes, Schedule PM-1612, high speed reducing valves and American automatic slack adjuster; Westinghouse friction draft gear; Pitt couplers; cast steel body center plates. The trucks are six-wheel, PRR standard, 5 x 9 journals with axles of O. H. S. steel; pressed steel bolsters; drop forged centre plates; grey iron journal boxes and 36 ins. Schoen rolled steel wheels. The weight of the car body is 83,860 lbs.; weight of trucks, 44,140 lbs., making the total weight of car 128,000 lbs.

INTERIOR OF U. S. ALL-STEEL RAILWAY POST OFFICE CAR.



NEW ALL-STEEL U. S. MAIL CAR ON THE PENNSYLVANIA LINES.

Electric Furnaces, University of Illinois.

There have recently been installed at the University of Illinois, through the combined efforts of the department of Electrical Engineering, The Engineering Experiment Station and the Department of Chemistry, two electric furnaces. One of these is a Hoskins resistance furnace and the other a Colb induction furnace. Both are of 20 kw. capacity. The furnaces will be used for the purpose of studying the changes that can be brought about in the mechanical and physical characteristics of cast-iron through the influence of the soaking process which it is possibe to maintain.

The McKeen Motor Car Company, of Omaha, Neb., have turned out ninety-nine of their 200 h.p. gasoline motor cars, which are operating in 24 States.

Items of Personal Interest

Mr. G. C. Nichols has been appointed master mechanic of the Jonesboro, Lake City & Eastern, with office at Jonesboro, Ark.

Mr. Minot R. Smith has been appointed master mechanic of the Chicago, Indianapolis & Louisville, with office at Lafayette, Ind.

Mr. W. A. Hopkins has been appointed supply agent of the Missouri Pacific, with office at St. Louis, Mo., vice Mr. C. A. How, promoted.

Mr. John W. Anderson, foreman of the Chicago & North Western at Eagle Grove, has been appointed general foreman of that road.

Mr. G. R. Couch, chief engineer of division 585. of the Brotherhood of Locomotive Engineers, has been made a traveling engineer.

Mr. F. H. Reagan has been appointed superintendent of the Scranton, Pa., locomotive shops of the Delaware, Lackawanna & Western.

Mr. T. Cassidy has been appointed locomotive foreman of the Canadian Pacific at Rogers Pass, B. C., vice Mr. W. B. Steeves, transferred.

Mr. Burchill Richardson has been appointed superintendent of motive power of the Duluth & Iron Range, with office at Two Harbors, Minn.

Mr. Isaac Dubois has been appointed day roundhouse foreman of the Chicago & North Western, at Boone, Ia., vice Mr. Richard Howe, transferred.

Mr. C. T. Norman has been appointed road foreman of engines on the Rutland Railroad, vice Mr. W. A. Bucbee, resigned to accept other service.

Mr. W. L. Cooper has been appointed division storekeeper of the Mobile & Ohio, with office at Murphysboro, Ill., vice Mr. D. L. Balch, transferred.

Mr. C. H. Montague has been appointed master mechanic of the Quincy, Omaha & Kansas City, with office at Milan, Mo., succeeding Mr. A. W. Quackenbush.

Dr. Guy G. Dowdall has been appointed chief surgeon of the Illinois Central Railroad, vice Dr. John E. Owens, assigned to consulting duties.

Mr. William C. Bower, has been appointed purchasing agent of the New York Central Railroad, with office in New York, vice Mr. S. B. Wright promoted.

Mr. T. Ross, heretofore acting master mechanic of the Temiskaming & Northern Ontario Railway, has been appointed master mechanic with office at North Bay, Ont.

Mr. Charles N. Page, road foreman of engines of the Lehigh Valley, has been promoted to master mechanic of the Auburn division, vice Mr. J. Mowery resigned.

Mr. Sidney B. Wright, has been appointed general purchasing agent of the New York Central Lines, with offices in New York, vice Mr. Frank H. Greene, resigned.

Mr. R. J. Moore has been appointed division storekeeper of the Atchison, Topeka & Santa Fe, with office at Argentine, Kan., vice Mr. A. P. Kephart, resigned.

Mr. Elisha Leo, now superintendent of the New York, Philadelphia & Norfolk, has been appointed assistant to the general manager, to succeed Mr. J. G. Rodgers.

Mr. D. C. Stewart, now assistant superintendent of the Pittsburgh division, was appointed assistant superintendent of passenger transportation to succeed Mr. Shaeffer.

Mr. Charles C. Custer has been appointed general advertising manager of the Chicago & North Western, with office at Chicago, vice Mr. Charles G. Hall, resigned.

Mr. John B. Munson, vice-president of the Georgia Southern & Florida, has been made general manager of the road. His title is now vice-president and general manager.

Mr. J. J. Jordan, member of division 208 B. of L. E., has been appointed traveling engineer on the Sandusky and Toledo division of the New York Central Lines.

Mr. C. M. Wickham, heretofore foreman on the Rutland Railroad at Bennington, Vt., has been appointed engine house foreman at Rutland, vice, Mr. E. T. Norman, promoted.

Mr. E. G. Heath, foreman of the Rutland Railroad at Alburg, Vt., has resigned his position to accept a similar position at Sorel, Que., with the Quebec, Montreal and Southern.

Mr. J. McQuarrie, shop foreman of the Canadian Pacific at Medicine Hat, Alta., has been appointed locomotive foreman at Sutherland, Sask., vice Mr. M. W. Boucher, transferred.

Mr. C. H. Shaeffer, now superintendent of passenger transportation, has been appointed general superintendent of transportation, vice Mr. M. Trump, assigned to special duties.

To fill the vacancy in the general managership, Mr. Simon Cameron Long, now general superintendent of the western Pennsylvania division, was appointed to that office.

Mr. M. A. Cardell, heretofore shop foreman of the Canadian Pacific at Lethbridge, Alta., has been appointed shop foreman at Medicine Hat, Alta., vice Mr. J. McQuarrie, transferred.

Mr. J. A. Walton, heretofore leading hand on the Grand Trunk at Lindsay, Ont., has been appointed locomotive foreman at Palmerston, Ont., vice Mr. J. R. Leckie, transferred.

Mr. H. A. Keswick, heretofore locomotive foreman of the Canadian Pacific at Field, B. C., has been appointed shop foreman at Kamloops, B. C., vice Mr. J. C. Reed, resigned.

Mr. John S. Tyler has been appointed night roundhouse foreman of the Chicago & North Western, at Boone, Ia. Mr. Tyler was formerly with the Pennsylvania Railroad at Logansport.

Mr. J. R. Leckie, heretofore locomotive foreman of the Grand Trunk at Palmerston, Ont., has been appointed locomotive foreman at London, Ont., vice Mr. J. Hay, transferred.

Mr. W. B. Steeves, heretofore locomotive foreman Canadian Pacific at Rogers Pass, B. C., has been appointed locomotive foreman at Field, B. C., vice Mr. H. A. Keswick, transferred.

Mr. R. L. O'Donnel, now general superintendent of the Buffalo and Allegheny Valley division, has been transferred to the general superintendency of the western Pennsylvania division.

Mr. J. C. Rodgers, now assistant to the general manager, has been appointed general superintendent of the Buffalo & Allegheny Valley division, succeeding Mr. R. L. O'Donnel, promoted.

Mr. James H. Downs, of division 160, B. of L. E., has been appointed assistant road foreman of engines on the Maryland division of the Pennsylvania Railroad, with office at Wilmington, Del.

Mr. J. Hay, heretofore locomotive foreman of the Grand Trunk at London, Ont., has been appointed locomotive foreman at St. Clair Tunnel, at Sarnia, Ont., vice Mr. W. H. Towner, resigned.

Mr. Alexander J. Sentman, of division 160. B. of L. E., has been appointed assistant road foreman of engines on the Maryland division of the Pennsylvania Railroad, with office at Wilmington, Del.

Mr. F. H. Greene, general purchasing agent of the New York Central Lines, at New York City, has resigned to become president of the Hale & Kilburn Manufacturing Company, of Philadelphia, Pa.

Mr. Ralph B. Quickel has been appointed fuel agent of the Queen & Crescent, vice Mr. S. L. Yerkes, resigned. Mr. Quickel has been connected with the school of mining of the Kentucky State College.

Mr. F. M. Johnson, auditor of the Fort Dodge, Des Moines & Southern, at Boona, Ia., has been also appointed purchasing agent of the same road, vice Mr. J. L. Blake, resigned to go into other business.

Mr. W. R. Shrodes has been appointed chief clerk and purchasing agent of the Quincy, Omaha & Kansas City, and of the Iowa & St. Louis, with office at Kansas City, Mo., vice Mr. L. A. Irwin, resigned.

Mr. R. L. Doolittle has been appointed superintendent of motive power of the Atlanta, Birmingham & Atlantic Railroad. The position of master mechanic, which he formerly held, has been abolished.

Mr. M. W. Boucher, heretofore locomotive foreman of the Canadian Pacific at Sutherland, Sask., has been appointed locomotive foreman at Hardisty, Alta., vice Mr. W. G. McPherson, assigned to other duties.

Mr. J. H. Bransford has been appointed general foreman of the Chesapeake & Ohio, with office at Thurmond, W. Va., vice Mr. Frank J. Walsh, resigned to go to the Chicago Pneumatic Tool Company.

Mr. J. E. Dillon, foreman of motive power and equipment of the Cincinnati, Lebanon & Northern, has resigned to become mechanical engineer of the Edna Brass Manufacturing Company, Cincinnati, Ohio.

Mr. D. L. Jones, heretofore district master mechanic of district 1, of the Canadian Pacific, at Smith Falls, Ont., has been appointed district master mechanic of the Atlantic division, with office at Farnham, Que.

Mr. O. S. Jackson, master mechanic of the Chicago, Indianapolis & Louisville, at Lafayette, Ind., has been appointed superintendent of motive power of the Chicago, Terre Haute & Southeastern, with office at Terre Haute, Ind.

Mr. M. Trump, now general superintendent of transportation, has been assigned to special duties on transportation problems in connection with the regulations of the National and State Railroad Commission.

Mr. W. T. Kuhn has been appointed assistant master mechanic of the Lake Erie & Western, the Fort Wayne, Cincinnati & Louisville, and the Northern Ohio, with office at Lima, Ohio, vice Mr. G. J. Duffey, promoted.

Mr. J. N. Mowery having resigned as master mechanic on the Lehigh Valley Railroad, to accept service elsewhere. Mr. C. N. Page has been appointed master mechanic in addition to his position as train master.

Mr. A. C. Adams, superintendent of motive power of the Spokane, Portland & Seattle, has also been appointed superintendent of motive power of the Oregon Electric and the United Railways Company, with office at Portland, Ore.

Mr. C. L. Bardo has been appointed assistant to the general manager of the Lehigh Valley Railroad, with office at South Bethlehem, Pa. He will perform such duties as may be assigned to him from time to time by the general manager.

Mr. Geo. W. Treasdale, member of division 547, B. of L. E., formerly master mechanic for the Tennessee Copper Company, has resigned to accept the position of general master mechanic for the United Mines Company, at Tumco, Cal.

Mr. W. E. Barnes, heretofore roundhouse and locomotive inspector of the Intercolonial Railway, has been appointed acting master mechanic of the eastern division, with office at Moncton, N. B., vice Mr. J. Stewart, assigned to other duties.

Mr. A. W. Horsey, heretofore district master mechanic of districts 2 and 4 of the eastern division of the Canadian Pacific, has been appointed district master mechanic of district 1, with office at Smith Falls, Ont., vice Mr. D. L. Jones, transferred.

Mr. T. A. Lawes, master mechanic of the Chicago, Terre Haute & Southeastern, at Terre Haute, Ind., has been appointed mechanical engineer of the New York, Chicago & St. Louis, with office at Cleveland, Ohio, vice Mr. L. B. Moorehead, resigned.

Mr. J. Gihain, heretofore engine inspector for the Rutland Railroad at Rutland, Vt., has been appointed foreman at Bennington, Vt., vice Mr. C. M. Wickham, promoted, he is now transferred to Alburg, Vt., as foreman, vice Mr. E. G. Heath, resigned.

Professor W. F. Schaphorst, of the Mechanical Engineering Department of the New Mexico College of Mechanical Arts has resigned his position there to become a technical writer on the staff of A. Eugene Michel, advertising engineer, New York City.

Mr. M. R. Smith, master mechanic in charge of terminals of the Chicago, Indianapolis & Louisville, at Lafayette, Ind., has been appointed shop master mechanic, with office at Lafayette, vice Mr. O. S. Jackson, resigned to go to another company.

Mr. L. G. Roblin, heretofore district master mechanic of the Ontario division of the Canadian Pacific, at London, Ont., has been appointed district master mechanic of the Lake Superior division, with office at North Bay, Ont., vice Mr. John Burns, transferred.

Mr. John Burns, heretofore district master mechanic of the Lake Superior division of the Canadian Pacific, at North Bay, Ont., has been appointed district master mechanic of the Ontario division with office at London, Ont., vice Mr. L. G. Roblin, transferred.

Mr. G. J. Duffey, assistant master mechanic of the Lake Erie & Western, the Fort Wayne, Cincinnati & Louisville, and the Northern Ohio, at Lima, Ohio, has been appointed master mechanic, with office at Lima, vice Mr. F. H. Reagan, resigned to accept service with another company.

Mr. George W. Wrightson, a locomotive engineer, and for fifty-one years in the service of the New York Central, has been retired under the pension rules. While a fireman the engine on which he was employed hauled the special train on which Abraham Lincoln made his secret trip for his first inaugural, and later the funeral train of the martyred President.

The board of directors of the Pennsylvania Railroad at a recent meeting, made the following changes in the organization, owing to the retirement of Mr. C. E. Pugh. Mr. Samuel Rea, first vice-president; Mr. J. B. Thayer, second vice-president; Mr. Henry Tatnall, third vice-president; Mr. W. W. Atterbury, fourth vice-president; Mr. W. H. Myers, fifth vice-president.

Mr. H. E. Creer, who was formerly general car foreman of the Missouri Pacific Railway at Atchison, Kansas, and general car foreman of the Pere Marquette., in charge of the Grand Rapids and Detroit districts, has accepted service as mechanical expert with McCord & Company, succeeding the late Mr. D. J. McOscar, who died of pneumonia on December 22 last. Mr. Creer's headquarters will be at the Chicago office in the People's Gas Building.

Mr. Robert V. Massey, formerly division engineer of the New York division, has been appointed superintendent of the New York, Philadelphia & Norfolk Railroad, with headquarters at Cape Charles, Va. Mr. Massey succeeds Mr. Elisha Lee, who has just been appointed assistant to the general manager of the Pennsylvania Railroad. Mr. Massey was born at Dover, Delaware, September 29, 1871. He graduated from Yale University in 1892, in which year he entered the service of the Pennsylvania Railroad.

Professor Charles Russ Richards, dean of the College of Engineering of the University of Nebraska, has been appointed Professor of Mechanical Engineering in Charge of that Department at the University of Illinois. Professor Richards was born at Clarkshill, Ind., in 1871. He graduated from Purdue University with the class of 1890, and he received the graduate degree of mechanical engineering from the same institution in 1891 and the degree of master of mechanical engineering from Cornell University in 1895. After serving one year as instructor in mechanical engineering at the Colorado Agricultural College at Fort Collins he became, in 1892, Adjunct Professor of Practical Mechanics at the University of Nebraska, which institution he has served in various capacities continuously since that date.

Mr. Charles Edmund Pugh, first vice-president of the Pennsylvania Railroad, retired recently from the service of that company after having served for fifty-one years and five months. He rose from station agent at Newport, Pa., to the second office in the organization of the railroad. President McCrea and the Board of Directors at the Pennsylvania Railroad recently tendered a reception to Mr. Pugh in the board room of the company at the Broad street station. Officers from all over the Pennsylvania System attended. Mr. Pugh's record with the company is indicative of the policy of the company which is that of starting employees at the lowest round of the ladder and advancing them step by step. Mr. Pugh entered the service of the Pennsylvania Railroad Company as agent at Newport, Pa., on October 1, 1859. Mr. Pugh, at the time of his retirement, was first vice-president of the Pennsylvania Railroad, the Northern Central Railway, Philadelphia, Baltimore & Washington Railroad, and the West Jersey & Seashore Railroad, and was an officer in some fifty other corporations affiliated with the Pennsylvania Railroad System.

Mr. Elisha Lee, who has just been made assistant to the general manager of the Pennsylvania Railroad, was born in Chicago, September 24, 1870. He graduated from the Massachusetts Institute of Technology in 1892, and in November of that year, entered the service of the Pennsylvania Railroad in the office of the assistant engineer of the Tyrone division. He was made a rodman in 1897, and on April 17, 1899, was promoted to assistant supervisor on the western Pennsylvania division. His subsequent appointments prior to being appointed division engineer, were assistant supervisor West Jersey and Seashore Railroad, November 1, 1899; assistant supervisor Philadelphia division, July 16, 1900; supervisor eastern division Philadelphia & Erie Railroad, April 15, 1901; supervisor Philadelphia division, November 10, 1902. On August 20, 1903, Mr. Lee was promoted to division engineer of the Buffalo & Rochester division. Three years later he was appointed division engineer of the Philadelphia Terminal division, and on April 1, 1907, he became principal assistant engineer of the Philadelphia, Baltimore & Washington Railroad. On March 24, 1909, he was promoted to superintendent of the New York, Philadelphia & Norfolk Railroad, which position he held until his latest appointment, that of assistant to the general manager.

Obituary.

Ezra Hounsfield Linley, of St. Louis, president of the E. H. Linley Supply Co., of that city, president of Wm. Jessop & Sons Steel Sales Co., of St. Louis, and a director of Wm. Jessop & Sons, Ltd., Sheffield, England, died at St. Louis on the 9th of March. Mr. Linley was born in Sheffield, England, in 1841, and since 1872 was the St. Louis agent for Jessops. For a number of years he was actively engaged in the railway supply business, and in 1897 organized the E. H. Linley Supply Co. Mr. Linley was well known and highly esteemed in the trade, and had many friends in America and England.

Major Melville W. De Wolf, a vice-president of the Erie, died a short time ago from heart failure brought on by an attack of asthma, from which he had suffered for years. Major De Wolf was 77 years old. He entered the railroad business in 1873 as agent of the Erie & Pacific Dispatch, at 399 Broadway. In 1893 Major De Wolf was appointed general eastern freight agent of the Erie, and on June 1, 1908, he was appointed special agent. In November of the same year he was made a vice-president of the company, which office he held up to the time of his death. He was always numbered among the most popular of railroad men.

Traveling Engineers and the Mallet.

The president of the Traveling Engineers' Association, Mr. F. C. Thayer, recently appointed Mr. J. B. Daugherty (406 West Cherry street, Mahonington, Pa.), to prepare a paper on the Mallet articulated compound. The paper to be read at the next annual meeting in August of this year. Mr. Daugherty has sent out a list of questions which we reprint below and we would urge anyone who has any information on the subject to give it to Mr. Daugherty without delay.

He says: "Having been appointed by the president to prepare and present a paper at the next annual meeting, viz.: Mallet compound in road service, would appreciate very much answers to the following questions, and any other information you can give to me on this subject will be very much appreciated.

"1. Average cost for maintenance of the Mallet locomotive, compared with all other classes of locomotives, handling the same tonnage.

"2. Average consumption of fuel of Mallet locomotive compared with all other classes of locomotives.

"3. Average cost of lubrication of Mallet locomotive compared with all other classes of locomotives handling same tonnage.

"4. Average speed of Mallet locomotive compared with all other classes of locomotives handling the same tonnage.

"5. Do you experience any trouble by the firemen being taxed to their physical capacity on the Mallet locomotive? Do you experience trouble of any kind with firemen on this class of locomotive?

"6. Are one or two firemen being used on the Mallet locomotive?

"7. Does the Mallet locomotive increase or decrease rail and tie strain?

"8. Are you using a locomotive stoker on the Mallet locomotive, and what type?

"9. Do you experience any trouble keeping flexible low pressure steam and exhaust pipe joints tight?

"10. Will the Mallet locomotive make same mileage handling same tonnage as other engines between classified repairs?

"11. Total weight of Mallet locomotive in working condition, kindly give size of driving wheels, also size of high and low pressure cylinders."

Superheating in South Africa.

Railway men in South Africa are displaying ambition to promote improvements in locomotive mechanism. They have formed the South African Institute of Engineers, which resembles our railway clubs, but with a wider scope. At one of the recent meetings Mr. G. G. Elliott led in a discussion on a paper dealing with modern locomotive practice in South Africa. On ordinary locomotives without superheating on the line between Pretoria and Braamfontein two trials gave an average coal consumption of 29.3 lbs. per 100-ton miles. A new engine without superheater, but fitted with a feed water heater, was run under the same conditions, and showed an economy of 9.1 per cent., the coal consumption averaging 26.9 lb. per 100 ton miles. A superheater engine was run under the same conditions and showed a consumption of 22.2 lbs. per 100 ton miles, representing a saving of 25 per cent., or, deducting the saving arising from the feed water heater, the economy shown was 17.4 per cent. On heavy passenger trains a saving in coal consumption was shown representing 35.6 per cent. The saving in coal was, however, relatively unimportant in comparison with other advantages resulting from superheating. The additional tractive power shown by superheater engines was remarkable, as, while the old type of engine could not haul more than 12 bogies and keep time, the superheater engine had hauled 15 bogies and appears capable of hauling more to time. Practically the whole of this increased power was due to superheating.

A really great man is known by three signs—generosity in the design, humanity in the execution, moderation in success. —*Bismarck.*

Pacific and Mikado Types Recently Built for the B. & O.

An order for fifty locomotives, recently filled by the Baldwin Locomotive Works for the Baltimore & Ohio Railroad, is of more than usual interest, not only because of the size and design of the engines, but also because of the extent to which interchangeable parts are used in two entirely distinct classes. Ten of the locomotives are of the Pacific type, and the remaining forty, of the Mikado type; the engines being, in each case, the heaviest of their respective types thus far completed by the builders. The following parts are interchangeable, or nearly so: Boilers, trailer trucks, cylinders and heads, driving boxes, pistons and rods, shoes and wedges, crossheads, driving springs, piston valves, cabs, throttles, dry pipes and steam pipes, back foot plates, smoke stacks, throttle and reverse levers, smoke-box fittings, cast steel cross ties, grates, furnace bearers, sand boxes, bells and headlights and various smaller details and fittings.

The cylinders of these locomotives are 24x32 ins., and the steam pressure carried is 205 lbs. The Pacific type, with 74-in. drivers, develops a tractive force of 43,400 lbs., and as the weight on the driving wheels is 166,200 lbs., the factor of adhesion is 3.84. In the case of the Mikado type, the drivers are 64 ins. in diameter, and the tractive force is thus 50,200 lbs.; the resulting factor of adhesion, with 219,000 lbs. on the drivers, is 4.37. Although the cylinder volume is 16.7 cu. ft., the boiler capacity is relatively large; as 300 sq. ft. of heating surface are provided for each cu. ft. of cylinder volume. The ratio of grate area to heating surface is as 1 is to 71.7.

The boiler is of the wagon-top type, 78 ins. in diameter at the front end and 86 13/16 ins. in diameter at the dome ring. The dome is formed of a single piece of flanged steel plate. The longitudinal seams are welded at the ends, and have diamond welt strips inside. The firebox is radially stayed, and flexible staybolts are freely used, especially in the throat and upper corners of the sides. The mud ring is supported on sliding shoes in front and a buckle plate at the rear. Surge plates are placed in the boiler barrel at the water level, one immediately in front of the fire-box, and the other about 7 ft. back of the front tube sheet. The injectors are placed on the back head, and they discharge into an internal pipe, which delivers the feed near the front end of the barrel.

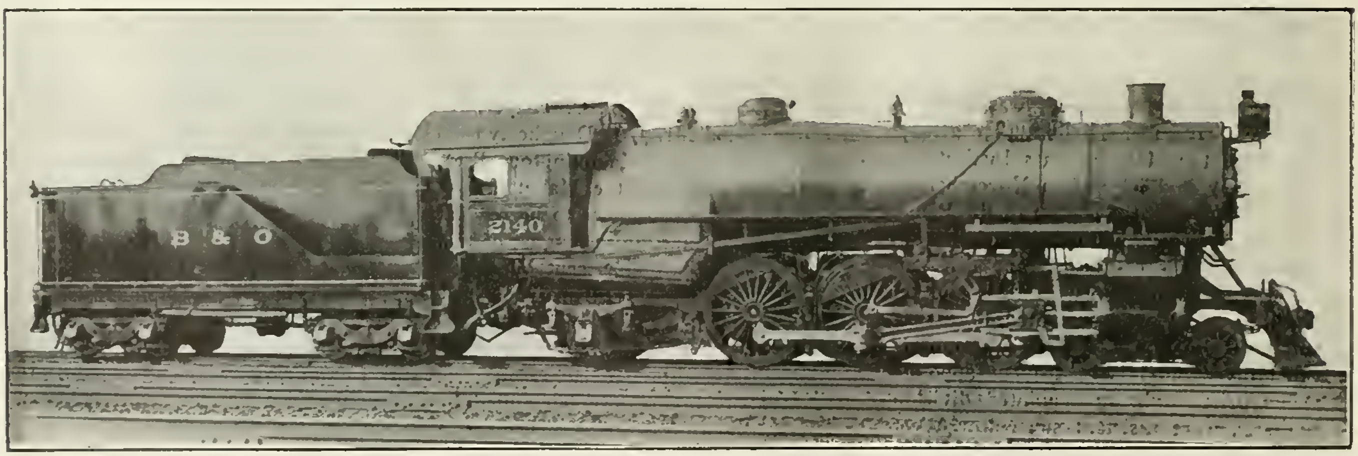
The steam distribution in both engines, is controlled by inside admission piston valves, 14 ins. in diameter. The valves are driven by Walschaerts gear, and are set with a lead of ¼ in. The cylinder castings are arranged for double frame rails, 5 ins. wide, and are keyed to the frames at the front only. The frame bolts are 1¼ ins. in diameter. Each cylinder casting is secured to the corresponding bottom rail by six horizontal and six vertical bolts, and to the top rail by four vertical bolts. The castings themselves are built with heavy walls, and are secured to the smoke box and to each other, by double rows of 1¼ in. bolts.

The frame construction is most substantial throughout, and is well calculated to resist the stresses occurring in locomotives of this size. The main frames are 5 ins. wide throughout, with separate rear sections 3½ ins. wide. The pedestal binders are held in place by three bolts on each side. The main and rear driving pedestals in both classes, are braced transversely by deep steel castings, which are interchangeable on the two types of locomotives. The top front rail, on the Mikado type, is of cast steel and is formed in one piece with a vertical lug, to which the guide bearer is bolted. On the Pacific type, the guide bearer is secured to the frames by separate cast steel knees. The shoes and wedges, on both types, are of cast iron, lined with brass, and the driving boxes have brass faces, which bear against the cast steel wheel centers.

The trailing truck used in both designs, is of the Hodges type, with outside journals. A feature of this truck, as used in the present case, is a centering spring, consisting of eight plates, each measuring 4 ins. x ⅜ in. This spring is placed in a vertical position, being riveted, at the top to a casting which spans the frames, and held at the bottom in a clamp which is bolted to the truck frame. The truck spring links are jointed, to take up the side swing when the engine is curving.

The tenders used with both classes have the same capacities for fuel and water, and are closely similar in construction. Water-scoops, operated by compressed air, are used on 25 of the freight tenders, and provision is made for subsequently applying them to the tenders of the passenger locomotives, if desired. The frame center sills consist of 15-in. channels and the side sills of 10-in. channels, with wood bumpers front and back. The tenders for the Pacific type locomotives have equalized trucks, while the trucks used under the freight tenders have one-piece cast steel side frames. Rolled steel tender wheels are used in both cases.

These engines undoubtedly rank among the most powerful single expension locomotives thus far constructed at the Baldwin Works, and the principal ratios entering into the two designs show clearly how well the weight has been utilized. For each square foot of heating surface the Mikado type weighs 54.7 lbs., and the Pacific type, about 52.7 lbs. The horse-power output is limited by the boiler capacity, and the advantage possessed by these two designs, in this important respect, is thus established, as the en-



PACIFIC TYPE, OR 4-6-2, FOR THE BALTIMORE & OHIO.

F. H. Clark, General Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

gines are comparatively light in proportion to the heating surface provided.

Some of the principal dimensions of each class are given below:

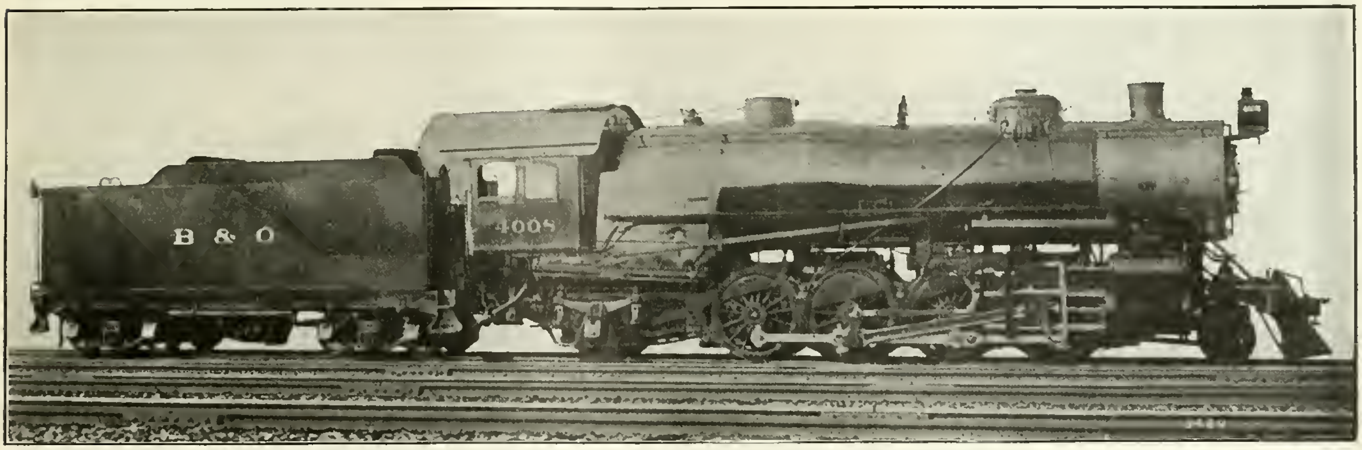
PACIFIC TYPE.

Cylinders, 24 x 32 ins.
Valves, balanced piston.
Boiler—Type, wagon top; material, steel; diameter, 78 ins.; thickness of sheets, 11/16 in., 23/32 in., ¾ in.; working pressure, 205 lbs.; fuel, soft coal; staying, radial.
Firebox—Material, steel; length, 120 ins.; width, 84 ins.; depth, front, 81 ins.; back, 71¼ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.
Tubes—Material, steel; thickness, 0.125 in.; number, 389; diameter, 2¼ ins.; length, 21 ft. 0 in.
Heating Surface—Firebox, 228 sq. ft.; tubes, 4,789 sq. ft.; total, 5,017 sq. ft.; grate area, 70 sq. ft.
Driving Wheels—Diameter, outside, 74 ins.
Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6½ x 12 ins.; diameter, back, 44 ins.; journals, 8 x 14 ins.
Wheel Base—Driving, 13 ft. 0 in.; total engine, 34 ft. 8 in.; total engine and tender, 70 ft. 10⅝ ins.
Weight—On driving wheels, 166,200 lbs.; on truck, front, 52,409 lbs.; back, 45,200 lbs.; total engine, 263,800 lbs.; total engine and tender, about 440,000 lbs.
Tender—Wheels, diameter, 36 ins.; tank capacity, 9,500 gals.; fuel capacity, 16 tons; service, passenger.

MIKADO TYPE.

Cylinders, 24 x 32 ins.
Valves, balanced piston.
Boiler—Type, wagon top; material, steel; diameter, 78 ins.; thickness of sheets, 11/16 in., 23/32 in., ¾ in.; working pressure, 205 lbs.; fuel, soft coal; staying, radial.
Firebox—Material, steel; length, 120 ins.; width, 84 ins.; depth, front, 81 ins.; back, 71¼ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.
Tubes—Material, steel; thickness, 0.125 in.; number, 389; diameter, 2¼ ins.; length, 21 ft. 0 in.
Heating Surface—Firebox, 228 sq. ft.; tubes, 4,789 sq. ft.; total, 5,017 sq. ft.; grate area, 70 sq. ft.
Driving Wheels—Diameter, outside, 64 ins.
Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6 x 10 ins.; diameter, back, 44 ins.; journals, 8 x 14 ins.
Wheel Base—Driving, 16 ft. 9 ins.; total engine, 35 ft. 0 in.; total engine and tender, 71 ft. 2⅝ in.
Weight—On driving wheels, 219,000 lbs.; on truck, front, 19,500 lbs.; back, 36,100 lbs.; total engine, 274,600 lbs.; total engine and tender, about 450,000 lbs.
Tender—Wheels, diameter, 33 ins.; journals, 6 x 11 ins.; tank capacity, 9,500 gals.; fuel capacity, 16 tons; service, freight.

We are informed by Mr. A. C. Morse, general manager of the Ohio Seamless Tube Company of Shelby, O., that the company has increased their capital stock from $350,000 to $1,000,000.



MIKADO TYPE, OR 2-8-2, FOR THE BALTIMORE & OHIO.

F. H. Clark, General Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Pretending to be an Engineer.

The complaint that business was dull was not in the railway vocabulary of 1882; in fact things were rushing, as they have seldom rushed since that period. There were over 12,000 miles added to railroad mileage of the North American continent in that year, so that every person possessing any skill or knowledge in any line of railroad construction or operation found no difficulty in securing a good job.

On a section of the Rock Island system where I was holding down the job of engine house foreman, we were greatly embarrassed for want of good engineers, the growing development of business and mileage extension calling for the service of more engineers than the natural increase by promotion could supply. Like many other railroad companies we were hiring all the efficient engineers who came along looking for work.

The active demand for locomotive engineers developed a fraudulent practice that sometimes proved very embarrassing to railroad officials. As a letter from a master mechanic, written on a railroad company's letter-head, intimating that the bearer had been employed as an engineer was generally considered worthy of credence. Many head brakemen, hostlers and ambitious firemen managed to obtain forged letters certifying that they were experienced locomotive engineers.

The Brotherhood *Journal* and various railroad papers had warned railroad officials against certain frauds who were posing as locomotive engineers and kept looking out for that species of human vermin. As I was a member of the Brotherhood of Locomotive Engineers I had an easy precaution, for I would hire no man pretending to be a locomotive engineer who was unable to present a traveling card.

There was connected with the road a clique of mean engineers who did not belong to the Brotherhood and they began to allege loudly that I was discriminating against independent engineers by having nothing but Brotherhood men. I paid no attention to their complaints, but they finally protested to the master mechanic who was unfavorable to organized labor, so he advised me to change my policy. I displayed no enthusiasm for the independents.

A few days after the protest was recorded the chief protester came to me with a reputed engineer looking for a job and asked me to hire him. Out of obstanacy I asked for his traveling card, and seeker for a job and escort immediately made for the master mechanic's office. They soon returned with an order for me to hire the man who called himself Gus Siper.

I advised Gus to ride on trains for a day or two to get acquainted with the road, then I assigned him to 26, a Grant engine, to take out a regular freight train at seven in the morning. The start was made promptly enough and all went well till about 9 a. m. when the train dispatcher informed me that engine 26 was stalled in the Vinton hollow with a slipped eccentric. That was no novelty and nothing serious, but half an hour later came word that 26 had run short of water and that Siper had dumped the fire.

That was a serious matter for the Vinton hollow was the bottom of steep grades extending in both direction. Traffic was highly congested on the road and strings of trains were soon extending in both directions waiting for 26 and its train to get out of the way.

Clearing the track was a tedious operation. The first engine available headed down to 26 and no chain could be found to couple the engines together. The Good Samaritan then had to return to Vinton for a freight car to act as an intermediary between the two engines, and after ordinary delays 26 was safely placed in a siding. It took about two hours more to get the train out of the way. Mr. Siper's mishap had prostrated train movements for about eight hours.

When the excitement had subsided I advised Mr. Siper, through the train dispatcher to bring 26 back to headquarters. A reply came that the eccentrics were slipped on both sides and that the boiler was empty. Then I ordered the engine to be hauled home.

In due course of time I had 26 pushed into the roundhouse, I proceeded to investigate. On going below I discovered that three of the eccentrics had been moved. On considering the situation, I diagnosed something was wrong inside the right-hand steam chest. so directed a man to remove the cover. Then we found that a broken valve yoke had caused all the trouble.

Mr. Siper did not offer to take out another engine. He went to work in a barber shop the following week. He was an amusing rogue, and made fun of his experience as a locomotive engineer. To the train men he confessed that all his previous railroad experience was working as head brakeman on the Missouri Pacific for seven weeks. He also confessed that he paid $5 for the letter certifying that he was an engineer.

The hardest blow I received from the incident was, that the master mechanic came to me like an accusing spirit and said "that man Siper *you* hired as an engineer last week is working in Brown's barber shop." A. S.

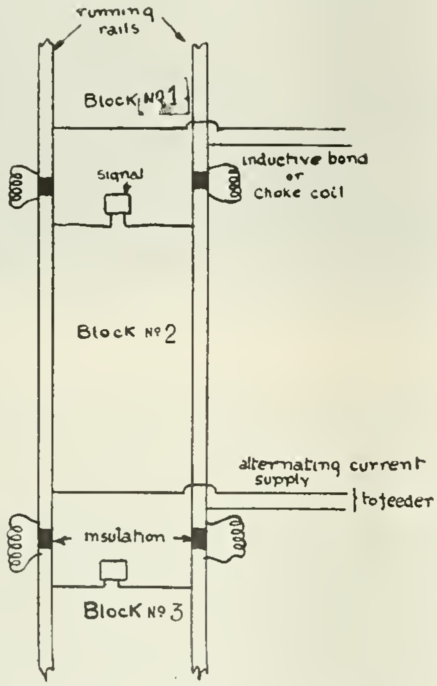
Alternating and Direct Current in Same Rail.

By Henry Martin, Jr.

Direct currents and alternating currents can each be made to perform certain definite functions, although both may be using the same circuit simultaneously. To investigate how this can be done, a particular application will be cited, that of the operation of automatic block signals on electric railroads.

The principle of block signaling is to divide a road into short stretches, or blocks, the length of each depending on the headway and speed of trains. At the end of every block, both running rails are electrically insulated from those of the next block and then again electrically connected, this time by means of an inductive bond, as shown in the diagram. The action of the inductive bond is similar to that of an ordinary choke coil, which consists of an iron core, around which many turns of wire are wound. Such a coil, if made with a core of good magnetic iron and with a sufficient number of turns of wire, will completely choke or prevent the passage of alternating current through it. Direct current, because of its continuous flow in one direction only, is unobstructed by the choke coil. This combination of an insulator and a choke coil between the rails of adjacent blocks, entirely prevents alternating current passing from one to the other, while direct current, which finds a path through the coils, may traverse the entire length of track. It is evident, then, that each block is an individual alternating current circuit by itself, consisting of the two leads connecting the rails with the feeder, the two rails themselves and the signal to be operated. Also each rail is one continuous direct current circuit throughout the entire road.

The operation of the signal in every block by the alternating current could be accomplished without the use of choke coils, but as will presently be shown, they are essential if the rails are to be used for a return circuit as is done in practice. On the Pennsylvania Railroad, at New York, for instance, the trains are operated on direct current supplied to the motors by means of a contact or third rail and the current returned to



THREE BLOCKS SHOWING CHOKE COILS.

the power house by means of the running rails. These being made of exactly the same quality of iron, each will offer practically the same resistance to the return current, causing it to divide into two parts, one-half passing through each rail. Let us confine our attention to small, but equal lengths of both rails, say five feet. The resistance of each rail will be the same, and since the current flowing through each is also the same, it follows that the voltage applied to the rails must be the same. This simply means if we have two pieces of rail of equal resistance and wish to send the same number of amperes through each, we must apply the same voltage or pressure to each. This follows from Ohm's law. This law may be interpreted in another way, by saying that if a definite voltage be applied to one end of each rail, the same number of volts will be used in sending the same number of amperes through equal lengths, and consequently, the value of the remaining voltage at the other extremities of the rails will be the same. This voltage will be equal to the difference of the applied voltage and that used in the length of rail.

Consider again the entire length of track, if the same voltage be applied to both rails anywhere along the road, the voltage at any point on each rail equally distant from the supply end, will be the same and, therefore, if these two points be connected by a metallic conductor, no current will flow through the conductor. This phenomenon may be likened to the case where two locomotives are each pushing on the end of a car, in opposite directions. If both exert the same force, there will be no movement of the car, and likewise as the voltage at both ends of the wire is of equal value, due to being connected to points of the rail having the same voltage, both rails tend to force current through the wire to the other rail. In other words, the fireman's rail will try to force current across the conductor wire and the engineer's rail doing the same thing, no current will flow.

This arrangement, using direct current, is admirably well suited, in this case, to the operation of automatic block signals. If instead of connecting the two points of equal voltage, to which we have just alluded, with a metallic conductor, a signal be substituted, no direct current will flow through it. The signal, then, behaves as though no direct current existed in the rails. In practice, however, there may often be some slight difference in voltage, across the signal. Consequently its resistance is made somewhat higher than that which the wire would have, so that the current which this small difference of voltage does send through the signal, is far too small to affect its operation.

The alternating current which is supplied to the rails of every block from the feeder, follows the same law that direct current follows; in other words, it must return to the source of supply, thereby forming a complete circuit, before it becomes operative. This alternating current flows through one of the rails, and due to the action of the choke coil preventing its passage to the next block, it takes the only other path leading back to the main, which is through the signal to the other track. This causes the signal to indicate clear track. It may now be asked, "How can the alternating current pass through the signal if the direct current cannot?" Consider a water tank being supplied from a pipe dropping the water into it. After the tank is filled, and if the pipe still remains open, water will flow over the sides. That water which does flow over the sides is the excess water dropped into it. The same reasoning will apply in the case of the alternating current. The direct current in both rails is at the same level or value, and as the alternating current is forced into one rail, for just an instant that rail contains more current than the other, and it therefore spills or forces the excess current through the signal into the other rail, which has no current over and above the direct current, and back to the supply. The excess is always the alternating current, and it is that only which finds a path through the signal and causes it to operate.

Consider, now, a train approaching block No. 2 from block No. 1. If there be no train in the block about to be entered, the alternating current will cause the signal to indicate a clear track. As the first pair of wheels enters the block, a conducting path is offered to the alternating current from the rail to one of the wheels through the axle to the other wheel and rail. As the resistance of this new path is very considerably less than that through the signal, practically all of the current will pass through it, thereby releasing the signal and causing it to indicate to the following train that the block is occupied. As the last pair of wheels of the train leaves block No. 2, the short circuit is removed, the current again flows through the signal, and the clear track indication is once more restored. The conducting path through the wheels and axle is similar to that of the wire and signal, that is, no direct current passes through it because throughout the entire run, each pair of wheels is always on points of the track having equal voltage, or if a slight difference does exist, direct current which may pass through wheels and axles at any time, is negligible.

A Bitter Complaint.

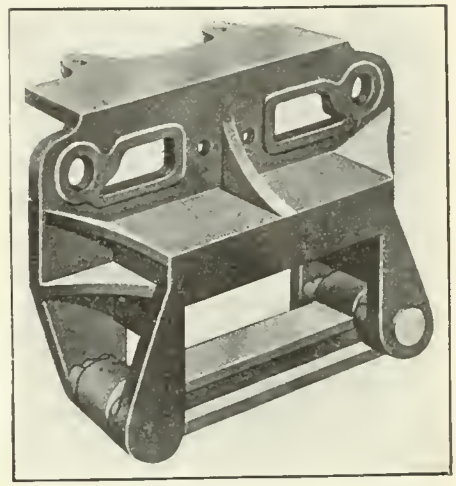
My dog is harmless as a child, but he likes to chase and race with the cars as they speed past my place, and he never harmed no one nor never would for I have known him from a pup, being peaceful and fond of children, especially from the butcher's shop, and would set up and beg. When he would run at the cars and automobiles he would act savage but would never injure them by word or deed, including his teeth. He was just having some fun.

Now what does a measely fireman on an Erie engine do but whistle to my dog and when he got him near pelt him with chunks of coal and half brickbats which makes me hot, as it takes the bark off my dog. That makes me hate the railroad and I shall walk when I want to go to Binghampton.

And that is not the whole by a long chock, for yesterday they misled my dog and got him in front of the ingine when they pulled her wide open and squashed my dog in a way that hurt his feelings and tail which makes every taxpayer and mother wrathy. Fry say how such a rode as that with its sandwiches with a thin rim of ham around the rige, so's when you lock your teeth in it you get left and the rode has your ten cents. Fry no such doings I say and my dog looks likewise.

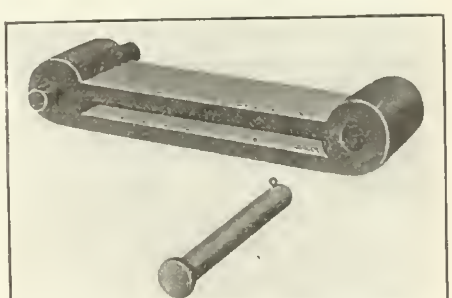
Striking Plate and Carry Iron.

An improved Striking Plate and Carry Iron, for use on steel or wooden cars, has been patented by Mr. B. P. Flory, superintendent of motive power of the New York, Ontario & Western, and is being manufactured by the Commonwealth Steel



FLORY STRIKING PLATE AND CARRY IRON.

Co., St. Louis, Mo. The indications are that it will meet with universal favor. The inefficiency of some of the old styles of plate need not be dwelt upon. As shown in the illustrations Mr. Flory's carrier is furnished with pockets which support and protect the draft timbers of wooden cars. The carrier is a simple and ingenious contrivance. There are no bolts or nuts to loosen. One end of the carrier is sustained by trunnions resting in recesses in the striking plate and the other end is supported by horizontal pin



THE ADJUSTABLE CARRIER IRON.

and cotter. When, owing to weak springs, the car and the draw-bar has settled below the standard height the carrier may be readily turned over and the coupler raised three-quarters of an inch. This latter contrivance is so simple and so valuable that we are not surprised to learn that many thousands of the device are already in use.

Defective Memory.

Andrew Carnegie is telling this story with great glee:

Many Scotsmen are noted for three characteristics that do not harmonize. As a rule, they are pious, a good many of them like a dram and some of them swear, especially railway men.

James Epstin, station master at Forfar, had been at a Burns' celebration one night and drank to all the toasts. In the "sma' short hours" he started for home well loaded, but with sense enough left to skip quietly into the bed room. Incoherent mutterings were heard by his wife who asked:

"Is that you, James? Is anything the matter wi' ye? Are ye no feeling weel?"

"Aye, Jean, it's me," was the reply, "there's naethin the matter wi' me, only I canna mind a damned word o' ma prayers."

Behind Time, But Up-to-Date.

"When a Train is Behind Time" is the title of a pamphlet recently issued by the Detroit Seamless Steel Tubes Co., Detroit, which is well worth the attention of the railroad men bothered by leaky flues. Leaky flues is made a mystery by some people, but there is generally no mystery when the cause of trouble is investigated. Those interested should send to the Detroit Seamless Steel Tubes Co., Detroit, for their latest pamphlet.

New Sales Headquarters.

J. A. Fay & Egan Company, the woodworking machinery people, announce the discontinuance of their Greensboro, N. C., agency. The Chattanooga, Tenn., office has also been discontinued, and a new suite of offices opened in the Candler building, Atlanta, Ga. The new Atlanta office will handle all business in the States of North and South Carolina, Tennessee, Georgia, Florida and Alabama (outside of Mobile). This merger was made in order that the business of J. A. Fay & Egan Company might be done direct with the customer, insuring prompt and careful attention to each individual. A complete office and traveling force, including Messrs. S. Lee Smith, Benj. H. Cox, Jr., and D. E. Gray, will now make 1322 Candler building, Atlanta, Ga., their headquarters.

We may say that this company have issued a neatly printed and concise folder dealing with features of general application and on their surfacers, planers and matchless flooring machines, etc. Apply direct for the folder to the company at their head office in Cincinnati, O.

Points on Filing.

To file a surface true it is necessary on commencing to squeeze the file tightly between the third and fourth fingers and palm of your hand until you become used to it. Your position in filing should be half face to your work, with the middle of your right foot fifteen inches behind your left heel, and to file your work true or square it is necessary to reverse your work often, as by this means you are enabled to see the whole surface you are filing and see while filing whether you are filing true or not. When, however, your work is so heavy that you cannot reverse it, you had better file to the right and then to the left, as by this means you can plainly see the file marks, and this again assists you in filing true.

Suburban Motor Cars.

The McKeen Motor Car Company inform us that recently they receivel an order from the Oregon Short Line Railroad for four 70-ft. motor cars, and an order from the Oregon-Washington Railroad & Navigation Company for one 70-ft. motor car, also one for the Sand Springs Interurban Railway, making forty-one railroads which are either operating or have ordered this style of motor car. Still more recently two 70-ft. motor cars for the Southern Pacific Company left the works, coupled together, en route to Sacramento, Cal., which makes 104 cars of the McKeen type now in service.

Not Arrived Yet.

At a spiritualistic meeting in Brooklyn a widow with the biggest hat in the place called up her departed and said: "My dear John, are you happy now?" "Yes, I am very happy," replied John. "Happier than you were when on earth with me?" she added. "Yes," was the answer; "I am far happier now than when I was on earth with you." "Tell me, John, what is it like in heaven?" "Heaven!" exclaimed John. "I'm not in heaven!"

Report of Inspector for W. H. Wood Loco. Firebox & Tube Plate Co. to His Head Office.

(Copy.)

Buffalo, N. Y., December 29, 1910.

MR. WM. H. WOOD, Engineer,
Media, Pa.

Dear Sir:—

In receipt of your letter of the 23rd, contents noted.

Our boilers are doing wonders every day, that is, they are more than making a record. In a very short time you will not need a recommendation from the New York Central to convince the railroad world that your boilers are a success, because time is what counts and the more our boilers run, why it seems the better they get.

Up to the present time our fireboxes and tube plates have made a splendid record, which can not be outdone by any engines which have a common firebox in.

When you were at Depew you could see yourself how good they were doing, compared with other engines standing alongside of them. Engine 2481 has been in road service over four months, and yesterday, while standing at E. Buffalo, there was not a leak visible on her. That is something out of the ordinary nowa-days with the big engines.

When the New York Central itself took the time to make a thorough test on the saving of coal on our engines, it must have shown a very wide margin in our favor or else the New York Central would have shown us their record of the test, because if it had come close to or gone above the coal used on their ordinary engines, they would have been only too glad to let you have it. It stands to reason that our engines are saving coal every day for the New York Central but they do not like to admit it. The saving of coal on those engines I think has paid for them many times over.

Remaining in the meantime,

Yours very truly,

FRED. H. SNELL,
Inspector.

To Editor of RAILWAY AND LOCOMOTIVE ENGINEERING:

This letter was received from our inspector who has been inspecting our boilers for the third year. You will oblige by publishing as received.

WM. H. WOOD,
Engineer.

Removal Notice.

The office of the King-Lawson Car Company, heretofore in the Metropolitan Life Building, New York, has been removed to the Singer Building, 149 Broadway, New York. The company will be pleased to see their friends in their new quarters and answer all questions concerning their air-operated, all-steel, 80,000 lbs. capacity, standard gauge dump cars.

Garland Ventilators.

The Garland Car Ventilation is fully described and illustrated in an elegant catalogue just issued by Robert W. Mudge & Company, Chicago, Ill. New applications of their methods of ventilation are being rapidly applied to every kind of car, among the latest being a slatted floor in refrigerator cars, the purpose of which is to obtain a free circulation of air under the load and provide a space for cooling and heating pipes, with six inches of space between the two floors. The slatted floor is made in five sections and is hinged at the sides so that each section can be raised up against the sides of the car. Not only is a means of heating provided by this appliance, but the danger of water dripping from the ice tanks is eliminated. The Garland method of ventilating high-class passenger cars has been amply sustained by its adoption by the New York Central Lines on their Twentieth Century Limited trains. Their recent addition of several hundred all-steel cars equipped with every modern device, includes the Garland car ventilation system. The new catalogue is finely illustrated, and all interested should send for a copy of the catalogue to the company's offices at 122 South Michigan Boulevard, Chicago.

The Grip Was Familiar.

Simkins, a little bald man, seated himself down to read, but dropped off to sleep. On the rack was a ferocious crab in a bucket, and when Simkins went to sleep the crab woke up, and finding things dull in the bucket started exploring.

By careful navigation Mr. Crab reached the edge of the rack. Down it fell, alighting on Simkin's shoulder, and it grabbed the man's ear to steady itself. The passengers held their breath and waited for developments, but Simkins only shook his head and said:

"Let go, Sarah; I tell you I have been at the office all the evening!"

The Safety Appliance Law and Long Shank Couplers.

The following letter addressed to Mr. Taylor has been handed to us for publication:

"Mr. Jos. W. Taylor,
"Secretary M. M. & M. C. B. Assns.,
"Chicago, Ill.

"My dear Mr. Taylor—I am writing this letter to call your attention formally to the fact that the new Safety Appliance Law will apparently necessitate a long shank coupler for locomotive tenders. While the law refers only to locomotives when in switching service as requiring 14-in. clearance between a vertical plane passing through the inside face of knuckle and any part of tender except fittings enumerated, yet many railroads will wish to allow the same distance on road engines so that if they should be converted into switching engines, even temporarily, they would be conformative with the law without alteration of draft rigging.

"On modern locomotives the draft rigging is attached to a steel casting fitted to the centre sills and back end sill of the tender, and it would be impossible to move this casting back or even to redesign it and give it sufficient strength where the follower plates come against the rear stops, practically destroying the end sill of the tender. It has been suggested that the pocket strap be lengthened and an intermediate filler inserted between the coupler and the rear follower, but this would generally weaken the end sill seriously and would make a very unsatisfactory and weak construction. It seems, therefore, as if the only thing to be done would be to have a coupler with shank about 30 ins. long from horn to back of butt.

"As we are ordering couplers of special length in order to conform to the present law, it seems very desirable for the railroads, as promptly as possible, to decide on some new long standard length coupler, at least tentatively, that can be used without introducing too many varieties all over the country, and if you will kindly have this taken up by the executive committees of the two associations and passed upon as early as possible, it will be a great advantage to the railway companies and the coupler manufacturers, as well as the locomotive builders.

"GEO. R. HENDERSON,
"Mech. Engr.
"Baldwin Loco Wks., Philadelphia, Pa."

First Successful Balanced Valve.

Many years ago, about 1870 we think, A. B. Underhill was master mechanic of the Boston & Albany Railroad. He was a conservative man and hated innovations, particularly the inventions intended to take the pressure off slide valves. He had seen several inventions of that kind tried and they all failed, so Mr. Underhill concluded that all such devices were impracticable.

One day George Richardson, inventor of the pop safety valve, called on Mr. Underhill and said that he wanted to try a balance valve which he had invented. Much persuasion was necessary, and that was George Richardson's forte, after inventing; so a set of the valves were applied to one of the largest passenger engines. Everybody concerned appeared to forget about the balanced valves till they had been running for four years, when the engine happened to be in the shop for a general repair. Then the shop foreman went to Mr. Underhill and asked what was to be done with the valves which had been running four years without being touched. On examination they were found to be in perfect order. That set of valves ran nine years on very hard service.

The fame of the balanced valve had spread over the line so that every engineer on the Boston & Albany wanted like valves to be put on his engine. Those were the days when locomotive engineers generally got what they wanted, if they wanted it badly, so the Richardson balanced valve became a standard of the road.

Lubrication.

The subject of locomotive lubrication is a live topic and McCord & Company have kept in touch with the discussion of this subject by issuing at this time a neat little pamphlet on "Locomotive Lubrication." It contains 37 pages, and is well illustrated. They show very clearly what it is that causes friction. Their sketch is simply the probable appearance of two quite smooth surfaces, when seen under the microscope. The laws of friction are stated, the conditions affecting friction are enumerated and the subject of lubricants and lubrication then follow in natural order. A very original illustration is a diagram of the hot box. This is arranged like the method of showing a railroad organization with the general manager at the top and all those who report to him arranged under various department heads below. In the hot box diagram the department of defective lubrication has quite a number of causes which, so to speak, report to it. The whole thing is very cleverly worked out, and is well worth while taking a look at. The booklet deals with the McCord system of force feed locomotive lubrication, and is followed with directions for its use and the advantages to be derived therefrom. The McCord Company, of New York and Chicago, are prepared to give this useful little booklet free to anyone who has interest enough in the subject of locomotive lubrication to make a request direct to them.

Growth of the Graphite Habit.

Plumbago was mentioned early in the 19th century, as an aid to reduce friction in cases of heavy bearings, when oils and grease had not prevented heating. Arthur Morin, famous for his researches on friction, experimented greatly with plumbago, and his writings did much to push the use of graphite into favor with engineers. Under the name of graphite, plumbago is much used for the reduction of friction, nearly every sensible locomotive engineer carrying an ample supply of Joseph Dixon graphite. An edifying booklet on the subject may be had free on application to Joseph Dixon Crucible Co., Jersey City, N. J.

Standard of Disinfectants.

Railroads, for years, have for self protection been compelled to require that all material used for rolling stock or railroad construction, must prove to be of a certain standard of efficiency, but we believe that this requirement is not generally made when purchasing disinfectants. One might well ask, what proof has any railroad that the disinfectants they use possess bactericidal efficiency, unless they adopt a standard and require manufacturers of such products to furnish a guaranty in that direction. The laws of public health should be of sufficient importance to stimulate railroads, traction and steamship companies to exercise the greatest care in the purchase of disinfectants and induce them to insist that only those of guaranteed efficiency shall be considered.

Carbondale Shops, D. L. & W.

The Delaware & Hudson Railroad, between Carbondale and Honesdale, is memorable in railroad annals from the fact that in August, 1829, the first locomotive to run on rails was used on the American continent. It was brought from England by the company then known as the Delaware & Hudson Canal Company, and under the supervision of an eminent engineer named Horatio Allen it was put to work hauling coal. Mr. Allen pronounced the engine to be too heavy for the trestles. Its career was short, but the mechanical curiosity, the "Stourbridge Lion," has since found an honored place in the Smithsonian Institution at Washington.

Nowadays the locomotives are over 200 tons in weight, and the weight is still growing. The Mallet articulated compounds are a great success here. With the power of two of the larger class of locomotives they are said to be run almost at the cost of one. There are six of them in use hauling the long trains of coal to the summit of the spur of the Alleghanies that shut in the valley of the Lackawanna. Mr. J. J. Reid, the experienced master mechanic takes a pardonable pride in the running and management of these great locomotives. The engineers and firemen are carefully selected from among the best. Crews of the most expert mechanics are set apart for their running and general repairs. Added to these is apparatus contrived by Mr. Reid for the proper handling of the ponderous locomotives while undergoing repairs.

Among these the most notable is a drop pit extending 50 ft. in length on which the Mallet compounds are placed, while the wheels are being removed, or driving boxes refitted or other work necessitating a lowering of the wheels or trucks. A system of shafting runs along both sides of the pit under the flooring. The shafting is engaged at intervals by bevel spur gearing to several perpendicular shaftings furnished with spiral threads that operate worm attachments that lower or raise the extended drop pit. Heavy steel trusses are placed under the locomotives. These trusses extend some distance over the substantial flooring, and are in reality portions of structural bridge work that suit the purpose of sustaining the locomotives.

With the equalizers and springs and wedges in place the raising of the wheels and the adjustment of the driving boxes to the spring saddles seemed an easier operation than the lowering of an ordinary locomotive vibrating as it does while hanging in chains. In half an hour the wheels are in position and the binder bolts are being secured in place.

Peculiarities in the Mallet compound have been noted at Carbondale that are worth recording. Among these is a tendency to a slight flattening of the wheel tires near the cranks, the flat part occurring at the point where the thrust on the crank pin begins after passing the dead centers, and when the slipping of the wheels occurs, if slipping occurs at all. This slight defect has been to some extent overcome by running the locomotive backwards as well as forwards, the forward running being up hill which extends over nineteen miles, the backward running being down hill. Mr. Reid claims that the best work of the locomotives is accomplished while running at a speed of from 12 to 14 miles an hour.

Flange lubrication has also been adopted with very gratifying results. An automatic lubricator is attached to the frames a little above the wheel centers, and supplied from a positive feed pump in the cab. It is especially serviceable on curves and reduces the lateral swing of the locomotives and also eliminates much of the wear and tear on the machinery without lessening the tractive power of the locomotives.

The speed indicators and recorders are being tested, as their action, whether induced by the flattening of the wheels referred to, or by the vibrations incident to the running of such heavy locomotives is not so reliable in their records as are those used on the level road. These machines when applied to the Mallet compounds are driven by a small crank attached to the crank pin of the back trailing wheels, similar to the cranks used in the Walschaerts valve gear. This motion is conveyed by a swivelled shafting to the indicator in the cab of the locomotive.

Work has been begun on new machine shops and roundhouses near the site of the present works. These will be fitted with every modern appliance and will be ready before the end of the year. The extensive plans involve a change in the course of the Lackawanna River, to admit of an uninterrupted access to the various buildings. This will involve dredging out a new channel for a short distance and reclaiming the ground where the river now flows.

The better education of the railway men keeps pace with the present-day requirements. A finely equipped apprentice school is in full operation, and the higher branches of education of railroad engineering are being taught. Here is also a large circulation of the best railroad literature. Mr. D. E. Atkinson, of the master mechanic's office, is the most active in the good work. He has the fine sense to gauge the requirements of the men. He does not believe in gorging beginners with lengthy and costly courses.

Dr. Sinclair's "Railroad Men's Catechism" is his text-book for the younger men. Other works follow, and to all and sundry Railway and Locomotive Engineering seemed to be their guide, philosopher and friend.

Select Superior Iron.

During a discussion at the Central Railroad Club on superheating, the following remarks were made: "An epidemic of broken piston valves arose and of other castings subject to severe strains. At different shops I would hear the same complaint of broken parts, piston rings, eccentric straps, wedges, and so on. One general foreman told me that he had ended the broken piston ring trouble by using Hunt-Spiller gun iron, a superior grade of iron made by the Hunt-Spiller Manufacturing Corporation, of Boston. I soon found others doing the same thing with the same result. American foundries used to be famous for the strength of the cast iron they turned out, but deterioration has crept in through various causes, and the common cast iron is now utterly unfitted for articles subject to severe shocks or strains. This being the case, the wise man looks for iron whose strength is known to be satisfactory, and thereby saves his company the expense, delay and annoyance due to breakage of important parts. It is poor policy to acknowledge defeat when any difficulty is encountered, such as defective metal and defective lubrication. Overcome the difficulties and prove yourselves masters of your business."

Could Not Stand Pay Day.

There is an old saying, "you can tell a mechanic by his tools," but it is not always reliable. During a rush time when machinists were scarce, I hired a tramp who said he had worked in railroad machine shops. He had the true tramp air and carried under his arm, rolled in a piece of paper, a hammer, a two-foot rule, a pair of callipers, a steel square and some miscellaneous articles. I set him to work in the rod gang, and before noon he was instructing his mates on new and advanced methods of doing work. I watched him closely for several days and found that he could do first class work and finish it better than any man in the shop. A job of coppersmithing turned up, and the coppersmith was absent. The tramp took hold of the job and finished it as if coppersmithing was his trade. After a few days his clothing was improved and the tramp appearance vanished, so I was congratulating myself in having picked up a jewel among rubbish. But the first pay day finished poor old Sam. A few days later he came in to take away his tools with the stamp of the saloon on his person. I told him to go and rest for a few days, then come back and try it again. He thanked me with tears in his eyes, but said he was compelled to go on, that he was the modern example of the Wandering Jew.

Thermit Welding.

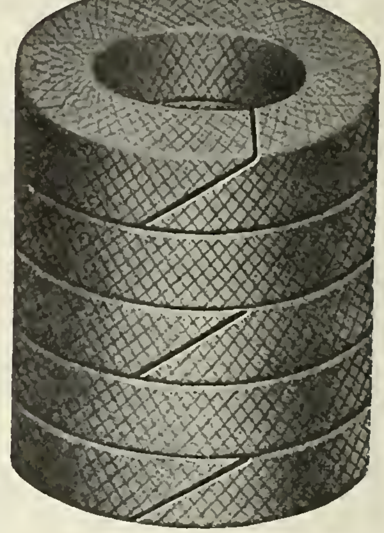
The Cleveland branch of The American Chemical Society at their March meeting, was addressed by Mr. W. R. Hulbert, Manager of Sales, Goldschmidt Thermit Company, on the Thermit Welding Processes. In addition to a general description of the process and its various applications, with lantern slides, Mr. Hulbert gave a demonstration of Thermit welding, comprising a number of experiments to show how the process is used commercially for repairing wrought iron and steel sections, and for welding pipes up to 4 ins. in diameter. Much interest was shown in the demonstration, which was witnessed not only by the local members of the American Chemical Society, but by members of the American Society of Mechanical Engineers, and others who came as far as Akron, Lorain and other towns in the vicinity of Cleveland.

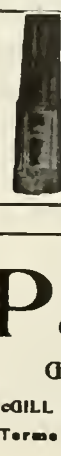
A Quotation from Job.

At a prayer meeting, held in the backwoods of Rhode Island, testimonies were requested, and a very old woman tottered to her feet. "I want ter tell this blest company," her voice quavered, "that I have rheumatiz in my back and rheumatiz in my shoulders, and rheumatiz in my legs, and rheumatiz in my arms, but I hev been upheld and comforted by the beautiful Bible verse, 'Grin and bear it.'"

Mayfield N. Y., O., & W. Shops.

A few miles from Carbondale the new shops of the New York, Ontario & Western Railroad are located. These will be ready for occupancy in the early summer, and Mr. W. H. Kinney, shop superintendent, and his force of over one hundred mechanics are delighted at the early prospect of entering their new quarters, which will be a model in point of equipment and convenience. The conditions at Mayfield, especially in roundhouse work, have been such that one might marvel how Mr. Kinney has been able to keep the larger locomotives in such excellent condition when the work has had to be done in the open air. Five of the heavy locomotives have recently been equipped with the Baker-Pilliod valve gear, but their short period of service has been such that a fair estimate of their performance has not yet been completely tabulated. The reports so far are of the most encouraging kind. A waste-cleaning apparatus has been in operation for some time and at the surprisingly low cost of five dollars per month as high as ninety per cent. of the cotton waste used in cleaning and packing is saved. When the new shops are in operation we will present a full description of them with illustrations of the fine equipment.





Railroad Y. M. C. A.

Next in importance, perhaps, to the establishment of the Apprentice Schools in connection with the railroad repair shops, are the Y. M. C. A., that have sprung into existence in proximity to the chief railroad centres. They are furnishing admirable opportunities for the better education of the railroad men. In visiting a number of these institutions we have been agreeably struck with the earnest spirit of studiousness that mark the attending classes. The examinations for promotion in the railroad service have become so complex that nothing short of the severest kind of application can familiarize the average aspirant with the subjects, and prepare him to answer the long array of questions correctly. The encouragement from the heads of departments and from almost every railway man in an official position is very helpful in the good work. The movement has also developed a type of instruction that is altogether admirable. Many of these teachers are men who are occupied in some other capacity than teaching, but who in teaching others contribute rapidly to his own better education.

Mixing the Sense.

Scottish Highlanders who have been brought up upon the Gaelic, as the saying is, make woeful blunders sometimes when talking English, and many of them are very prone to display their mental progress by talking the language that they understand indifferently. Three Highlands were enjoying the contents of a whisky bottle, and one holding up a partly emptied glass remarked, "that is the finest drop of whisky that I haf never drank before." "Me too whaterfer," remarked the second crony. "And I haf neffer tasted anything like it since tomorrow," remarked the other.

P. R. R. Bulletin No. 5.

Bulletin No. 5, just issued by the Pennsylvania Railroad Company, gives the latest record of the locomotive testing plant at Altoona, Pa. This important branch of the company's work which is being systematically carried on under the best conditions and supervision is supplemental to the interesting series of tests on the locomotive testing plant which formed such an interesting feature of the company's exhibit at the Louisiana Purchase Exposition in 1904. The report before us gives in detail the results of an exhaustive series of tests on a two-cylinder simple Atlantic type of locomotive known as "E-2-A" on the P. R. R. The report is particularly valuable, as it gives the means of comparing the performance of the simple cylinder locomotive with that of the four-cylinder compound locomotives. A particularly interesting feature of the tests was the very high calorific value of the cinders and sparks. They practically represent unburnt coal, and point positively to the conclusion that we have frequently mentioned in the pages of Railway and Locomotive Engineering that better results could be obtained from burning the same quantity of coal on a much larger grate and where the draft action is not so intense. The importance of the tests is of real value to all who are interested on fuel consumption on locomotives, and we particularly recommend a careful study of the bulletin to the heads of the mechanical departments of railways.

Simple Solutions.

We have noticed a growing tendency among our railway and mechanical contemporaries to decorate their reading pages with algebraic formulæ, some of them involving the use of the calculus. That may appear to be highly learned, but very few people engaged in mechanical pursuits are familiar with the higher mathematics, and we have the best of reasons for knowing that articles containing algebraic formulæ are habitually skipped. We have always had great respect for the expressions used by the late John C. Troutwein in the introduction to Rules and Tables for Engineers. Troutwein's book was a reference and a never-failing guide for several generations of engineers, and enjoyed the highest kind of popularity.

Troutwein referred to Rankin and other high mathematical exponents as men of master minds displaying a profoundity of learning beyond the comprehension of ordinary men. The high mathematics school of engineers and college professors he held used language so involved that few working engineers could understand them. It had been necessary for him to solve many complex engineering problems, but he found the explanations in engineering text books were sufficient for his use without entering into difficult mathematical problems.

New Car Wheel Co.

The Nickel-Chrome Chilled Car Wheel Company was incorporated on the 23d of February, 1911, at Newark, N. J. The purpose of the company is to furnish nickel-chrome alloy to makers of chilled car wheels. The alloy is said to increase the tensile strength threefold. It gives strength and hardness to the tread and flange, insuring safety and wearing qualities. On a mileage basis the cost of nickel-chrome wheels is but one-fourth of that of steel wheels, and one-half the cost of cast iron wheels. The corporate office of the company is at Newark, N. J.; New York office, Hudson Terminal Building; Pittsburgh office, at Frick Annex, Pittsburgh, Pa. The officers of the company are Messrs. Robert C. Totten, president and treasurer; Stephen D. Barnett, vice-president and general manager; Charles A. Millington, secretary.

N. Y. C. Electric Equipment.

The New York Central & Hudson River Railroad have ordered the following apparatus from the General Electric Company for the extension of their electrification scheme on the Hudson River division to Irvington: Four 2,000 kw. rotary converters of the commutating pole type, twelve kw. 11,000 volt transformers, two 20,000 cu. ft. per minute, blower sets. Three of these rotaries with their step-down transformers and the blowers will be installed in the new sub-station now in course of construction at Irvington-on-the-Hudson, while the remaining one with transformers will be installed in the new sub-station at Yonkers.

Machine Lore of Long Ago.

Considering the great importance of applied mechanics in the development of industries very little scientific information was published in Great Britain before the eighteenth century.

De LaHirè's work is also remarkable as being one of the earliest in which the resistance of materials to fracture was treated of. This subject, the strength of material, which now forms the physical basis on which a large branch of machine science—namely machine design—rests, was first worked in by Galileo, who published a theory of beams. Mariotte had at this time also written on the same subject. De LaHirè introduces it as an essential part of mechanics, which meant, with him, the science of machines. In his chapter on the subject he adopts the theory of Galileo, which was an erroneous one, but which, nevertheless, in certain special cases gave results identical in form with those now known to be true. In the absence of experiments to determine the value of constants, of course, the theory, right or wrong, did not admit of any direct application in machine design. Another century had passed before we find traces of rational proportioning by engineers of the dimensions of rods or links, or beams of their machines to the load or pressures they had to sustain.

Some practical work in machine design, however, De LaHirè did, for he gave constructions for determining the force of cams, and of the teeth of spur wheels, which might have been, and no doubt were, used in practice. If this was the case, we have here the first definite contact between the theoretical mechanics of the time and the actual work of machine design or construction.

Far More Precious Than Gold.

Great demand and limited supply has sent up the price of platinum until that metal is now more expensive than gold. The discovery has recently been made that the black sands on the California and Oregon sea coasts are rich in platinum. These sands also contain paying quantities of other rare metals.

The black sands, indeed, are a wonderfully complex mixture. One of the substances they contain is monazite, the name of which, signifying the "lonely mineral," is bestowed because it is found nowhere in quantity, being represented only by an occasional crystal that turns up here or there. In it is held, as an impurity, the metal thorium, which is now in demand at a high price, being used to give a better color to incandescent mantles of gaslights.

Another of the minerals is tantalite, which, like monazite, has been regarded until recently as valueless, save as a curiosity of the laboratory. It gets its name from the exceedingly tantalizing way in which the metal derived from it, tantalum, eluded the chemists who first tried to separate it from the ore. Tantalum, which is very hard, rust proof, and with an extremely high melting point, seems likely to replace carbon as a material for the filaments in incandescent electric lights. It can be drawn into a wire as fine as a spider's web.

Rust may be easily removed from steel by rubbing sweet oil vigorously on the surface of the metal. Steam it for 48 hours, then rub with finely pulverized unslacked brine until the rust appears.

Railway and Locomotive Engineering

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Lifting "The Great Bear."

Our frontispiece illustration this month shows the Great Western Railway 4-6-2 passenger engine being lifted by two wrecking cranes. We are indebted to the *Great Western Railway Magazine* for the photograph from which our engraving is made and also for the data concerning engine and cranes. In the first place this engine is modified slightly, but still is one of what the Great Western people call the "star" class, as each engine in this group is named after some well-known constellation in the heavens or after some "bright particular star."

The engine, which has been appropriately named "The Great Bear," is of the "Pacific" type, and was the first of its kind in Great Britain. It has four high-pressure cylinders fitted with piston valves. The cylinders, coupled wheels and valve motion are arranged similarly to the "Star" class, the driving, or rigid, wheel base, being reduced to 14 ft., and a pair of radial carrying wheels added. The boiler is of the Belpaire type with wide firebox, and is fitted with a superheater of the "Swindon" pattern.

Quite a departure from standard practice is the tender, which has two four-wheel bogies. It is fitted with an improved type of water pick-up.

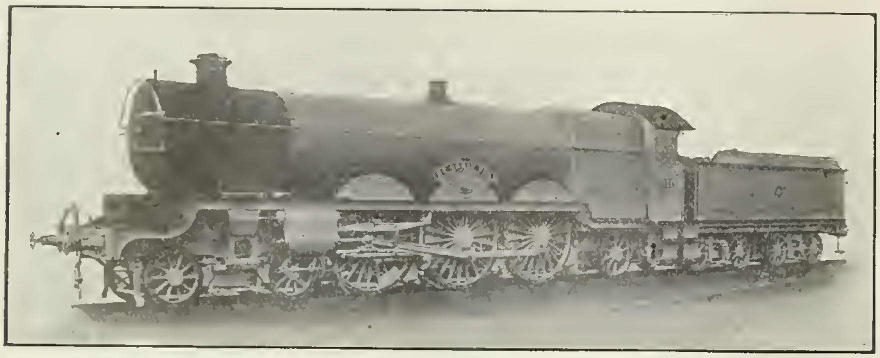
GREAT WESTERN ENGINE "GREAT BEAR," WEIGHING 194,884 LBS., LIFTED BY TWO WRECKING CRANES.

Some of the dimensions are as follows: Wheels—Driving, 6 ft. 8½ ins.; bogie, 3 ft. 2 ins.; trailing, 3 ft. 8 ins. Wheel Base—Center of bogie to leading, 9 ft.; driving, 14 ft.; trailing to carrying, 8 ft. Cylinders (4)—Diameter, 15 ins.; stroke, 26 ins. Boiler barrel—Length, 23 ft.; diameter (maximum,) 6 ft. Heating surface—Tubes, 3,242 sq. ft.; firebox, 158 sq. ft.; total, 3,400 sq. ft. Grate area, 42 sq. ft. Working pressure, 225 lbs. per sq. in. Tractive effort, 29,430 lbs.

The two cranes, as shown in the picture, stand about 45 ft. apart while lifting "The Great Bear," and they are nearly perpendicular. The maximum working capacity of the cranes is 36 tons at 20 ft. radius, lighter loads being lifted at increased radii. One of these cranes is fitted with a curved lattice jib. The motions for lifting, slewing, jib-derricking and self-propulsion are operated by a pair of double, inclined cylinder engines, 10 x 12 ins., while the traveling motion is driven by means of a shaft passing through the center of the crane post operating a horizontal shaft coupled to two of the axles by sprocket wheels and chains. The boiler is of the "Hopwood" type, 4 ft. 6 ins. x 7 ft. 6 ins. high, working pressure 100 lbs. per square inch. A heavy forged steel post and a ring of live steel rollers carry the superstructure, and the top of the post is fitted with ball bearings.

In the other crane the lifting, slewing, jib-derricking and self-propelling motions are operated by two horizontal cylinders 9 x 14 ins., the traveling motion being driven by a shaft passing through the center of the post operating a horizontal shaft by means of a worm and worm wheel. The horizontal shaft drives two intermediate shafts which are geared to two traveling axles. The crane turns upon a live ring of steel rollers, running between cast steel roller paths, the upper bedplate also being of steel. The boiler is of the vertical multitubular type, 4 ft. 8 ins., diameter by 7 ft. 2 ins. high, working pressure 80 lbs. per square inch, and the jib is constructed of wrought steel.

The following details are common to both cranes: Steel wire ropes are employed for derricking and lifting, and to admit of the clearing of the load gauge the chimney is hinged. A removable balance weight is provided; in one of these cranes the weight can be racked in and out. Mounted upon five pairs of wheels, 3 ft. 2 ins. diameter, and axles, the cranes are capable of taking a five chain radius curve. The wheels and axles, axle boxes, buffers, etc., were supplied by the Great Western Railway, and the match-trucks were built at Swindon. Clutches are provided so that the traveling gear can be entirely disconnected when the crane is being hauled by train. In accordance with Great Western standard practice, the cranes have been subjected to, and have successfully passed, a test load of 25 per cent. above the working load.



GREAT WESTERN ENGINE "GREAT BEAR."

Over the Tehachapi in 1888.

By Joseph Anthony.

We pulled out of the yard at 11 p. m. with eighteen loads and a caboose. There was a hard road ahead of 162 miles up and down, over three ranges of mountains. Only on ten miles of this division is steam worked in going both ways—that is, on all the rest of the road the engine is either pulling hard or holding back and drifting.

The fireman and I were acquainted and he had agreed to take me with him; said I could help him fire, and if I could not do that would have to break coal, as he always had a hobo on each trip, giving him a ride in exchange for helping him. I was pleased to go with him, not only for the ride, but to have the experience of trying to fire an engine. I was curious to know whether a man who had the theory and knew how it ought to be done, but who never had had any practice, could keep up steam.

The engineer looked like a drover or a rancher. He had on an old slouch hat, on his feet were boots with the trousers tucked in the top. We were not five miles out before he was leaning back in the seat with his feet on the reverse lever. This was his favorite position during the trip. Up the valley of the Los Angeles River we went, crossing the dry washes that came in from the east, up a long cañon and through the San Fernando tunnel, then down into the head of the Santa Clara Valley.

When we started to climb the second range, going up the Solead cañon, the fireman gave me the shovel, saying, "Now you can take her." It was to my advantage that we were on a freight engine and going up a heavy grade. Going slow and steady one can keep his feet, while on a passenger engine a fireman must be very active and skillful to do the work.

The work for me to do was to keep this engine "hot," the steam at 165 lbs. and no more. I soon learned why no more, at a trifle over this amount the safety valve would open and the steam blow off until the pressure in the boiler had been reduced about 5 lbs. before the valve would close; then what a time to get steam up again! Three times on this grade the fireman had to get down and help me. It was not only the physical strain I was put to but the mental one also, of being afraid I was going to fail, of finding myself not capable of doing that which looked so easy, still it was not easy.

It seemed to me as though we would never get to the top of the "hill" and as though morning would never come. We had been hours and hours (to judge by my feelings) climbing. I was hot and tired, my hands were sore, still there was the comfort of not having entirely failed on my first trial, then the pleasure of drifting down the other side onto the Mojave desert. We reached the top at early morning, where the head brakeman came and rode with us. We could see a railroad and a little station below and off to one side of us. I asked him what road that was, as I had never heard of any other being in that part of the country. He said, "Why, that is our road, and we will be there within an hour." Half way across the desert we came to the town of Mojave, where we stayed for several hours. While waiting, the Overland passed us, a double header, two fine engines with clean and trim-looking enginemen. There was such a difference between their fast, smart-looking train and our slow, side-tracked freight; but ours was the one that helped pay the dividends and theirs the one that ate up the profits.

It was in the second night that we started up our third and last "hill," as the heavy grades are called by trainmen. Here it was my turn to fire and I got through all right this time. It certainly was an experience for me, a green country boy, to be placed in such a position. On this grade, after getting well started and settled down to work, the engine was apparently turned over to me. The engineer on his seat with his feet up, the fireman on his seat looking as though asleep, but I knew mighty well he was not. There was no talking, no whistling for crossings, no ringing of the bell, just

General Correspondence

Value of Lubrication.

Editor:

I am somewhat of a crank on the subject of lubrication, especially that part which applies to the valves of a locomotive. I have been an interested reader of the many fine records made by some of our experts, with so few drops of oil to the mile, and some of them have been so good that the maker of the lubricator should feel complimented on being able to furnish a machine that could be adjusted down to so fine a point. These records, no doubt, look good on paper to those who have their money invested in the locomotive, but if compared with the machinist bill prior to the reduction in oil, I believe that it would make someone sit up and take notice.

How can we strike the happy medium and say that a locomotive can only have so many drops of oil to the mile for a certain run, when there are so many different and changeable conditions surrounding that run? One day the engine may be in first-class condition, the train an easy one, and you will make the schedule on time, with oil plenty, but on the next trip we have a very heavy train, windy and dusty, until we strike the hills, then find it rainy and bad with the track very slippery, we just have an awful trip, double several mountains, slip fifty miles more than the schedule calls for, have many delays, and find lubricator empty long before reaching the terminal, with cylinders groaning, air pump singing a song, and engine in anything but a satisfactory condition; so you can see that after the hostler has shifted a lot of dead engines around the yard for several hours, and then filled her to the stack with water, so as to last all night, it will take a large dose of your regular supply to get engine in condition to make the trip; and there you are, short of oil at the beginning of the next run.

I do not want it understood that I wish to be extravagant in the use of oil, as I am a firm believer in economy, and think that expenses should be held down as far as consistent; but I do not believe it economy to save one dollar in oil and spend two dollars in cylinder packing, facing valves, etc., to do it. I began firing in the days of the full oil pail, and it was quite a long time before I ever saw the inside of my engine cylinder, or saw a valve faced off; but now it is a new set of cylinder packing most every trip, and you seldom see a work report that does not say packing blowing, or valves blowing, and all because a fellow has to stretch the oil to run the required number of miles, regardless the number of hours it takes to run them.

I would like to tell you how the car inspector used to go along the train and, after looking at each journal carefully, would pour a small quantity of oil in each box, and how we used to shut off the engine and roll down certain inclines for miles, and scarcely ever heard of a hot box, but now the car inspector does not carry an oil can, the train refuses to drift down these same inclines, and hot boxes are numerous, with plenty of old brasses laying around, etc., but I can not speak of these things because I have no money invested in these enterprises, and it is really none of my business if the cars will not drift down hill, or whether the engine could pull two or three more cars if well oiled, or whether it takes a few more tons of coal to make the trip or not. But I work for a railroad company, am dependent on them for a living, and feel that a little discussion on this line might result in mutual benefit to them and my "brother engineers," as every good engineer dislikes to hear his "noble steed" groan for just a few drops of that oil.

O. P. Angelo.
Engr. Div. 317.

Alexandria, Va.

Some Queries.

Editor:

None get too old to learn, and the young especially need advice and instructions—in fact all are or should be benefited by information. For these reasons I am going to ask the following questions and your valuable periodical being considered authority, hope you will publish the questions and your answers, and would also be glad to hear from others on these subjects. Am an engineer in actual service and a subscriber to your magazine.

1st. An eccentric blade or strap to right forward motion eccentric breaks; what disconnections are absolutely necessary to proceed?

2nd. A blade or strap to right back motion eccentric breaks; what disconnections are absolutely necessary to proceed?

3rd. With forward motion eccentric strap or blade broken, and link hanger disconnected on disabled side, with back motion eccentric still intact, will top of link move or valve shift on seat from movement of back motion eccentric? If valve moves, will its travel over-reach or under-reach regular points with both eccentrics working?

4th. With engine all right on left side, can the link lifter on right side be disconnected should back motion eccentric strap be broken on right side and thus proceed working engine hooked up on left side and full stroke on right?

5th. Is there an absolutely accurate way to locating a valve strip blow (Allen-Richardson type) while engine is laboring? Can this be done by placing engine or valves at any special point for testing? Can it be done by the location of the cross-head? If so, please explain.

6th. Will a release valve "suck air" on side as fully where strips are broken as will the other?

THE FUTURE S. M. P.

7th. Will the location of the lubricator, that is so placed as to cause "water traps" in the oil pipes, interfere with the proper working of the lubricator?

"Three Times Seven."

New Orleans, La.

[Answering your first question, if the right forward rod broke, it should be taken down, also its strap, and the back-up strap and rod put on the forward eccentric and the engine run in full forward gear. If this is not possible, the eccentric strap and rod must be taken down, the valve clamped on the center, the main rod taken down and the crosshead blocked. If the eccentric strap had broken and not the rod, it might be possible to put the back-up eccentric strap on the forward eccentric and clamp the rod to the strap.

In this case both rods would be actuated by the same eccentric and the engine would run in full forward gear and could not be reversed. In regard to leaking or broken valve strips, a common method is to place the valve on the centre of the valve seat and open the throttle valve slowly and listen. A whistling sound is a sure sign of a leaking valve. The real cause cannot be positively known without uncovering the valve. As our correspondent has expressed his desire to hear from others on this subject, we may say we would be very glad to have our readers contribute to this discussion.—Editor.]

Easer Joint for Scales or Bridge Track.

Editor:

I am mailing you herewith, for publication, a photograph of a recently patented invention, which is used in connection with draw or lift bridges, track scales and turntables, also a print showing the installation of same on what is probably the largest and most complete track scale in the South. Until recently an open joint was used on the track, causing a

EASER JOINT FOR SCALES OR BRIDGES.

severe pound on the scale as cars passed over, consequently decreasing the life of the scale. Following is a description of the Bohannan-Dugger Easer Joint.

The ball of the approach and scale or the bridge rails are planed off on the outside even with the web, after which the easer is bolted firmly to the approach rail, allowing ⅜ ins. clearance between the side of the scale rail and the easer joint, which gives ample room for movement of the scale. The easer being 3/16 in. higher where the approach and scale rails meet, the car wheels are practically lifted over the open space and allowed to land on the scale without any perceptible jar or pound. The device is made of manganese steel and will, therefore, wear indefinitely.

Neal Dugger,
Scale Inspector,
Tenn. Coal & Iron R. R.

Ensley, Ala.

The Traveling Fireman.

Editor:

In reading Barr's "Combustion of Coal and Prevention of Smoke," reference is made to a traveling fireman whose duty, it appears, is to ride on locomotives and report, and I take it, instruct if need be, on the duties appertaining to the fireman. I would be obliged if you could supply me with any fuller information relative to this matter, as I always believe in practical tuition wherever it can be imparted, but the difficulty that presents itself in this instance is that the duties of traveling firemen would clash with the duties of the engine driver. It is for this reason that I would like to know the status of the person appointed to such positions and whether he would be compelled to give practical demonstration of the methods advocated. I cannot recall any reference to this matter in your esteemed magazine, of which I am a reader, nor in Dr. Sinclair's book entitled the "Development of the Locomotive Engine." I shall before concluding take this opportunity of thanking you for some information supplied to me some time ago regarding the peculiar construction of American built locomotives.

Thanking you in anticipation of a ready compliance with my request, which I hope is worthy of your valuable attention,

C. E. Baker,
West Perth, Locomotive Driver.
Western Australia.

[We would like any of our readers on whose road a traveling fireman was or is working, to write us and give our West Australian friend the information he desires.—Editor.]

An Early Steam Carriage.

Editor:

As far back as December, 1824, Mr. David Gordon patented the steam carriage shown in the illustration. The carriage ran upon three wheels, one in front for steering by, and two behind. Each of the wheels ran upon a separate axle. The engine was placed in the fore part of the carriage, and consisted of two horizontal cylinders mounted upon trunnions. The piston rods gave motion to an eight-throw crank—two in the middle for the cylinders, and three on each side, which were attached to the propellers. By the revolution of the crank the propellers or legs were successively forced outwards with the ends of each pressing on the ground in a backward direction. They were lifted from the ground by another crank working in parallel with the former. To the lower ends of the legs or propellers were attached feet. These feet were made somewhat like brushes, but instead of bristles, pieces of whalebone intermixed with iron spikes were fastened on the faces. The feet were arranged to press against the ground in regular succession without digging or unduly damaging the road. The driver could at will lift the feet entirely off the ground, this being necessary when descending a hill. B. R. A.

London, England.

[This steam carriage is very similar to Brunton's mechanical traveler, which was invented in 1813. An account of the "Traveler" is given in the chapter

EARLY STEAM CARRIAGE.

on Freaks and Curiosities in Locomotive Design in Dr. Sinclair's work on the Development of the Locomotive Engine, copies of which may be obtained at this office.—Editor.]

Big Nozzle Advocated.

Editor:

Referring to your note, column 1, page 146, April number, I would say that I had not overlooked the fact that the article was in the air brake department, but referred to the excessive back pressure encountered when the exhaust from the pump was turned into the exhaust chamber in the cylinder saddle.

The article is good and I approve of the recommendation made, but the well known fact that there has been a number of cases shown where back pressure and compression in the cylinders was equal to or in excess of the mean effective pressure, when if the compression had begun at a reasonable amount of back pressure, it would only have given the proper cushion for high speed and had no bad effect on the free working of the engine.

Tell a stationary engine builder that you have an engine with a 9-in. dry pipe, two 6-in. steam pipes, two 22 x 28 ins. cylinders having 30 sq. in. steam ports, 60 sq. in. exhaust ports, then exhausting through a nozzle tip having 20 sq. in. area for both cylinders and he will immediately say, "How can your engine carry any load" and wouldn't expect over 66⅔ per cent.

A 22 x 28 in. cylinder has a volume of approximately 11,224 cu. ins. of steam exhausting at a pressure of probably 50 lbs. Certainly sufficient to expel all the air from the stack, if the stack was proportioned so the steam would fill near the exit, and no more than vacuum pressure can be created, no difference how much the nozzle is choked. I have some times thought that creating a forced draft was like a man blowing his nose; if he kept his hands down he couldn't accomplish much, but by closing his nostrils he could blow it easily, and wouldn't have to go down and bush his nozzle to do it.

I'm a big nozzle crank, I know it, but I have something to crank about.

J. A. Esou.

Denver, Colo.

New York to the Pacific.

Editor:

How fast can one travel from New York to the Pacific coast? Most people have the idea that the trip occupies about five days. As a matter of fact it can be accomplished any time in the year in 90 hours and 10 minutes, using regular trains, and without risking connections. Note the schedule:

	Miles.	Hrs.	Min.	Speed, Miles per hr.
Arr. Chicago	970	17	55	54.0
" Kansas City....	1,428	30	15	47.2
" La Junta, Col..	1,999	45	30	43.9
" Albuquerque ...	2,347	57	50	40.5
" Williams, Ariz..	2,725	70	30	38.7
" Los Angeles....	3,235	90	10	35.9

The route is by 18-hour train to Chicago, thence by Santa Fe to the coast. It will be seen that even as far west as New Mexico the average speed from New York exceeds 40 miles per hour. This is, incidentally, the quickest route to Kansas City. The best time via St. Louis is 31 hours 55 minutes.

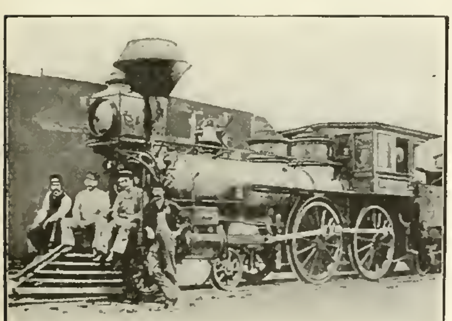
Andrew Linn Bostwick.

St. Louis, Mo.

Engine with Mason Bell Stand.

Editor:

I enclose herewith picture of engine "W. D. Sewall," which carried the first Mason Standard bell stand of this pattern. It was installed October 31, 1864. The engine was built by the Mason Machine Works, of Taunton, Mass.



FIRST MASON BELL STAND.

Relic Hunter.

Fall River, Mass.

Wrongly Used Air-Brake Valves.

Editor:

Having been asked what would be the result of attempting to use an H6 brake valve on an engine equipped with the H5 brake or if an attempt was made to use the H5 brake valve with the No. 6 E. T. Equipment I tried each of the equipments with the wrong brake valve and found that: If the H6 brake valve is used with the No. 5 equipment the brake will apply and release all right except in double heading.

With the valve handle in running position the brake can be applied from the leading engine but will immediately release on account of the application cylinder being open with the valve handle in running postion.

If the valve is lapped the brake will apply and remain applied but cannot then be released from the leading engine.

If the H5 brake valve is used on the No. 6 equipment the brake can only be applied in the emergency position, train brakes can be released and engine brake held on in holding position, but the handle must be placed on lap position to release engine brake. Should this be the second engine, in double heading with the valve handle in running position the brake can be applied from the head engine, but not released and if the valve is placed in lap position the brake will release as soon as it is applied.

W. S. Henry.

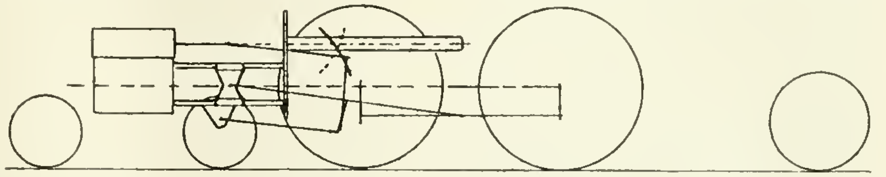
Springfield, Ill.

Theoretical Attachment of Joy Gear.

Editor:

The chief objection in applying the Joy valve gear to an American locomotive is the up and down movement of the wheels due to uneven track, which affect this form of gear more than others, and consequently results in poor steam distribution. The accompanying diagram shows a scheme designed to overcome this difficulty. The main rod is attached to the side rod half way between the crank pins. Now, when one of the driving axles moves up, the equalizing bar and springs transmit part of this movement into a downward movement of the other axle and vice versa.

As the center of the side rod is more or less close (depending on the position of the cranks) to a point where the fulcrum of an imaginary lever connecting the two axles would be, the movement up or down becomes much less than that at the center of one of the wheels. So, if the Joy gear were used under these circumstances, it would probably give good results and economy on account of its lightness and fewness of parts. Incidentally the following advantages would result: An equal amount of counterbalance on each driver and consequently less pound on the track; equal distribution of stresses on the crank pins; a shorter main rod, which in some cases might be desirable on engines connected to the second or third pair of drivers. A disadvantage is the fact that the side rod would



SKETCH OF THEORETICAL METHOD OF ATTACHING JOY GEAR.

have to be made much heavier. As I am not engaged in railroad work, I don't know the disadvantages which would probably come up in service, and therefore the whole arrangement might be impracticable. I am just giving a theoretical consideration to the subject, but if I am wrong theoretically I wish some one would point it out.

Wm G. Landon.

Pomfret Centre.

The "Shakopee" Again.

Editor:

In answer to the inquiry in the February number of Railway and Locomotive Engineering, by Mr. Herbert Fisher, about the engine "Shakopee," I will say that it was built in 1865 in the old Piqua shops, at Columbus, Ohio, by Wm. Romans, who was M. M. at that time. Three of these engines were built here. The first one was called the "Economy," the second "Express" and No. 3 was the "Shakopee."

The "Economy" was used between Columbus and Piqua on the accommodation run and I fired her with two different engineers, Jas. Drugan and Robt. Chadwick. The distance was 73 miles. The engineer received $65 per month and the fireman $1 for the round trip of 146 miles, putting in 14 to 18 hours per day. No extra time allowed. Compare these wages of 45 years ago with those of today.

John Cassell.

Retired Engineer of Penna. Co.

Columbus, Ohio.

Likes the McKeen Car.

Editor:

Enclosed you will find order for two dollars for advance subscription to your most appreciated magazine. Note my change of address. I am now in the far away Evergreen State, but appreciate everything everyone else does, but especially your paper.

I am and have been for past two years operating a McKeen Motor Car on the Northern Pacific Railway at various places, as the cars seem to be getting scattered quite generally on various roads, others evidently find them as successful as we have found one to be and just as reliable as steam.

As these cars are operated as a rule, I believe, by enginemen and readers of RAILWAY AND LOCOMOTIVE ENGINEERING, I think something more explicit than I have yet seen on this subject would be appreciated by many readers, as I can assure anyone, that to keep one of these cars in service regularly and continually is not the easy task that some people think. This statement can be corroborated by some of the engineers I have instructed, as I also have that work to do on this road.

I would be glad if I can be of assistance to anyone operating these cars and who may read this. I trust you will find room for this, as it may reach some of my various friends over the country who are readers of your paper. Anyone wishing any information or assistance that I can furnish can reach me at address following. C. HUGHES.

Darrington, Wash.

The First Balanced Valve.

Editor:

I was interested in the article in the April number RAILWAY AND LOCOMOTIVE ENGINEERING about the "First Successful Balanced Valve." I worked under Mr. A. B. Underhill, with the exception of three months, from 1868 to 1874. I well remember his opposition to the trial of the Richardson balanced valve, and the reasons for it. While I was working in the shop in Boston about 1870, Mr. Underhill tried a balanced valve invented by a man named Nesbitt or Nesmith. We called it the Scotsman's valve. It had a concave shield, and I helped fit up the first set making the packing strips. It was a nice working valve, but had some defects, one being a tendency of the shield to spring, causing a blow. After awhile Mr. Underhill took them out, and said he would not try another balanced valve.

Among the engines equipped with the valve was the "Union," a Wm. Mason engine built in 1865. She was a 28-ton engine, 16 x 22 and a 5½-ft. wheel. When this class of engines came on the road there were but two heavier engines, the "Express" and "Despatch" built by the Boston & Worcester Railroad in 1858. These were 30-ton engines 16 x 21, and a 6-ft. driver. But at the time the Scotsman's valve was put in there were a few 17-in. engines, some of them Burnside engines, and the rest Underhill engines set up in the Boston shop.

The engineer of the "Union" was James M. Alger, who began his service on the road in 1846. He felt the loss of the valve very keenly, and hated to return to the plain slide valve. When Mr. Richardson came along with his valve, he was sent to "Jim" Alger, for he was the man who took an interest in anything that he thought would help to lighten the duties of an engineer. They took the matter up with Mr. Underhill, but it was a long time before he would listen or even look at the merits of the valve. At last he consented to make a trial and selected the "Union" for it. But, he said, "I will not face off the seats, and if the valves blow when the engine gets back to Boston tomorrow morning, out they come."

In October, 1872, I left the shop in Boston and was in a shop in Worcester, staying until January, 1873. Snow was on the ground when the valves were put in. When my father arrived at Worcester that afternoon he came and asked me if I would go to the engine house after supper, and help Mr. Richardson lift the covers and fix the valves, but said he, "The valves blowed coming up, and if we cannot stop it I will lose them when the 'Union' gets back to Boston tomorrow." And he added, "I can hook her up with my thumb and finger." I went down and we took off the covers, eased up the strips. Went all through the valves, put the covers back, got her out and ran her up and down a piece of track, and she was perfectly tight. Mr. Underhill was on hand the next morning, but no blow. Still he would do nothing more with them for a long time. The valves in the "Union" went month after month and he watched them. At length he ordered a set for a 17-in. engine. After they arrived and before using them father called his attention to an engine that was causing trouble on account of a soft seat. It required frequent facing and the time had come when either a false seat or new cylinder must be furnished. The engineer had to shut off on the hills to oil the valves, the lever rattled so bad. So Mr. Underhill put the valves in, and the trouble was entirely eliminated and the engine was good for another car. Then he saw the merits of the valve and equipped every engine, switchers and all.

My father ran the Union until the year 1880 and the original valves were in her when he gave her up. But he continued his running until 1895, when he retired at the age of 71. He began with an 8-ton engine built in Lowell in 1839 and named "Meteor." And he finished with one weighing about 80 tons. But he always was a friend to the man with the new invention and used his influence to have it introduced.

I send this to you as a matter of history. Perhaps you will find some things in it of interest. I look back to these facts of the former days and like my father I realize that we are never too old to learn and something new is turning up every day. J. E. ALGER,

Engineer Boston & Maine R. R.

Reading, Mass.

Train Announcing System.

There has recently been installed at the Grand Central station of the New York Central Railroad a new system of announcing departing and arriving trains as well as finding travelers who are supposed to be in the terminal. The apparatus is a combination of the telephone and megaphone. The instruments are made by the Megnaphone Company, of Wilmington, Del. There is a telephone in a booth where the train-announcer speaks and in the waiting room there are perhaps half-a-dozen telephone transmitters on each of which a megaphone is mounted. The operator in making the announcement simply telephones the public in all the rooms of the whole station and each magaphone speaks the same word at the same instant.

This is the way Mr. L. F. Vosburgh, general passenger agent of the New York Central Lines speaks of it:

"Suppose you had an engagement to meet a friend at the Grand Central and had some difficulty in finding him, and granting that your friend had the same trouble and both of you were looking aimlessly around, when suddenly and very distinctly you hear the words: 'If Mr. Jones is here will he please step to the information bureau.' You would be a little startled at first, but whether you were in the waiting room proper, the smoking room, or the train concourse, you would go to the information bureau and would there find your friend."

One of the great advantages of the use of this instrument is that trains may be announced as soon as they are ready to receive passengers, which is usually from 15 minutes to half an hour before leaving time, and several times during the interim until the time of departure, thus keeping the public informed and avoiding crowding at the gates.

It occasionally happens that there is some bit of special information that the railroad officials would like to convey to passengers in the waiting room and on the concourse and this new system affords the means of reaching practically everyone anywhere on the station property instantaneously. A passenger may ask the information bureau to call out the name of a friend just arrived but missed in the crowd and the bureau will have it done at once.

Catechism of Railroad Operation

By Angus Sinclair

Second Series.

34. What is the temperature of a fire when it is burning with an incandescent appearance?

A. About 3,000 degs. Fahr. To produce this temperature good coal must be burned with an admixture of about 20 pounds of air to every pound of coal, which supplies the necessary volume of oxygen without excess of air.

35. What is a locomotive engine?

A. A locomotive is two steam engines placed on wheels, equipped with the mechanism necessary to move itself on rails and to haul trains of cars.

36. What are the principal parts of a locomotive?

A. The principal part of a locomotive is the boiler which is carried on substantial frames that also carry two cylinders that transmit power generated in the boiler, as steam to the driving wheels secured in the frames. With an eight-wheel engine there are two pairs of driving wheels coupled together by side rods and a four-wheel truck supporting the front end of the engine. The cranks of the driving wheels are set at right angles with each other so that when one crank is on the dead center the other will be transmitting the maximum power. Power is transmitted to the driving wheels by main rods that extend from the piston connection in the cross-heads to the crank pins. Nearly all road locomotives have a tender attached which carries the necessary supply of fuel and water.

37. What are the principal parts of a locomotive boiler?

A. The shell or cylindrical part to which is attached the fire-box in the rear and the smoke-box in front. The fire-box is a square or oblong box with outside and inside sheets forming a water space on all parts except the bottom where the fire grates are situated. The sides and back sheets are secured to each other by staybolts and the crown sheet is generally supported by radial stays secured to the outside shell. Sometimes the crown sheet is supported by crown bars that extend across the fire-box and rest upon the sheet seams at each side of the box. From the front of the fire-box an equipment of flue-tubes, each about two inches in diameter, conveying the products of combustion to the smoke-box, thence to the atmosphere.

38. What are the principal strains endured by a locomotive fire-box?

A. First, to the strains due to the high pressure of steam; second, to the strains that result from varying temperatures with the hot water on one side of the sheets and a hot flame or, perhaps, cold air on the other side. These changes of temperature act to lengthen or shorten the steel sheets putting immense strains upon the material. Varying temperature of feed water also puts strains upon the fire-box.

39. Why is the fire-box surrounded by water?

A. To prevent the hot fire from burning the sheets. The surface of the fire-box sheets being exposed to the direct heat from the fire forms a valuable steam making area.

40. How is the bottom of the fire-box secured?

A. By a heavy ring made to conform to the shape of the fire-box. The outside and the inside sheets are riveted to this ring which is generally called the mud-ring, because the mud that drops from the evaporated water settles there.

41. What is below the mud-ring?

A. Attached to the mud-ring is a frame which supports the grates, and beneath the grates is the ash pan to catch the ashes that drop through.

42. How many forms of boilers are in common use?

A. The straight boiler which has the top of the fire-box flush or on line with the top of the cylindrical part; the wagon-top boiler in which the top of the fire-box is raised considerably above the line of the cylindrical top; the Bellpaire boiler which has the top of the fire-box flat.

43. For what purpose is a dome placed on a boiler?

A. To provide the exit for steam at a point considerably above the level of the water level, thereby tending to supply steam free from mixture of water. It also provides a convenient place for the throttle valve, for safety valves and other attachments.

44. In operating a locomotive, what is the most important duty concerning the boiler?

A. To keep a proper supply of water.

45. What would happen if the crown sheet becomes bare of water when the engine was working?

A. If it became sufficiently hot the crown sheet would be forced away from the staybolt and an explosion might result.

46. If you found that the water had fallen so low that the crown sheet was hot, what would you do?

A. Start both injectors.

47. Is there any danger of damaging the sheets if water is poured upon them when hot?

A. No. Quenching hot sheets with water may make them leak, but there is no danger of fracture.

48. What results from many of the flues becoming stopped up?

A. Every flue stopped up takes away an important part of the heating surface, with the result that when many flues are stopped up the steaming capacity of the boiler is impared.

It has been found on some roads that removing one or two of the bottom rows of flues has improved the steaming of engines.

49. What is the purpose of placing the injector check valves near to the front end of the boiler?

A. The front end of the boiler is considerably cooler than the back end, and the coal gases keep cooling as they approach the front end. When the feed water is injected close to the front end it presents a heat absorbing medium to the cooling gases.

50. How is the flat surface of the flue sheets prevented from collapsing under the great pressure upon them?

A. The flues which are expanded or beaded at the ends act as stays to strengthen the flue sheets.

51. How is the boiler secured to the frames?

A. At the front end of the smoke-box, which is an integral part of the boiler, is substantially secured to the cylinder saddle casting preventing any movement at that end. Then there is a cross-brace at the back end of the cross-head guides which secures the boiler to the frames. The fire-box end of the boiler is secured to the frames in such a manner that there is fore and aft motion, but no side motion.

52. What is the purpose of giving the boiler fore and aft motion?

A. To provide for the expansion and contraction of the boiler. It is longer when hot than it is when cold.

53. What must be the condition inside the boiler to give the best results in steam making?

A. It must be kept as clean as possible, and as free from mud and scale as circumstances will permit.

54. What is meant by an engine priming or foaming?

A. It is water mixed with the steam passing into the cylinders.

55. What is the cause of priming?

A. Impurities passing into the boiler with the feed water. When an engine first leaves the shop priming may be caused by oil and grease left inside the boiler by workmen.

56. What is meant by circulation in the boiler?

A. The water inside the boiler is always moving from one point to another, due to the action of the heating gases. That movement is called circulation. Circulation tends downward at the cooler parts and upwards close to the heating surfaces. It is strongest about the fire-box and arises from the steam rushing away from the sheets where it has been generated.

57. What is the leg of a fire-box?

A. The parts extending down to the mud-ring.

58. What happens when the leg of the fire-box gets filled with mud?

A. The sheets exposed to the fire get burned, so that they bulge between the staybolts and are likely to crack.

59. If the water became low in the boiler and the injectors failed to work, what should be done?

A. Quench the fire or smother it with earth or slack coal.

Air Brake Questions—Second Series.

1. Why is the present brake called the automatic brake?

A. Because it is automatic in its action; that is, its normal condition is when it is held off due to the maintenance of train line pressure, and anything which happens to reduce train pipe pressure will cause the brake to apply of its own accord, or automatically.

2. Where is the compressed air stored?

A. In the main reservoir on the engine; in the train line which extends throughout the train, under the cars and connects the brake valve with the triple valves, and in the auxiliary reservoir under each car.

3. What are the functions of the auxiliary reservoir, train pipe, triple valve and brake cylinder?

A. The auxiliary reservoir holds a storage of compressed air for supplying the brake cylinder with pressure with which the brake piston is pushed out, engaging the system of levers which brings the brake shoes up against the wheels and supply braking power. The train pipe stores a quantity of compressed air which holds the triple valve in release position normally, but when the train pipe pressure is reduced, the triple valve will shift and apply the brake. The triple valve performs a three-fold function. When in release position, it permits a charge of pressure to pass from the train pipe into the auxiliary reservoir. In application position, it permits pressure to pass from the auxiliary reservoir into the brake cylinder. In release position, it permits pressure to discharge from the brake cylinder to the atmosphere. Thus air passes through the triple valve three times. The brake cylinder receives pressure from the auxiliary reservoir in service application, and from both train pipe and auxiliary reservoir in emergency application, which pushes out the piston and applies the brake.

4. Where does the pump deliver the air?

A. To the main reservoir on the engine.

5. Where does the main reservoir pressure begin and end?

A. It begins with the discharge valve of the air pump and ends at the rotary valve of the engineer's brake valve.

6. What is excess pressure?

A. That amount of pressure contained in the main reservoir higher than that in the train line, available for releasing brakes.

8. How should a brake be cut out?

A. By turning the stop cock in the branch, or cross-over pipe.

9. How should the handle of cut-out cock stand when closed?

A. Parallel with the pipe.

10. How should handle of the angle cock stand when closed?

A. At a right angle with the pipe.

11. What does line, or mark, at end of plug cock indicate, regardless of position of handle?

A. This line, or mark, indicates the direction of the passage way through the plug cock, and by it may be known whether the cock is open, regardless of the handle itself.

12. How should a brake be "bled" off?

A. The release valve should be sharply opened for an instant, then quickly closed. This operation may be repeated until the triple valve begins to discharge the air, which can be heard at the returning valve or exhaust port of the triple, then no further opening of this valve should be made.

13. When should the brake valve be used in the emergency position?

A. Only in extreme emergency cases to prevent accident, such as loss of life or property, then the handle should be placed in the emergency position and left there until the train stops or the danger of accident is over.

14. What does the red hand on the air gauge register?

A. Main reservoir pressure.

15. What does the black hand register?

A. The pressure above the equalizing piston and also that in what is called chamber D. This pressure may be properly classed with train line pressure.

Energy.

Energy is the capability of doing work. When this is in virtue of a position it is called potential energy, but when it arises from momentum it is called kinetic energy. Energy in action shows its relation to force and motion. Force is inseparable from matter. It is recognized in one form as gravity or attraction between masses. Left to itself, gravity would draw all matter together in a motionless mass. Energy is the capability of doing work, as muscular energy that overcomes the force of gravity and raises a weight. Heat energy overcomes the force of cohesion and separates the mass of molecules that form water, and converts them into steam. Electric energy overcomes the force of affinity and separates atom from atom as in the case of atoms of sodium from those of chlorine. Of the relation between potential and kinetic energy, one may be said to be the counterpart of the other. Taking coal, or gunpowder, or a coiled spring, these may be said to possess potential energy, and the effects of their action when heated or exploded or let loose may be properly called kinetic energy.

To Improve Your Memory.

Here is a good memory exercise. Glance into a shop window for one second only and then try to name all the things displayed in it. At first you will recall only two or three, but this number will rise to thirty with practice. Another good plan is to sit down at the end of the day's work, and think of all you have done since morning—where you have been, whom you have met, what you have spent, and so on. In time you will be able to recall exactly what you said and did at a certain hour, and the advantage of possessing this faculty is obvious. Incidentally, it will keep you from wasting your time, for it is not pleasant to remember that you did nothing at all. If your weakness lies in forgetting faces, make a mental note of such details as the color of the hair, the straightness of the nose, and the curves of the mouth.

A Political Machinist.

He was a political machinist who had worked long enough in a navy yard to make a kit of tools for himself. He was dressed like a broker's clerk, and carried a black walnut tool box. Like his tool box he was of good appearance and highly polished. His head, like the heads of his hammers, had seen little machine shop service; he also had a bad temper, was untruthful and unreliable. He was put to work and spoiled the best job, then he stole quietly away, himself and his tool box. He left behind the opinion that I was a rousing crank.

"Scientists have succeeded in compressing a square meal into a cake the size of a soda cracker."

"The world wants the price of a square meal compress into a disc the size of a quarter."—*Houston Post.*

Simple Atlantic Type for the Lehigh Valley

The Baldwin Locomotive Works have recently built five Atlantic type locomotives for the Lehigh Valley Railroad. These engines are designated as class F-3 on the road, and are the latest development of a type originally introduced in 1896, for handling the "Black Diamond Express." Although not exceptionally heavy for a locomotive having this wheel arrangement, they present a marked increase in capacity over the original engines, as the following table shows:

1896—Tractive force, 18,900 lbs.; cylinders, 19 x 26 ins.; drivers, 76 ins.; steam pressure, 180 lbs.; grate area, 63.9 sq. ft.; heating surface, 2,230 sq. ft.; weight on drivers, 81,800 lbs.; total weight, 140,940 lbs.

1911—Tractive force, 22,900 lbs.; cylinders, 20 x 26 ins.; drivers, 77 ins.; steam pressure, 200 lbs.; grate area, 76.9 sq. ft.; heating surface, 2,883 sq. ft.; weight on drivers, 107,250 lbs.; total weight, 184,650 lbs.

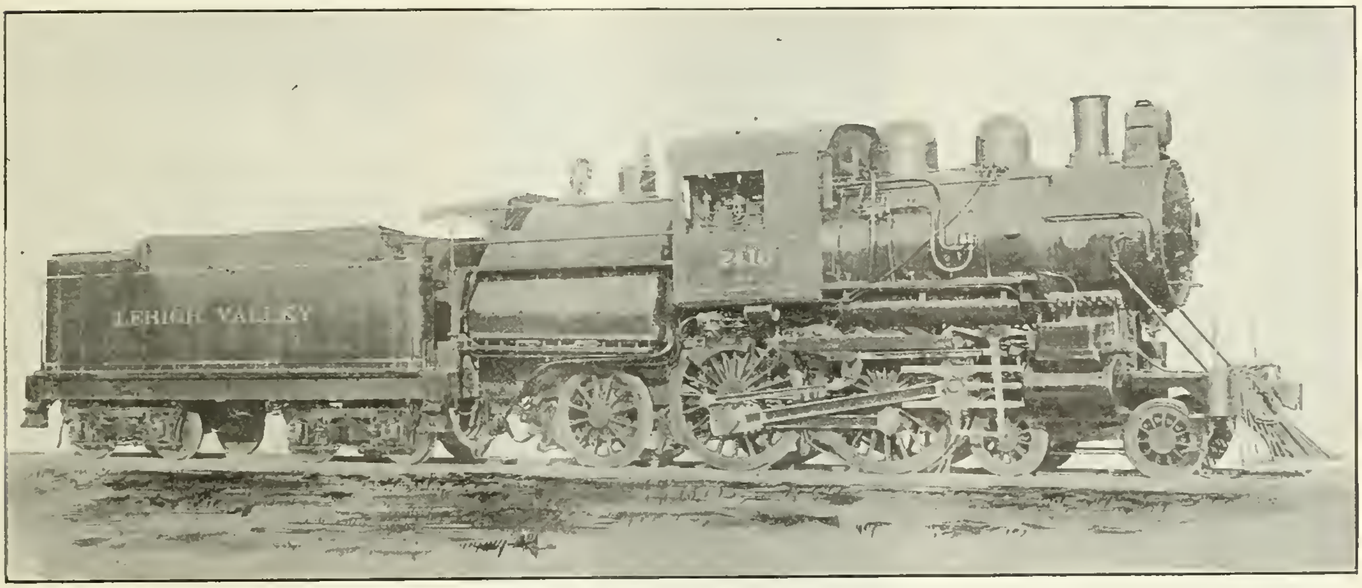
The longitudinal seams are butt-jointed, with diamond welt strips inside.

The arrangement of the front end is rather peculiar. The nozzle is double, of medium height, and the spark arrester, consisting of netting, is in the form of a cylinder, which is fastened at the top to the stack base, and at the bottom to the nozzle-stand. Two adjustable petticoat pipes are placed inside the spark arrester, and a fixed diaphragm plate is placed in front of the lower tubes. A cinder pocket is used with this arrangement.

The cylinders are lined with hard bushings, and the steam distribution is controlled by balanced slide valves, driven by Walschaerts motion. The valves have an outside lap of 1¼ ins. and

leaf springs on each side. One of these is placed under the firebox, in the rear of the trailers, which is an arrangement which should promote easy riding.

The tender is carried on equalized pedestal trucks, having cast steel transoms and steel-tired wheels. The frame is composed of 13-in. channels, with oak bumpers. The tank carries 7,000 gallons of water and 12 tons of coal; it is U-shaped in plan, and has a sloping bottom, so that the coal is shaken forward to the fireman. These engines are excellent representatives of anthracite-burning locomotives for fast passenger service. The design is of special interest, because of the success of similar locomotives previously used on the Lehigh Valley.



HARD COAL BURNING ATLANTIC FOR THE LEHIGH VALLEY RAILROAD.

F. N. Hibbits, Superintendent of Motive Power. *Baldwin Locomotive Works, Builders.*

It is thus seen that, for an increase in total weight of 31 per cent., the tractive force has been increased 21 per cent., the grate area 20.3 per cent. and the total heating surface 29.5 per cent. The new locomotives, in proportion to the tractive force developed, thus have a relatively larger heating surface than the original design, and the increase in heating surface is very nearly in proportion to the increase in total weight.

The new design uses a modified Wootten type of boiler, with straight firebox tube sheet and sloping back head. The mud ring is supported on vertical expansion plates at the front and back, and at one intermediate point. The grate is composed of longitudinal water-tubes and rocking bars. Firing is accomplished through two 16-in. doors, placed 42 ins. between centers, transversely. The boiler barrel is composed of three rings, and is straight topped. The second ring carries the dome, and is the smallest in the shell, as it laps inside the first and third rings.

an inside clearance of ⅛ in. and are set with a travel of 6 ins. and a lead of ¼ in. The link and reverse shaft bearings are combined, on each side, in a single casting, which is supported by longitudinal bearers, outside the leading drivers. These bearers are bolted, in front, to the guide yoke, and at the back to a cast steel frame brace, which is made in two sections, and spliced at the center. These sections are interchangeable. The guide yoke is also of cast steel, and is spliced like the frame-brace. It is bolted to vertical lugs cast on the frame, and the use of separate knees is thus avoided.

Castle nuts are used on all machinery pins and bolts, also on the waist sheet and furnace bearer sheet bolts, the guide yoke splice bolts, pedestal binder bolts, and the bolts in the equalizing work. The trailing wheels are rigid in this locomotive, but sufficient clearance is provided between rails and flanges to enable the engine to traverse 16-deg. curves. The spring rigging is arranged with four

The leading dimensions of the new engines are given in the table which follows:

Boiler—Type, Wootten, straight; material, steel; diameter, 66 ins.; thickness of sheets, ⅝ in.; working pressure, 200 lbs.; fuel, hard coal; staying, radial.

Firebox—Material, steel; length, 108 3/16 ins.; width, 102⅝ ins.; depth, front, 58¾ ins.; back, 54¼ ins.; thickness of sheets, sides, back and crown, 5/16 in.; tube, ½ in.

Water Space—Front, 4 ins.; sides and back, 3½ ins.

Tubes—Material, steel; thickness, No. 11 W. G.; number, 320; diameter, 2 ins.; length, 16 ft. 2⅞ ins.

Heating Surface—Firebox, 178 sq. ft.; tubes, 2,705 sq. ft.; total, 2,883 sq. ft.; grate area, 76.9 sq. ft.

Driving Wheels—Diameter, outside, 77 ins.; journals, 9 x 12 ins.

Engine Truck Wheels—Diameter, 36 ins.; journals, 5½ x 10½ ins.

Trailing Wheels—Diameter, 56 ins.; journals, 8 x 12 ins.

Wheel Base—Driving, 6 ft. 11 ins.; rigid, 13 ft. 7 ins.; total engine, 24 ft. 10 ins.; total engine and tender, 56 ft. 2⅝ ins.

Weight—On driving wheels, 107,250 lbs.; on truck, 42,200 lbs.; on trailing wheels, 35,200 lbs.; total engine, 184,650 lbs.; total engine and tender, about 320,000 lbs.

Tender—Wheels, diameter, 36 ins.; journals, 5½ x 10 ins.; tank capacity, 7,000 gals.; fuel capacity, 12 tons; service, passenger.

The Oxy-Acetylene Process and the Steel Car.

It is not so many years since the first steel freight car was built. Today it is the highest type of construction and is in general use on the leading railroads. The steel passenger coach is comparatively a novelty, although it is pretty evident that it has come to stay. The effort to make buildings alsolutely fireproof is to be assigned as the reason for the development of the steel window-frame, door-frame, and so on. Steel office furniture is also coming into vogue. Three principal problems have risen in connection with these developments: (1) the making of a strong joint, (2) making this joint invisible, and (3) the performance of the work by a method which would involve only the parts in the immediate neighborhood of the joint. The great strength of the riveted joint has made it a favorite in many locations on the steel car. But the riveted joint, even where the rivets are countersunk and the heads are filed or ground flush, is not an invisible one. Soldering is sometimes used in this connection, and at times with success. Soldering has also been used alone where strength was not required. There are, however, two objections to the soldered joint: (1) it is weak, having only about 40 or 45 per cent. of the strength of the metal united; and (2) it has a different co-efficient of expansion from that of steel.

The new process of welding by the oxy-acetylene flame seems to afford a very practical and economical solution. The joint has 80 or 85 per cent. of the strength of the steel; it can be made invisible and the effects of its application are local. The writer has recently had opportunity to investigate some applications of this process to steel car construction of the highest class. This work was being done for the passenger departments of certain leading railroads. The high standing of these roads is a guarantee of the class of work required.

On the coaches for the one road, the joints of the roof plates are being closed by the oxy-acetylene torch. On a standard car, the roof joints total about 232 lineal feet. The principal joints are transverse, extending clear across. At either end is a longitudinal joint several feet in length where the right and left hood plates meet. The metal of the roof is perhaps 1/16 or 3/32 in. thick. A difficulty that has been met in such work is a tendency of the plates to bend downwards and form a groove with the joint at the bottom. Such grooves may be a couple of inches deep. On these cars, this tendency is successfully dealt with by using a little T-bar. The edges of the plates are riveted to the arms of the T; the web lies immediately underneath the joint. The oxy-acetylene process is employed to effect a waterproof closure. Those familiar with the application of this method are aware of the relation between the size of the welding stick and the weight of the work in the immediate vicinity. The T-bar so increases the capacity for the absorption of heat that a wire, ⅛ in. thick is employed. The welding is done economically both as to labor and consumption of gas. Conditions differ on different parts of the roof. However, a flat rate of 4 cents per lineal foot is paid for the labor; the gas expense is estimated at about 1½ cents. The total for the entire roof is thus about $12.75. It is not necessary in butt welding such thin sheets to chamfer the edges. The roof plates are perhaps 7 ft. across. The T-bars have a metal thickness of ⅛ in., the arms are about 1 in. wide and the web about 1½ ins. deep.

Another example of welding on steel coaches relates to the joints of the panel frieze. This is a flat longitudinal panel with a molding above and below. There are three sections on one side of a car. The pieces are themselves straight, but the joints must be such that when in place the center is ⅜ in. above the level of the ends, which are perhaps 60 ft. apart. This arrangement is to provide for the effect of loading the car. With the load on, the frieze will be approximately level. When the load is removed it will spring back. It will readily be understood that such changes of conditions will severely test the joints. Formerly, soldering was employed. It was, however, quite expensive and not so satisfactory because of the weakness of the joint. The actual figures for soldering were probably excessive; the superintendent thinks, however, that it would reasonably cost $9 per car. By the oxy-acetylene process the work is being done for $4.50, ensuring better work. The plates here are 1/16 in. thick, and in making the weld, work is begun at a point distant one-third of the total width from the side which is to be uppermost when the frieze is in final position. Beginning at this point, this upper third is first welded. By beginning at the same point as before and welding the remaining two-thirds, this camber is eliminated and the correct one introduced. There are no supporting strips riveted to the frieze; the plates are held together by the weld alone. So perfectly is the joint made and the excess removed that it would probably require very close inspection to find the joints in the finished car.

STEEL TRAP DOOR FRAME FOR VESTIBULES OF STEEL COACHES, MITERED AND WELDED.

Another piece of interesting work in steel car construction relates to the mortised joints of door frames. It is very necessary that this shall be a perfect piece of work. It presents, however, no great difficulty where the oxy-acetylene process is used. While speaking of door-frames, attention may be called to an experience in connection with some door-headers. It was found in the case of five cars that the ten door-headers were each ⅜ in. too narrow. The old remedy would have been to tear out the frames, involving an expense estimated by the superintendent concerned, at $5 per door. A strip was successfully welded on, correcting the defect. The cost of welding and subsequent filing was estimated at 20 cents per door.

The diamond-shaped window frames used on some coaches under construction are made of 3/32-in. plate and have four mortised joints each. Oxy-acetylene welding is employed here. Again, similar joints in the rectangular deck frames of other cars being built are also welded by the same process. In a single car, there are upwards of 176 such joints, or about 30 lineal feet of welding. In certain construction the ventilator frames have a cast iron fitting which is attached interiorly to each upright. If a bolt and nut were used, uncertainty would ensue as to the solidity of the attachment. But with the oxy-acetylene welding process, the gray cast iron and the hot rolled plate are readily and firmly bound together.

In the last example, the oxy-acetylene welding process was used to secure the two pieces together. The process is also used, as has already been noted, to close the joint. Another example of welding in steel car construction as a finishing procedure is in connection with the grab handles. These consist each of three parts, a steel tube and two fittings. The fitting when in position has a vertical projection which is enveloped by the tube end. A counter-sunk pin is employed to hold the two firmly together. The welding process is used to efface the joint where the end of the tube contacts with the shoulder on the fitting. The labor cost of setting and welding these fittings is 1½ cents each or 3 cents for each grab handle.

An interesting piece of work is now being done in making a kind of support used on certain coaches. In these cars, the roof sheets and the steel headlining are about 1⅞ ins. distant, along the axis of the roof. There are ten chandeliers per car, so that the double covering of the car made of thin material would have to be strengthened at ten points. This is accomplished by inserting a box-like support in two sections in the space between head linings and roof at each position. Each of the twenty pieces is a rather complicated sheet metal form. The upper and lower bases are shaped somewhat like the letter C in Gothic type, only they are not precisely duplicates. These are joined by a strip connecting the convex sides of the C's. Formerly this entire plate was formed by pressing. There were, however, a large percentage of failures on account of radial cracks at the bends of the C's. Moreover, it required six operations on the press. At the present time, these pieces are formed each from three pieces of 3/32-in. sheeting through the oxy-acetylene process. The superintendent having charge of this work estimates that a saving of 50 per cent. has been accomplished by the change in method. There are practically no failures now.

In certain steel cars, there is a recess or alcove for the drinking water cooler. At the bottom of such an alcove a somewhat complicated depression is made for the reception of the glass. It seems to be practically impossible to form this bottom together with the depression out of one piece by the use of the press. The press is quite competent to form the depressed piece apart from the bottom of the alcove. The oxy-acetylene process comes in here and permits the pressed piece and the bottom to be united into a single piece. It may be added that the bottom is also welded to the vertical part of the alcove.

There are a number of such opportunities in steel car construction for the union of plate metal part to plate metal part to form an angle. Thus on one of the steel cars, the emergency tool case being a box-like form, is built up by welding. The ends and the connecting plate both are provided with flanges, and then are welded together. The welds are, however, not lap welds. The dust plates on the bolster of the motor truck of cars intended for use on an electrical section of a great railroad system are constructed with the aid of oxy-acetylene welding. These dust plates are quite complicated and perhaps 2 ft. long and 1½ ft. wide. They are made of galvanized iron, No. 12 sheeting.

Perhaps the most interesting piece of work in steel car construction is the welding together of sheets to form units of head lining. The units required are about 7 ft. square. The requirements of the highest class of steel passenger coach construction called for the use of patent level stock. Apparently this is the only steel sheeting that is absolutely flat. But patent level stock is not obtainable in sufficient width. By the use of the oxy-acetylene welding process two strips are so united, edge to edge, that a piece of the desired width is produced without destroying the required flatness. The stock used is quite thin, being about 1/16 in. thick, and no reinforcing strip is employed. It is a butt weld. In carrying out this operation, the two half-sheets are secured edge to edge on a suitable table by heavy bars properly clamped. The edges of the sheets are not prepared, but they are placed in contact on one side and perhaps ¾ in. apart on the other. The operator begins on the side where there is contact, using a No. 4 tip and 1/16-in. wire. At first the separation of the edges opposite tends to increase. But as the work advances they tend to move towards each other. Two or three times during the operation the clamps on the open side are loosened and the edges permitted to approach a little. As the operator works across the 82-in. seam, a buckle follows him. But this disappears as he finishes the weld. The ends of the lengths which have been joined may now not form a line that is quite straight. This is readily corrected, however, by trimming. The surface of the weld will not be smooth, and this is remedied by filing. The expense for the labor, including the filing, is 4 cents per lineal foot. The gas expense may be taken at 1½ cents, so that the weld costs, altogether, about 38.5 cents.

Such apparatus as are actually being used in the operations referred to in the foregoing account are manufactured by the Davis-Bournonville Co., 90 West street, New York City. Such apparatus are torches, and generators of oxygen and acetylene.

Lubricating Oils.

At a meeting of the New England Railroad Club held several years ago, General Miller, of the Galena-Signal Oil Company, read a paper on "Lubrication," with excited a very valuable discussion in which certain speakers insisted that thick valve oil would cool a hot journal better than the ordinary lubricating oil. General Miller held that the lubricating oil was more effective for that purpose than valve oil and gave the following reasons.

Cylinder oil is a pure petroleum product to which is added some animal fats. The engine oil is composed of whale oil, petroleum and lead. Friction is produced by the coming together of two parts, the pressure of two parts, the rapidity of motion of the two parts, the roughness and smoothness of the two surfaces coming together. Your hands become warm, quite warm, if you rub them, because of the uneven places that are in the hands. If you fill up these uneven places your hands will not get warm. Now engine oil is composed of lead. Why? First because it is indestructible, and it fills up the rough places in the bearing. If you will take that oil and put it in a lamp, you will prove two things: first, that it has lead; second, that it is by capillarity drawn up from the vessel and brought to the top of the wick, so that the oil is consumed, and the lead is found on the top of the wick in crystals to be seen by the naked eye just as clearly as are the ashes on a cigar. The lead filling up the uneven places will cool down a hot bearing quicker than the oil that has no lead in it.

The reason that valve oil is made thicker than engine oil is because in service it is used under a different condition. The steam entering the steam chest is very hot, therefore the moment the steam strikes the oil it forms a little film around the cover on the inside of the cylinder, which would not happen if the oil were mixed with lead. The oil must possess ability to spread itself on the heated surfaces.

When Crude Machines Were in Use.

Among the many difficulties that had to be overcome by the pioneer railroad mechanics of America was the scarcity of machine tools. New England shops were better provided with machine tools than any others. Yet as late as 1850 crank axles for locomotives were turned on a lathe that had a wooden bed. The driving wheel tires were bored on another lathe of similar construction, being fastened to the face plate by means of a wooden chuck with straps and bolts. Before being removed from the place where they were bored, the key ways were spliced with a tool fixed in a bar attached to the foot-stock spindle forced forward by a screw.

The hydrostatic wheel press did not come into use for many years later, and the wheels were forced on the axle by long bolts and nuts passing through heavy straps secured outside the wheels. If the force applied was not quite sufficient a few blows from a 50-pound sledge hammer helped to finish the job. The crank pins were driven into the wheels in a similar manner.

Metal Polish.

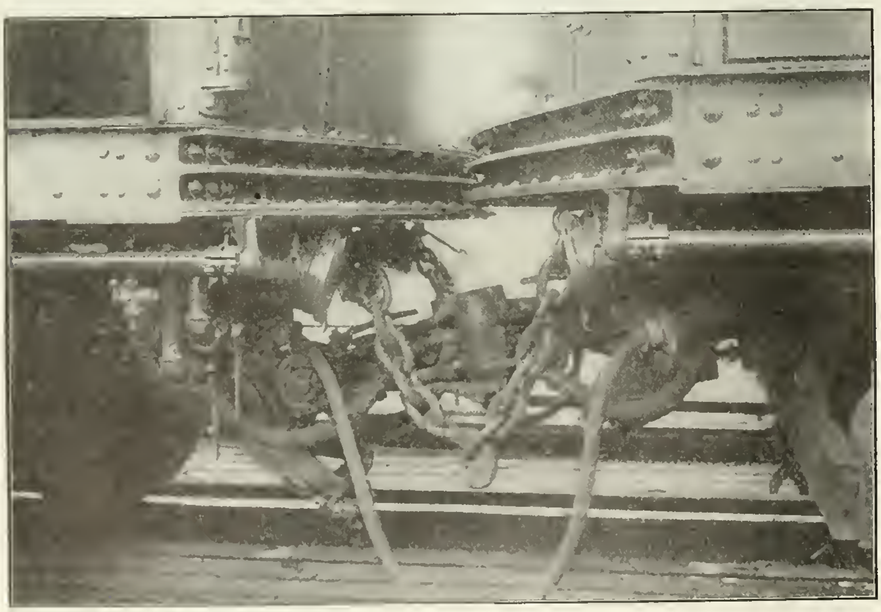
In a quart of gasoline mix eight ounces of whiting, taking care that the whiting is free from hard particles. Shake up the whiting thoroughly and add thirty-two drops of oleic acid. It will be observed that the whiting does not settle to the bottom of the receptacle but remains in solution. Apply to any kind of metallic surface with a piece of cotton flannel, rubbing well. Polish with a piece of the same cloth perfectly dry.

Coments on The Willesden Accident.

The finding of the British Board of Trade on the cause of the accident on the London and North Western Railway has been made public. The blame rests upon the signal man who permitted one train to enter Willesden station while another train was at the platform. A collision with serious loss of life was the result.

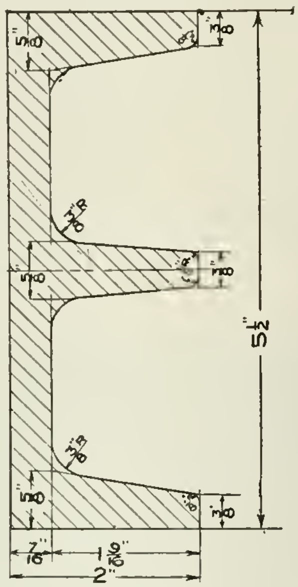
Col. H. A. Yorke, who conducted the investigation, as quoted in *Engineering*, has made several interesting comments on various phases of the disaster. He says, when considering the oft-repeated assertion, that two men are better than one in an important signal box; that on this occasion there were two men in the box, and that "it is by no means improbable that the division of responsibility between the two men was in some way or other the cause of the accident."

He points out that an effective track circuit could be arranged in connection with the signal box near the station and the next, so that with a train between the two, the home signal, which permits a train to advance to the platform, could not be lowered. It has been noticed that the Mansell wheels used under passenger cars in Great Britain, do not offer very good connections for the passage of a track current, and it has been found necessary to bond these wheels from the tire to the axle in order to get a good circuit. The London and North Western are proceeding with this work as speedily as possible. Col. Yorke further remarks that various appliances might be used which would mitigate the serious results of similar accidents, and he refers to the Hedley platform buffer which is used on the Metropolitan District Railway in London. This is one of the original "underground" steam railways of the British metropolis, which has since been electrified.



HEDLEY ANTI-COLLISION BUFFERS ENGAGED.

Some of our readers may not be aware of the fact that the buffer to which Col. Yorke refers is an invention patented in England and the United States by Mr. Frank Hedley, vice-president and general manager of the Interborough Rapid Transit Company of New York.



SECTION OF THE ANTI-COLLISION BUFFER.

Our half-tone illustration shows this platform bumper, or as it is more aptly called, the anti-telescoping and anti-climbing device, as it appeared after a very serious collision had taken place in the New York Subway. On that occasion, the cars, crowded with passengers, came together at a speed of from 12 to 15 miles an hour. There were no serious injuries to persons, beyond that occasioned by a very severe shaking up. The trains weighed about 325 tons each, and although only one was moving at the time of impact, the damage and loss of life would probably have been very heavy if this device had not effectually prevented that most horrible form of disaster—telescoping.

The official report of the subway accident contained several photographs, one of which we have reproduced. It shows the devices interlocked as they actually were at the time of collision. The report says the Forsyth draft gear and Westinghouse automatic car and air coupler, which are also shown in this photograph, as having acted as they were intended to act, and became detached from the car supports, thus allowing the proper engagement of the anti-climbing devices. This anti-climbing device is an integral part of the car structure, and when it is considered that the combination of car sills and anti-climbing device forms a portion of a steel arch, the most formidable design possible to obtain, where strength is the great requisite, some appreciation may be had of the force of the shock which was absorbed by the friction draft gear and car structures. The radius or rounded end of the car platform was crushed in a distance of 4 ins. in the center. The whole work of arresting the movement of the train was concentrated upon a very limited area, and the effectiveness of the Hedley device is thus clearly demonstrated.

Our line illustration shows the section as used on the Interborough. It is made of rolled steel and weighs 16½ lbs. to the foot. It can be bent to suit any form of end sill and is furnished in mill lengths by the Whipple Supply Co. of New York.

Ignoring Things Mechanical.

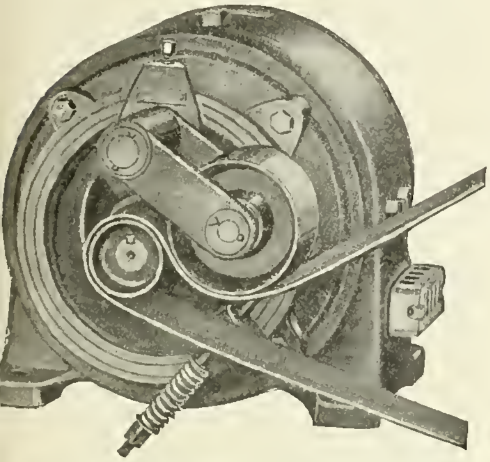
Modern writers on industrial subjects frequently complain because the ancient philosophers considered themselves too refined and elevated to describe the engineering and mechanical operations of their day, but modern collectors of industrial information are by no means above reproach. Intellectual snobbery is as rampant today as it ever was, and the man who has bettered the world through mechanical inventions and achievements receives small praise compared with the man who has attracted attention through the use of his jaws.

Even in our most modern encyclopedias inventors and promoters of the mechanic arts are placed second to a lawyer whose voice advocated questionable measures or of the preacher who published some of the sermons that lulled his hearers to comfortable repose. The word "tool" is not found in the Encyclopedia Britannica nor in Americana, a work that claims a specialty of mechanics and engineering.

General Electric Commutating Pole Motor.

The severe service that electric motors are called upon to perform in many industrial power applications, and the consequent necessity for reliability and efficient all-day operation, requires the use of machines possessing exceptionally good commutation, overloading and non-heating characteristics, combined with great mechanical ruggedness. The type "CVC" commutating pole motor just brought out by the General Electric Company of Schenectady has been specifically designed to meet such requirements.

The "reason for being" of commutating pole design may be readily understood if



C. V. C. MOTOR WITH BELT TIGHTENER.

it be remembered that sparking under the brush of a non-commutating pole D. C. machine is almost wholly due to the absence of a magnetic field, automatic in action and of sufficient intensity to reverse the armature coils successively short-circuited as corresponding segments pass under the brushes.

The commutating poles of "CVC" motors are connected in series one with another, and also with the armature; their magnetizing power is, therefore, in proportion to the armature current, and may consequently be employed to compensate for armature reaction, allowing sparkless commutation over wide ranges of load and under adverse conditions of operation. In addition to this, commutating pole motors allow a wider range of speed control by field than is permitted with motors of non-commutating pole design.

Due to freedom from sparking, the heating of the commutator and brushes is reduced, minimizing attention and repairs, and thus increasing the life of these parts. Internal ventilation is secured by a very simple, rigid and durable form of fan mounted on the armature shaft within the pulley and bearing head. This fan, while consuming a negligible amount of energy, insures cool operation under very severe conditions of temperature and load. Internal ventilation has been advantageously applied to transformers, motor generator sets, etc., for a number of years.

The main field coils are wound on strong horn fiber spools, amply insulated with pressboard, mica, varnished cambric, etc., to insure freedom from breakdown under possible excess potential strains. The windings are rendered moisture-proof by thorough impregnation with a special insulating compound. Before final assembly the coils are armour-wound with a single layer of enamel-covered wire, serving the double purpose of protecting the active windings from mechanical injury and assisting to a higher degree of heat radiation. The commutating poles are wound with rectangular copper wire, the coils being assembled on horn fiber spools, which thoroughly insulate the coils from the pole pieces.

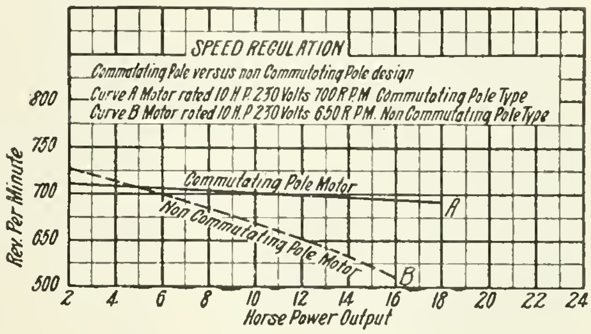
The commutator bars are insulated from one another and from the commutator shell by selected sheet mica, micrometer gauged to a uniform thickness and of proper hardness to wear down evenly with the copper. The outer corners of the segments are rounded to prevent chipping of the mica, and the inner edges are notched out to prevent short-circuiting between the bars. There are small grooves in both the flat sides of the copper segments which serve, when the commutator is hydraulically pressed in its assembly ring, to firmly anchor the mica insulating segments, thus avoiding the possibility of high mica.

All bearing brackets and frames are drilled and tapped symmetrically so that motors may be readily arranged for side-wall or ceiling suspension by turning the bearing heads 90 or 180 degs., respectively, with relation to the frame. Many other important improvements in minor electrical and mechanical details of design and construction ensure for the completed "CVC" motor the possession of exceptionally desirable mechanical and electrical characteristics.

In the twenty-three years that elapsed between 1883 and 1906 the charge per ton for freight rates in the United States has been reduced from 12.2 mills to 7.7 mills, a reduction of 37 per cent. This is a good indication of how things move.

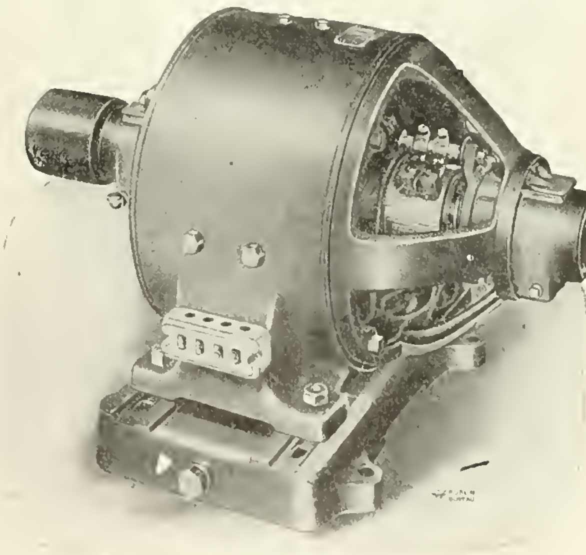
Discovery of Blotting Paper.

The discovery of the blotting paper was due to the observing habit that has brought fame and fortune to people who had the faculty of seeing things and reasoning about them. Blotting paper was



SPEED CURVE OF C. V. C. MOTOR.

discovered through the blunder of a workman in a paper mill who forgot to put in the sizing material. The whole of the paper made in the batch was regarded as being useless. The proprietor of the mill desired to write a note shortly afterwards, and he took a piece of waste paper, thinking it was good enough for the purpose. To his intense annoyance the ink spread all over the paper. Suddenly there flashed over his mind the thought that this paper would do instead of sand for drying ink, and he had at once advertised his waste-paper as "blotting." There was such a big demand that the mill ceased to make



G. E. COMMUTATING POLE MOTOR C. V. C.

ordinary paper, and was soon occupied in making blotting only, the use of which spread to all countries.

According to the report of the United States Bureau of Labor in 1908 between 30,000 to 35,000 adult laborers were killed in following various occupations. The now fatal injuries were supposed to reach a total of 2,000,000 persons.

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The Statical Moment.

The mere fact that you can add certain things together, or rather that you can add the numbers representing them together takes it for granted that the things added are similar. You can add up the numbers representing the sets of chairs in each room of a house and thus ascertain the total number of chairs there is in the house. You cannot add chairs and tables together unless you can find some way of bringing them all in to some form of classification which will make them alike. If you have three tables and five chairs, they remain respectively tables and chairs, and the figure eight (the sum of three and five) has nothing to do with the chairs and tables.

If, however, you call tables and chairs articles of furniture, and thus bring them as it were to a common denominator, then it is possible to add them together and say you have eight articles. In performing the other arithmetical operations the same idea of homogeneity exists, you cannot subtract unlike things one from another, nor can you multiply or divide unlike things. There may just here appear to be a fallacy, when you come to dividing unlike things someone will say "you can divide fifty apples by ten boys and each will get five apples." You certainly could distribute fifty apples among ten boys so that each would have the same number and be quite a liberal allowance at that, but from the arithmetical point of view you have divided fifty apples into tens and found that you had five such groups.

Now the point we come to next is the statical moment or the moment of a force about a point. It has been defined as "the product of the force by the perpendicular distance from the point to the direction of the force. The fixed point is called the center of moments; the perpendicular distance is the lever-arm of the force; and the moment itself measures the tendency of the force to produce rotation about the center of moments." Here it looks as if we had transgressed the idea of homogeneity, which we mentioned above. The force in pounds or ounces has been multiplied by a distance in feet or inches. The objection would have been well taken if we had attempted to multiply ounces by inches. We have, however, multiplied the number of pounds representing a force, say fifty pounds, by a number representing a distance, say ten feet. The product is not five hundred foot-pounds as it would be if it was the measure of energy or work. It is the moment of the force. This is an arbitrary but useful name. Here 500 is simply the moment of a force acting at right angles to the line ten feet long, which joins its direction to the point or center of moment.

Next comes the practical use to be made of the moment of a force about a point, or the statical moment, when we know what it is and how to find it. As an example of this, here is an ordinary crow bar or pinch bar, say 5 ft. long from end of handle to heel, and the point is 3 ins. from the heel. How can we compute the amount of power which should be applied at the end of the handle to support a weight of 100 lbs. on the point of the bar? This can be worked out after one ascertains that moment of the force called the power about the point at the heel of the bar must equal the moment of the force called the resistance about the point at the heel. In this case the moment of a force of 100 lbs. at 3 ins. distance is 300, and the distance 5 ft. when reduced to inches is 60 or twenty times the distance from heel to point. The force whose moment at 60 ins. would equal 300 is manifestly 5 lbs. This force at the handle end of the pinch bar exactly balances the force of 100 lbs. at a distance of 3 ins. from the fulcrum, and the equality of moments in each end assures the bar being in equilibrium.

Applying the Stitch in Time.

A stitch in time saves nine is a sensible old proverb which conveys a wise lesson of experience that gives more profitable returns than most of the novel methods that are urged so fluently by the new apostles of industrial progress. We know of no practice which produces so satisfactory results in preventing failures of machinery as persistently applying the stitch in time. This is particularly true in regard to railway rolling stock, more especially with the prevention of failure of locomotives.

From the first day that a locomotive is put to work deterioration begins and some parts wear so rapidly that failure on the road soon arrives unless the stitch of repairing is regularly applied in time. Every man who has acquired experience in running locomotives is aware that many of the mishaps on the road charged as engine failures arose from trifling defects that a little attention in the round house would have obviated.

What is really needed in applying the stitch in time is to apply it systematically. This has been done by the Mechanical Department of the Erie Railroad with the result that engine failures on the road are becoming very rare.

When an engine goes in to have the boiler washed out the broken stay bolts or other foreign matter is carefully removed from the leg of the boiler. The steam gauge is removed, tested and inspected. Gauge cocks are removed, ground in and re-applied. Pops are set; water glass heads removed and overhauled. All globe valves in cab repacked. The throttle packed; all steam leaks stopped; cylinder heads inspected carefully; side rods and main rods white leaded and inspected for defects; tanks cleaned out; tank valves examined and repaired where necessary; where soft plugs are used they are taken out and new metal applied; stay bolts tested and renewed where broken; union on air pipe exhaust in front end inspected; flues blown out and worked over; grates given thorough inspection; grate frame studs inspected; drawbars and pins examined; water valves in cylinder heads inspected.

That represents considerable work, but no reform that has ever been tried that pays better.

Increasing Speed of Production.

American mechanics have always been celebrated for performing more work than the artisans of any other country. The high wages prevailing encouraged employers to take the lead in devising labor saving machinery and the habit developed among workmen of doing their best to compete with machines or to turn out so much work that the introduction of labor saving machinery was unnecessary. The result has been that although the wages of our mechanics have ruled high, finished parts are produced more cheaply here than they have been in any other country.

There is a shop sentiment in foreign countries that calls for a fair day's work for a fair day's pay, but the practice so common in America of urging the workman to hurry with their jobs is practically unknown out of the United States. When the writer first went to work in an American machine shop, he was put upon a job which called for chipping and filing. He went to work with the idea of doing a good job, working steadily, but with no idea of hurrying. When he had been at work about two days the foreman, a Scot more by token, came round and said, "Are you not yet done with that job? You are working too slowly, remember you are not in Scotland now." The comment was a great shock, for he had never before heard of a mechanic being told that he worked too slowly when there was no appearance of wasting time. Before long he discovered that the striking difference between a British and an American machine shop was, that in the former good work was the first demand while in America it was expedition—get the job done quickly.

The spirit of constant hurrying, the increasing demand for greater output demoralizes the workman and confers no substantial benefit upon the employer. The American workshop method is a form of competition that tyrannizes over those who are doing the work and forces the manufacturers to offer their products at depressingly lower prices, a demoralizing practice without fairness, a practice akin to murderous warfare.

Some years ago a certain class of industrial critical agitators made the discovery that machine tools might be worked up to much greater performance than most of them had been doing. Everything possible was then done to work the machines up to their utmost capacity, but still the rushers were not satisfied. When a machine was forced to its limit the discovery was made that the cutting tools heated so quickly that the forcing was of no avail. Then high speed steel was invented, so that iron was sliced off like pieces of cheese, but still the speeders were not satisfied.

The next point that called for attention was the workman. The reformers discovered that ordinary workmen made some movements in doing work that did not count for efficiency. Bricklayers executed lost motions that prevented the bricklaying art from reaching its highest possible efficiency and the bricklayers were taught to reform their ways. This resulted in increasing the performance of the bricklayer from ten to twenty-five per cent. Consequently the cost of building houses was reduced, but it had no effect in cheapening rent. It brought profit to someone, however, but did nothing that could be identified for the community at large or for the individual who bore the burden of speeding.

Of late the cheapeners have been devoting their attention to nearly all trades: to blacksmithing, machinists, carpenters and other workers who display very little gratitude to the reformers who are striving so zealously to make every workman strike two blows where one and a half had been struck before. Workmen as a rule are not taking kindly to the high speed system which puts oppressive toil upon the strongest men and under which the weak collapse.

In our opinion this high speed system of production represents the worst phases of tyranny ever introduced among civilized people and it is done under pretence of being a benevolent movement. Since machinery has done so much to accelerate and cheapen production, the people at large ought to reap the benefit in shorter hours of labor and in surcease of heavy toil, but the cheapening process produces the opposite result. The proportion of capable workers employed in the world at large is now so small that there is a chronic margin of people seeking employment. Civilization and the behests of popular liberty are supposed to be working for the greatest good of the greatest number; but the working of the high speed system tends to pauperize a large proportion of every industrial community, while treating those employed with heartless severity. It would be a sad day for humanity should the fake reformers of labor processes succeed in their scheme of keeping every worker constantly keyed up to the maximum performance possible to mental and physical endurance. Enjoying labor has redeemed people from the curse of weariness. The enjoyment of labor has moved mankind to the stupendous performances that have turned wildernesses into gardens, and have wrenched from the bowels of the earth the metals and minerals which have done so much to promote popular comfort and happiness. To take away the enjoyment of labor and to put the workers in the position of dumb driven cattle, is the purpose of the speed advocates. They propose substituting a curse for a blessing.

Lubricants and Lubrication.

Railroad officials are as enterprising and progressive as the average business man, but they have always been extremely conservative in making changes that might interfere with the efficiency of the motive power and things that have proved decided improvements have been adopted only by persistent advocacy of manufacturers and of patentees. The introduction of improvements in lubrication have been a good illustration of this spirit.

In a paper read by Mr. O. H. Taylor at the Central Railroad Club, the following statement appears:

"It is within the memory of many who are in active service today, when vegetable and animal oils were the sole lubricants for valves and cylinders. The introduction of a mineral cylinder oil in 1870 met with derision by some, scepticism by many, and it was received in confidence by but few. It was of such superior merit that long before its general introduction a railroad master machanic made the statement in convention, that since its adoption as a substitute for tallow, the gain in power permitted the addition of one car to each train, it would have seemed an easy matter to induce the user of tallow to leave it for something better, but the change came about only through the persistent efforts of the manufacturer, and this statement applies to every user of steam, as well as to the railroads.

"The evolution of the locomotive has carried with it the progress from the earlier method of delivering the lubricants through the medium of a plug cup, located on top of the steam chest, to the more convenient location in the cab. The automatic displacement cup, located on top of the chest, has been superseded by the hydrostatic or mechanically operated lubricators, but it seems that because, in the infancy of the locomotive, from the top of the steam chest was the logical place to admit the lubricant, precedent rules that the old custom shall prevail, and at present, on a large percentage of the locomotives in this country, the oil for valve and cylinder lubrication is delivered direct to the steam chest or valve chamber.

"With the increase in steam pressure came the locomotive of increased valve and cylinder dimensions, and a revolution in train service. Runs scheduled at higher speeds for long-continued distances without closing of throttle. A new problem was presented. Precedent offered no solution. The revival of an old question, familiar to those who have seen the transition from tallow to mineral oil, the adaptability of the oil for the service, became a subject of discussion and 'flash point' was freely handled by many who have never given it thought before. The lubricator and the oil manufacturers were placed on the defensive. In the minds of many there must be a different device for delivering the oil and a better oil. The manufacturers of the hydrostatic feed lubricator, without any deviation from the principle upon which that device is operated, promptly met the requirements by changes in construction, strengthening and increasing areas. In the vernacular of the day, the manufacturers of the oil, 'stood pat.'

"Through all the changes incident to the growth, from the 20-ton locomotives of years ago, to the mammoths of the present, through all the gradations of temperature, as steam pressures have increased from 120 to 230 pounds, and the higher temperatures incident to superheating steam, the oil has stood the test. It has been stated that with the lubricant properly introduced and distributed with the steam the pressure and temperature of the steam are factors worthy of but little consideration. The best authorities are agreed that the ideal method of lubricating steam surfaces is by having the oil introduced in a highly attenuated form and thoroughly intermingled with the steam, the steam becoming lubricated."

Acquiring Scientific Education.

To be of full benefit to its recipients education ought to be readily applicable to the business in which a person is engaged. What is known as the "higher education," is notorious for failing to confer practical benefit upon those who have labored for years in its acquirement. The time devoted in schools to the study of science is very often wasted because the graduates fail to reach fields where their knowledge can be readily applied to practical purposes. Knowledge of the principles underlying nearly all mechanic arts facilitates production and tends toward excellence of finish; but it is only in rare instances that science reinforces manipulative skill.

In spite of all that has been said and written about the failure of the apprentice system, it remains a fact that persons who have acquired skill in the various trades are today performing the labor that produces all the finished products of our shops and factories. Among the schemes recommended for supplying substitutes for apprentices, were trade schools where pupils would be trained in both the science and the manipulative parts of every trade. That plan has not turned out to be entirely satisfactory and many industrial concerns are again cultivating apprentice systems and making arrangements to give their apprentices the benefit of scientific instruction. Railroad companies are taking the lead in the educating of apprentices, thus performing services to the country that deserves the most cordial praise. The Erie Railroad Company, for instance, is maintaining apprentice schools at six of their repair shops where the apprentices are given free instruction during working hours. The subjects taught are arithmetic, mensuration, drawing and all branches that give information likely to be useful to officials in the mechanical department. This plan of instruction has been in use long enough to provide men for filling the position of machine shop or of boiler shop foremen.

The writer recently made a tour of inspection of these apprentice schools and was surprised at the manifestations of progress made by the young men attending the classes. This was particularly apparent in the drawings made, some of them having been so skilfully executed that the authors were recommended for positions in the drawing offices. The instruction given in these apprentice schools calls for considerable private study which has been cordially given by most of the pupils. When the course they are following is completed, these young mechanics are in the very best position for promotion to positions of trust and responsibility in the mechanical world. One fly in the ointment is, that the graduates of the Erie apprentice schools, and indeed of every railroad school, are a little too ready to fall before the temptation thrown out by other companies, that have not displayed the enterprise of maintaining apprentice schools, but appreciate the value of the graduates.

The young men who are receiving the education conferred in the apprentice schools are fortunate in their generation far beyond the privileges denied to ambitious young men of earlier days. The writer cannot help envying the good fortune of these apprentices when he recalls the depressing struggles he endured in trying to acquire the engineering knowledge that they obtain with every difficulty cleared away by efficient instructors. The mind of the writer reaches back to the time when he was an apprentice imbued with the ambition to acquire engineering knowledge. He remembers canvassing the shops to induce other apprentices to join in an evening class for the purpose of mutual instruction. He remembers that all who would promise to join in the scheme of self-help was two and that one of those failed to appear on the night when work was to begin. The other did not return after the first evening and we were left to pursue the rocky road of self-help alone. Burning the night lamp in pursuit of knowledge is illuminated by a halo of romance; but the actual experience is a heart straining ordeal that might make angels weep.

Coal Briquets.

The use of briquets made from inferior coal and other combustibles is growing in popularity. The government investigations and experiments concerning the efficiency and heat value of briquets shows that with mine-run bituminous lump coal the thermal heat units were 12,155, with briquettes made from the same coal the units increased to 16,969. The unit B. T. U. meaning the amount of heat required to raise the temperature of one pound of water from 39 to 40 degs. Fahrenheit. Coal from Oklahoma gave a boiler efficiency of 59 per cent. Briquets from the same coal increased it to 67 per cent. A sample of Iowa coal tested at the state college at Ames showed 12,600 British thermal units which puts Iowa coal high in the scale.

The average cost of manufcturing briquets per ton from bituminous coal in the western states, exclusive of the binder and coal used, has been fixed at 40 to 60 cents per ton.

There are now in operation nearly one hundred plants for making briquets with a capacity of one hundred to two hundred tons per day each, for commercial purposes. Indianapolis has one, the output of which is about 3,000 tons annually, which is consumed in that city. One in Del Ray, Mich., turns out one hundred and fifty tons per day, utilized for domestic fuel in Detroit. Kansas City has two plants.

Mr. Edward W. Parker, chief of the division of geological survey, says the experimental stage respecting briquet fuel has passed, and the manufacturing industry is established. H. M. Wilson, chief engineer of the survey, estimates, as the result of exhaustive tests, that 8 per cent. of the coal used in the production of heat, power and light, goes up the chimney in smoke, a dead waste, a loss and damage in the United States of $500,000,000 per year, detrimental to the public health, great disfigurement of buildings in a city, which can be eliminated almost completely by proper stoking and construction of fireboxes, for which numerous plans are in successful operation.

Heterophemy.

This word heterophemy which stands as the caption for this article is, of course, a Greek compound. It means the saying or writing of something different from that which was intended. The actual components may be mentioned for the sake of those of our readers who like to go down to the very root of things. The word *heteros* means another or different and *phemi* to say, or now-a-days to write, and so understand. It was perhaps fifteen years ago that the managing editor of this paper first came across this word in one of the two remarkable works of the late Thomas Jay Hudson, of Washington. In the sense in which he used it he implied that a train dispatcher might write or telegraph a certain name, like Highburgh, as the meeting point for two trains, but at the same time be convinced in his mind that he had ordered the meeting at Padroville, and strangely enough the dissimilarity of the written words would in no way disturb the mental conception of what had been done.

In the April issue of the *Locomotive Firemen and Enginemen's Magazine* Mr. W. W. Wood, the air brake instructor for the Monon, has contributed a most thoughtful and well reasoned article on "Taking Things for Granted." In this article Mr. Wood really defines heterophemy or the cause of it, though he does not use the word, by pointing out what Dr. Hudson insisted on in his works in 1896, that the law of suggestion is one of the most powerful and one of the persistent agents in directing a course of conduct that can be found anywhere on earth.

We have called men Chancetakers in these columns who were reckless enough to believe they could disregard a warning because later on the situation they thought or believed or hoped would change. The law of suggestion or of auto-suggestion may have operated in their case and made them almost automatic Chancetakers, but the cause does not ameliorate the result and it never can. Mr. Wood gives a thoroughly practical every day case which happened on a well-managed railway and his recital of the facts may well give us pause. The dispatcher fixed a crossing at Farm Siding. The head brakesman got that much, went off and told the fireman. The order was changed to Nelson before the train started and the conductor and engineer understood exactly what they had to do. On the engine the injector refused to work and the engineer tinkered at it, while he absorbed, unwittingly, the fragments of a conversation about what they would all do at Farm Siding, and did he "forgot his orders," or was he hypnotized or mesmerized? Nothing of the kind. He was the victim of the terrifically potent power of suggestion, and the moment the conductor put on the air at Nelson the engineer realized where he was, stopped, flagged the opposing train and saved an accident.

It has been proved before now that a perfectly well man can be driven home and to bed by the concerted action of perhaps twenty-five or thirty men each one repeating some such formula as, "I say, old man, what's the matter with you? You don't look well! Go home and rest up for a day or so." There is nothing the matter with this man, until he *thinks* he is sick.

Mr. Wood's able article has pointed out a very real danger to the safe operation of railways which can be called taking things for granted, but which really is the surrender of the mind to the suggestion of another.

Those of the railway world, the outside workers in the rain who do things of importance, who run trains, obey orders, watch signals, to whom time is counted out in minutes, whose straight reading of an order and the clear understanding of the same means more than the President's message to the few people who trust them with their lives. These are the men who have to look at this law of suggestion in the face and know its force as they know the pressure of steam.

A duty is here very clearly indicated. We know that the law of suggestion operates in every phase of human life. We cannot deny that. It operates with the greatest power, and we can grasp it as our friend and resolutely tune our minds to the respond to the word "safety." We can refuse every hearsay word and insist on the "show me" when told, ordered, or addressed. The so-called "safety-button" of the Santa Fe is simply the suggestion of safe working constantly made in a sort of automatic way by every employe to every other employe and even if Mr. J. D. M. Hamilton, the claims agent at Topeka, knew or did not know the significance of his proposal when he made it to the management of his road, he nevertheless put his fingers on the push button which has never yet failed to cause the flow of a strongly dynamic current that has influenced human action since the days when the earth was young.

Our duty in view of these facts is to go about our work on the road imbued and impressed with the suggestion that safety is the object to be attained. That we will work for that end, that we will read our orders and understand English words as they are intended to be understood and that whatever suggestion we can make by our cool, commonsense, manly, straightforward, rational conduct on the road will be in the direction of compelling others to work for safe operation now and always.

A Simple Separator.

The use of separators for extracting water of condensation from steam supplied to a steam engine, has met with considerable opposition from engineers, who claim that the separators break up the water into particles, which become entrained with the steam and pass into the cylinder. Claims are made that the piping can be put up in such a way that the steam may be made to free itself of the entrained water. The plan is to extend the steam pipe at a curving point a short distance in the original direction, the additional part being closed at the bottom, its purpose being to act as a receptacle for any water that might collect. When particles of water come mixed with the steam they would continue on a straight line to the reservoir. The more elastic steam would turn the corner, but the heavier water would not, and thus would be separated from the steam.

Book Notice

LOCOMOTIVE BREAKDOWNS AND THEIR REMEDIES, by George L. Fowler, revised by William W. Wood. Fully illustrated, 270 pages. Published by the Norman W. Henley Publishing Company, New York, Price $1.00.

This is a useful book in pocket edition size which has now been brought up to date by the author and has been revised by Mr. W. W. Wood, the airbrake instructor on the Chicago, Indianapolis & Louisville Railway. This book treats of all possible engine trouble, and presents the remedy, in the form of question and answer. Walschaerts locomotive valve gear troubles are treated in detail, while the electric headlight is included, and the defects and troubles of the engine, dynamo and lamp are given. One of the good things in the book is the part on the airbrake. This chapter has been entirely rewritten, and is the result of long and careful study in selection, guided by years of experience. It tells how to avoid mistakes and guard against, as well as remedy, troubles of the improved engine and tender brake equipment.

Destructive Power of Lightening.

The question was asked in the London *Spectator* last June whether it was worth while for a householder to protect his building with lightning-conductors. The *Spectator* replied that Mr. Alfred Hands, in a little book just published by J. W. Gray & Son, London, entitled, "Lightening and the Churches," gives a very good answer to the question.

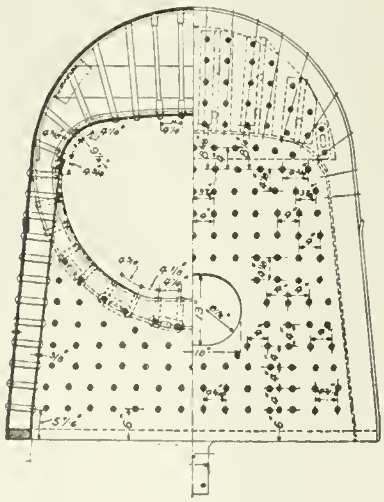
He has collected into some ninety pages a large number of instances of the effect of lightning, and without trying to fit the facts to his theories he manages to make out a case worth careful study, both from the scientific point of view and that of the mere calculator of pounds, shillings and pence. The damage done by lightning, in England and Wales, as regards which countries Mr. Hands has occupied himself in collecting information, is probably more extensive than most people would believe. He has compiled a chart showing the places known to have been struck in the years 1897 and 1908, and on the chart 7,793 different spots are marked, to indicate damage done to 211 cathedrals, churches and chapels; 3,190 other buildings of various kinds; 226 ricks and stacks; 1,251 trees, and 398 other objects; while 194 persons have been killed and 1,016 injured, and there have been 1,307 cases in which animals have been killed, these being either single creatures or several killed by one stroke. There have been as many as 49 sheep struck dead in a single flock. The monetary loss is estimated at £50,000 to £100,000 per annum.

Locomotive Running Repairs

XVI.—Firebox Repairs.

While there are over fifty different types of locomotives running on the world's railways, their boilers have nearly all the same general features. The chief variations are in the form and structure of the firebox. This box is the heart from whence the power-giving movement of the locomotive comes. Its form may be flat or round-topped, narrow or wide-based, but the general principle is the same.

Coming to the problem of the careful use and repairs to locomotive fireboxes it may be truthfully said that while no part of the locomotive gives so much trouble as the boiler, by far the largest amount of these troubles are due to the firebox. The avoiding of these troubles, or overcoming them demands more time and attention than any other part of the machine does. This is not to be wondered at when we consider the forces that are operating towards the destruction of the firebox when in use, taking a first class passenger locomotive as an illustration. If the heating surface of the firebox amounts to 200 sq. ft. with a steam pressure of 200 lbs. per sq. in., there is no less than 2,880 tons pressure upon the sides and top of the firebox. If to this we add the variations in temperature tending to alter the crystallization of the metal, the difference in the expansion of the outer and inner sheets of the boiler, the impurities inseparable from all kinds of water, the destructive action of the intense heat on rivet heads and the projecting ends of flues, the sand blast action of the fine particles of coal, and the tendency of staybolts to fracture by reason of the unequal expansion of the boiler sheets, it will be seen that the causes of much trouble and rapid decay are not far to seek.

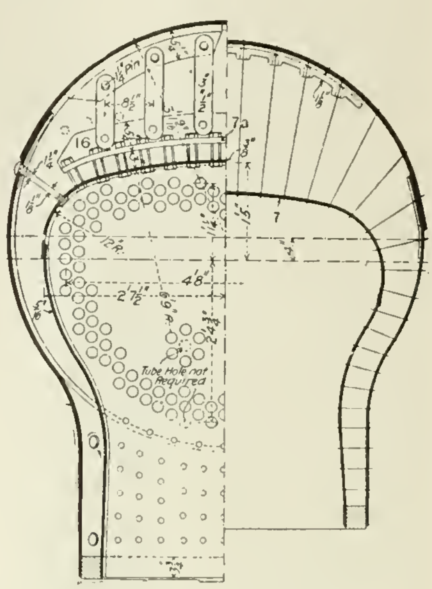


RADIAL STAYED CROWN SHEET.

With regard to holding the sheets of the firebox in place, the sides and back of the box are secured to the outer plates by staybolts, the front sheet is secured by the flues riveted to the smoke-box sheet, and also to the sheet in the front end or smoke-box. In supporting the top or crown sheet of the firebox there are three methods in use. The first, and generally admitted to be the best, is by screwed stays attaching the crown sheet of the firebox directly to the outer shell of the boiler, the other methods are by having girders or bars placed on the top of the crown sheet of the firebox, the bars being secured to the crown sheet by screwed bolts. The ends of the crown bars rest on the edges of the two side sheets. From these girders, slings are attached that reach suitable attachments on the outer roof plate.

The Belpaire system of bracing, so called, from its inventor, Mr. Belpaire, a Belgian engineer, is an adaptation of the radial stayed type, skilfully contrived to meet the changing stresses and insure a larger degree of rigidity of the parts. The main objection that has been raised against the system is that it has been found difficult to keep the crown stays tight in the spaces near the ends of the braces running from the back head to the top of the firebox shell. The trouble is generally conceded to be that the rigid system of bracing does not allow the flue sheet sufficient room to expand vertically. Various modifications of this type have been successfully installed, and when fitted with staybolts of a flexible type the results have been that the breakage of staybolts have greatly diminished. In testing flexible staybolts the caps should be removed, as hammering on the caps will speedily affect the threads. Careful experiments have shown that flexible staybolts are very reliable and need not be subjected to inspection oftener than once in a year, the period having recently been extended by the government commission to sixteen months.

From this brief outline of the structure and causes of failure of the firebox it will readily occur to those engaged in the running repairs of locomotives that an avoidance of rapid changes of temperature is a natural and important safeguard against some of the troubles to which we have referred. With the important improvements that have been made in recent years in boiler washing appliances, with the refilling of the boiler by hot water, a valuable advance has been made in the saving of fireboxes, but where such apparatus is not in use it is well, however limited the appliances may be, to constantly guard against a sudden change of temperature.

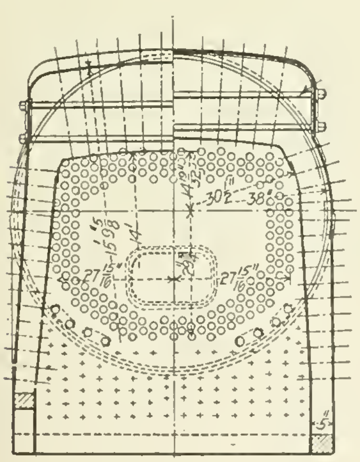


FIREBOX WITH CROWN BARS.

It should also be borne in mind that the washing of the boiler may readily become a mere perfunctory performance unless accompanied by a thorough and systematic inspection of the boiler. To this end it will frequently be noticed that there are parts of nearly all kinds of boilers that are difficult of inspection and, of course, difficult to keep perfectly clean. This is especially the case in boilers where the crown sheets are equipped with crown bars, crow's feet, or other attachments. In such boilers it is the proper province of those having charge of repairs to instal plugs of sufficient size not only to admit of a thorough inspection of the sheets, but also for the admission and operation of such tools as may be necessary in completely removing the scale that accumulates very rapidly on the crown sheets of fireboxes so constructed. The hardening of scale on the crown sheet makes its presence known by the appearance of lime around the rivet heads, and also by particles of coal adhering to the sheet. With such evidences of internal incrustation, if it is not practicable to have holes cut for inspection plugs, it is advisable to have the dome cap and throttle pipe removed to reach and clean the crown sheet thoroughly. It is frequently noted that the same appearances are observed over the firebox door, showing an accumulation of scale in that part of the inner chamber of the boiler. In this case the insertion of a plug over the firebox door is a matter of easy attainment, and that part of the boiler may be readily cleaned. In the matter of plugs it should be noted that the threads are subject to injury, and plugs should be made sufficiently long and with sufficient taper to submit to having the threads rechased and the holes retapped. In putting back plugs after a washout it is advisable to coat the plug with graphite grease.

The common method of testing staybolts is when the boiler is emptied of water, to hold a sledge on one end of each bolt, in rotation, and tap the other end with a hand hammer. A broken staybolt that has its broken ends separated can be very readily found, but where the broken ends are pressing hard against each other the break cannot be so readily detected. Where compressed air is available a pressure of 40 lbs. per square inch in the boiler while the testing of the staybolts is going on is of assistance in detecting broken staybolts, as the pressure has the effect of slightly separating the fractured parts from each other.

In view of the fact that sound tests are not altogether reliable, an excellent method of detecting broken staybolts was established when the practice of



BELPAIRE FIREBOX.

drilling holes one inch deep in their outer ends came into use. The staybolts almost invariably break near the outer sheet of the boiler, and hence the hole need not be more than one inch in depth. The period between inspection is different in different localities, the time varying from one month to six months, and even longer. The extra work in removing lagging should not be permitted to interfere with the proper and systematic examination of so important a part of the locomotive as the firebox.

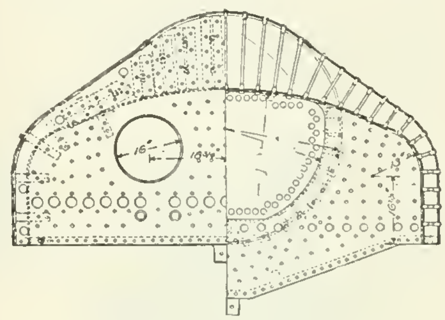
One of the first indications of the pernicious influence of the formation of scale around the staybolts will be the appearance of cracks in the sheets running from the staybolt holes in the lower part of the firebox. If such cracks are attended to in time they may be remedied by removing the staybolt, and drilling a hole near the staybolt hole, leaving about one-eighth of an inch of metal between the staybolt hole and the new hole, the center of the new hole should be located in the crack and need not exceed ¾ in. in diameter. The hole should be tapped with a fine thread tap and a suitable plug inserted. If the crack extends further than the space covered by the plug, another hole should be drilled and the center of this hole should also be located in the crack, and the drill should be allowed to cut into the first plug a sufficient distance to cut into the thread. When the plugs are securely in place, a projection of two threads of the plugs should be allowed for riveting over. The staybolt hole should then be retapped and a new bolt fitted and riveted in the enlarged opening.

It is hardly necessary to state that when a considerable number of cracks manifest themselves, and especially if more than one crack is observed as running from the same bolt hole, the sheet may be set down as nearly past remedy, and new firebox sheets alone will place the boiler in safe condition.

It is sometimes observed that defects will be confined to a limited area, in which case the weakening part may be cut out and a patch put on. The patch should overlap the opening 1½ ins., and holes to admit ¾-in. tap bolts should be drilled around its outer edge 1¾ ins. apart, or as nearly so as the space will admit. The holes in the patch should be countersunk and the tap bolts carefully fitted to match the angle of the countersink. The holes in the sheet to receive the tap bolts should be tapped with a 12 thread taper tap. The patch should be annealed and fitted as closely as possible to the sheet. When the tap bolts are tightly screwed into place the patch should be hammered around the bolts and the tap bolts again tightened and finally hammered over, securely closing the countersink. The outer edge of the patch should be caulked as the last part of the operation.

Plugs and patches may prolong the life of the side sheets of the firebox, but in five or six years it will be necessary to remove the lower part of the side sheets on the firebox as well as the flue sheet. Indeed if the firebox is of the shallow kind, it is more advantageous to cut out the entire sheets, as in the case of half sheets it is often found that the seam where the new and old metal is found is very apt to develop cracks in the old part, just as patching an old garment will develop new rents in the vicinity of the new material.

As a rule crown sheets outlast several sets of side sheets from the fact that they are not subject to the extreme changes in the temperature. The formation of the firebox has also much effect on the durability of the sheets. In the Wootten type of furnace, the part that fails first is generally that portion



WOOTTEN FIREBOX.

of the sides that approach the vertical. It will also be noted that the door sheets of fireboxes that slope forward do not last as long as those that are vertical. This is readily accounted for by reason of the wiping action of fire and water circulation on sloping sheets. On the other hand it is noticeable that firebox sheets that slope outwards are more durable. Whether the sloping sheets induce circulation and greater steaming qualities which may overcome the increased cost of maintenance is a question with which running repairs may be closely associated, but into the merits of which we need not enter at present. Suffice it to say that in whatever form the firebox of a locomotive appears it requires constant watchfulness, skill in repair, and thoroughness in cleaning. On its stability largely depends the generation of the energy that creates and sustains the power of the steam engine.

Sowing the Seeds of Success.

To know how to bide one's time is the secret of success. To be impatient for results means failure to get any results which are worth while, for all good things grow slowly. Merely to wait like Mr. Micawber for something "to turn up" is to accomplish nothing; but to sow seeds, and then more seeds, and occupy ourselves with something else while waiting for the harvest, will bring the success for which we wish.

In France a spinister is not allowed to put money in the bank or have a check book. However, once married or a widow she can do business with bankers as far as her means and mind go.

Questions Answered

MAKE UP OF TRAINS.

00. C. C. S., Palestine, Tex., writes: Do you know of any railroads that have changed their methods of making up freight trains with the object of an equal distribution of weight and braking power throughout the train in order to prevent excessive shocks or strains on the draft gear? A.—We do not know of any railroads that make up freight trains solely with a view of simplifying air brake operation, as it is generally understood that the handling of the brake must conform to the make up of the train. It will occur to you that the make up of trains alone will not solve the problems in which defective brakes, unequal piston travel and improper manipulation are the most important factors. We might, however, add that railroad air brake men have made many experiments along this line and that the difference in braking power, due to the presence of empty and loaded cars in the same train, can be equalized by the use of the "Empty and Load brake," manufactured by the Westinghouse Air Brake Co.

HAULING POWER AND SAND.

00. C. E. R., Boonville, N. Y., asks: Is the hauling power of a locomotive lessened in drawing a train over a slippery track when one of the sand pipes is clogged, and if so what percentage is lost?—A. It is impossible to tell what percentage of power is lost by the use of sand on only one rail. If the track is so slippery that sand is necessary, it stands to reason that sand on two rails is better than sand on one. The sanding of one rail is very bad practice and should never be permitted. It is dangerous, because if a slip occurred, the sudden catching of one wheel or one side of the engine on sand, may break a pin or rod or other important part of the machinery. If sand is used it should always be fed to both rails in equal quantities as nearly as can be done.

CLASP BRAKE.

00. L. D. Utrecht, Holland, writes: On page 339 of the July, 1910 issue I note, to my astonishment, a suggestion relative to the application of two brake blocks to each car wheel, while in Europe every passenger car has two blocks per wheel. Can you explain to me why this apparent remedy has not been applied to the air brake problems existing in the United States instead of the complicated apparatus designated as the P. C. equipment?—A.: The reason the clasp brake is not used in this country at the present time is that all the permissible retarding effect on the wheel can be transmitted through the medium of one shoe per wheel; therefore the use of two shoes would be excessive, and would be similar to using the fifth wheel on a wagon. The slight gain in efficiency primarily derived from the employment of two shoes per wheel would be almost totally offset by the additional losses in the foundation brake gear, to say nothing of the inconvenience of installation on six-wheel trucks. If another material increase in the weight of passenger cars should take place, it may necessitate the use of the clasp brake in this country, chiefly because the shoes would break down under the pressure necessary to keep the stop within reasonable limits. The P. C. equipment does not prevent the use of two shoes per wheel, but it was designed principally to create a considerable difference between service and emergency braking power, and to reduce the time that elapses between the time of brake application and brake effectiveness, and when this was accomplished some other important features were easily added. You will appreciate the fact that this subject is entirely too broad to be minutely commented upon in these columns, but in view of your interest in this intricate problem of brake efficiency we take pleasure in presenting you with a copy of "Development in Air Brakes for Railroads," which is the most advanced air brake treatise in existence. While this is not our custom, we have made an exception in your case, and are able to do so through the courtesy of Mr. W. V. Turner, chief engineer of the W. A. B. Co. A study of this book in connection with pages 162, 163 and 164 of the M. C. B. proceedings of 1910, will enable you to appreciate some of the difficulties in the air brake problems of the United States.

TENSILE STRENGTH OF STEEL AT HIGH TEMPERATURES.

00. Subscriber, Covington, Ky. asks, what is the tensile strength of steel plates from the heat of steam at 200 lbs. boiler pressure up to the fusing point of the metal? A.—Kent's Engineering Pocketbook, quoting James E. Howard's tests, shows that the tensile strength of steel diminishes as the temperature increases from 0 degs. until a minimum is reached between 200 degs. Fahr. and 300 degs. Fahr., the total decrease being about 4,000 lbs. per square inch in the softer steels, and from 6,000 to 8,000 lbs. in steels of over 80,000 lbs. tensile strength. From the minimum point the strength increases up to a temperature of 400 degs. Fahr. to 650 degs. Fahr., the maximum being reached earlier in the harder steels, the increase amounting to from 10,000 to 20,000 lbs. per square inch above the minimum strength at from 200 degs. Fahr. to 300 degs. Fahr. From this maximum, the strength of all the steel decreases steadily at a rate approximating 10,000 lbs. decrease per 100 degs. Fahr. increase of temperature. A strength of 20,000 lbs. per square inch is still shown by 0.10 C. steel at about 1,000 degs. Fahr., and by 0.60 to 1.00 C. steel at about 1,600 degs. Fahr. The strength of wrought iron increases with temperature from 0 degs. Fahr. up to a maximum at from 400 degs. Fahr. to 600 degs. Fahr., the increase being from 8,000 to 10,000 lbs. per square inch, and then decreases steadily till a strength of only 6,000 lbs. per square inch is shown at 1,500 degs. Fahr.

AVERAGE OF THREE TESTS OF EACH FROM 68 TO 925 DEGS.

Temperature, degs. Fahr.	68	575	925
Charcoal iron plate—			
Tensile strength.......	55,366	63,080	65,343
Reduction of area.....	26%	23%	21%
Soft O. H. steel—			
Tensile strength.......	54,600	66,083	64,350
Reduction of area.....	47%	38%	33%
Crucible steel—			
Tensile strength.......	64,000	69,266	68,600
Reduction of area.....	36%	30%	21%

VALVE GEAR.

00. W. E. H., Denver, Colo., writes: I am running an engine the valves of which are out of square, according to sound of exhaust and also to train measurements in full stroke. The eccentric rods need lengthening in short cut-off, and the same rods will need shortening at full stroke. I had a similar experience with another engine, and it was found that the saddle pin had about three-quarters of an inch too much offset. Do you know of any other cause that would produce the same effect? A.—There are a number of causes that may distort the valve gearing, among them being a bent rocker arm, a valve rod or reach rod too long or too short. A bent lifting shaft arm will also cause distortions of the valve gear. With the serious defects referred to it would be necessary to have an expert machinist test the various parts of the gearing and begin the examination of the adjustment of the gear by finding new centres and making new marks on the wheels and new marks on the valve rods. Experiment could then be made in full stroke on the forward motion and the gearing carefully adjusted to the required amount of "lead." When this is accomplished, the lever could then be "hooked up" and the cut-off point noted. If the variation is particularly marked, it is safe to assume that the trouble is in the link saddle. This is an organic defect and cannot be remedied except by a new saddle. If the variation is not great a compromise may be made by re-adjusting the gearing at the cut-off point. The construction and adjustment of the valve gearing is treated fully and clearly in "The Valve Setter's Guide." We could not give definite rules for the exact location of a particular saddle pin unless we were furnished with the measurement of all of the parts of the gearing.

Air Brake Department

Conducted by G. W. Kiehm

Westinghouse Air Compressors.

In connection with the subject of air-pump repairs, we wish to show an illustration of the 9½-in. air pump. This is about the most comprehensive view of the movable parts and the ports and passages that can be shown, and with this view before him the reader will more effectually grasp the meaning of the fit of parts.

The views indicate that the pistons fit the air and steam cylinders, that the rings come together at the ends, that the rod is a fit in the air piston and that the packing glands are very near the size of the rod in their inside diameter. If this illustration is accepted as a model or a guide for repair work, it will also be observed that the air valves strike the stops and caps squarely, and that all valves have the same lift, apparently the main valve pistons fit the bushing and cylinder head and the reversing valve rod extends into the steam piston without the button on the end of the rod touching either side. The flow of steam through this pump and the manner in which air is compressed, is too well known to be repeated here.

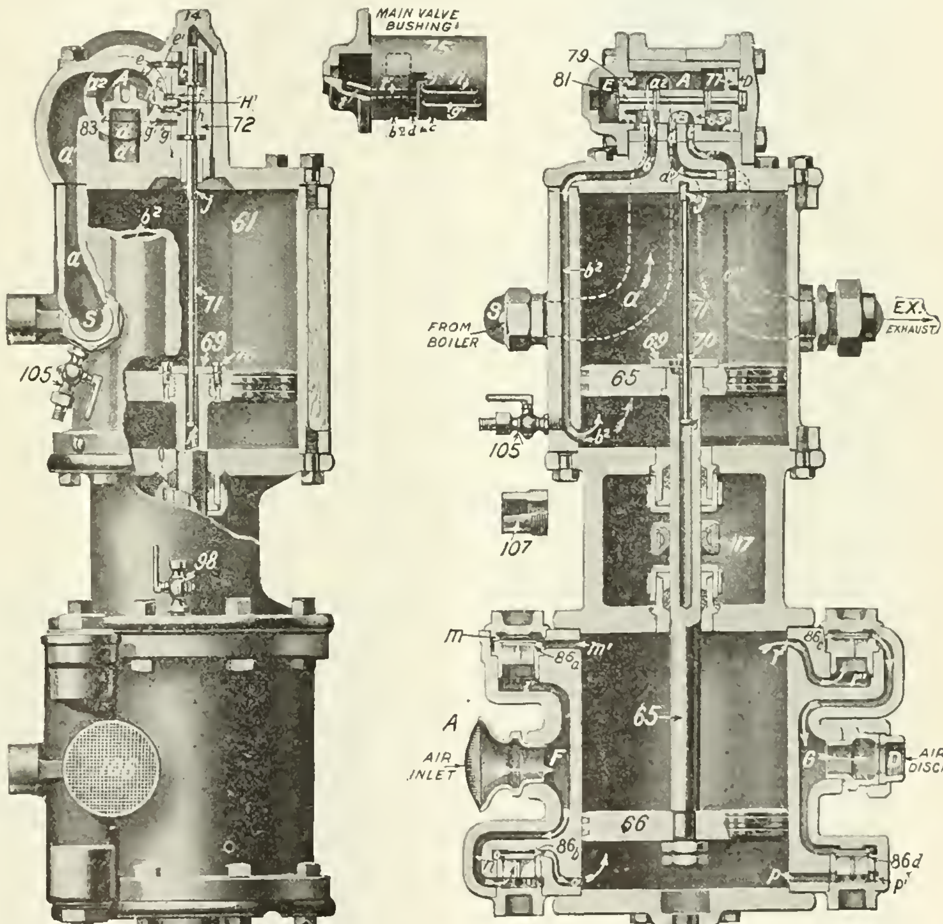
This machine can be used to compress air to a pressure of 150 lbs. if the service is intermittent or if the periods of work and rest are nearly equal, no undesirable effect will be experienced; but if the machine is to run constantly against a pressure of 100 lbs. or more, a water-jacketed air cylinder should be used. A water-jacketed cylinder may also be necessary where conditions are such that a great volume of air at a somewhat lower pressure is required, but where a comparatively high steam pressure results in a speed in excess of that which is recommended.

The water-jacketed cylinder as shown in the illustration, is confined to industrial service and is impractical for locomotive work and is unnecessary if the work of the pump on the engine is intermittent, as it should be, and if not operated at an excessive rate of speed.

The recommended rate of speed for the 9½-in. pump is 120 single strokes a minute, and for the 11-in. and the cross compound compressors, 100 single strokes a minute.

Instead of observing these recommendations, and complying with them as far as possible, the air pump on a locomotive is very often run an entire trip against leakage that cannot be maintained with the maximum pressure carried, and at a rate of speed governed by the size of the steam pipe and the boiler pressure.

The cross-compound air compressor was designed to meet the requirements of an increase in the length of trains and size of equipments. and the consequent increase in leakage. In point of efficiency and economy in steam consumption, it has no equal for air-brake service, but before the advent of the cross-compound type, two compressors in series, as shown in illustration, on next page, were used for industrial work.



9½-INCH AIR COMPRESSOR. DIAGRAMATIC SECTION.

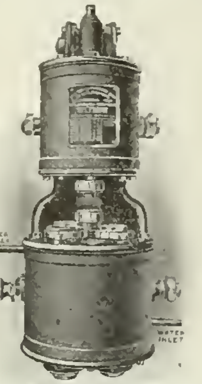
The air is compressed in the same stages by the compounded pumps as with the cross-compound type, but owing to the economical feature of a decreased steam consumption, the cross-compound pump supersedes the series system for industrial work.

Air Pump Repairs.

In taking up this subject of repairs to air pumps it is desired to submit a practical and economical method of repairing pumps and to invite the attention of those who may be interested, to certain recommendations in connection with the subject, which if followed out to the letter will be the means of maintaining air pumps in a high state of efficiency under the most exacting conditions of service.

Very often a locomotive is equipped with an insufficient air pump capacity from which it may be inferred that deciding upon the size of the air pump was based upon an estimate of the number of cars the locomotive was capable of hauling and as the result of "double heading" trains, the 9½-in. air pump is frequently relied upon to maintain the air pressure in the brake pipe of 70 or 80 cars on level divisions or to supply the requisite quantity of compressed air with which to control trains of 40 and 50 cars, on long and heavy mountain grades.

In taking this to represent a serious condition of insufficient air supply and one that is well calculated to tax the air pump to its utmost capacity, it is obvious that if adhering to a systematic method of air pump repairs will enable the 9½-in. pump to remain in service without failure for a reasonable length of time under the conditions cited, it should be a comparatively easy matter to modify the system of repairs should a close observance of the points brought out be considered unnecessary to maintain the larger capacity air pumps in a reasonable state of ef-



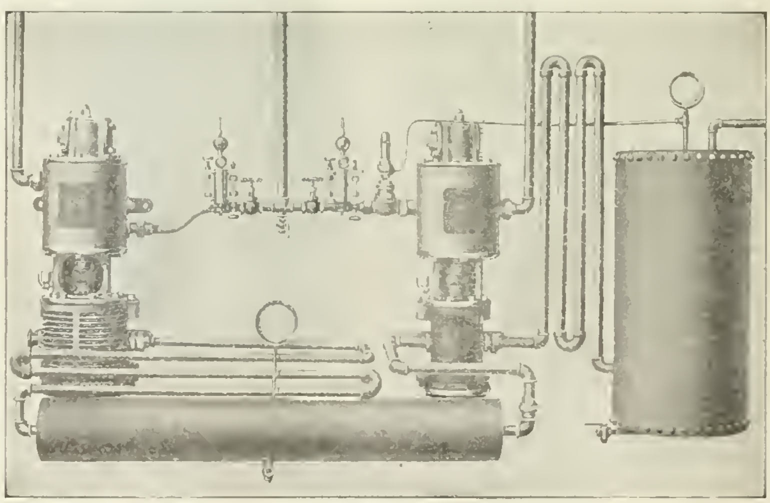
9½-INCH AIR PUMP.

ficiency. Let us assume then that our problem consists of keeping a 9½-in. pump in service for a reasonable period of six months without any repairs other than an occasional packing of the stuffing boxes, renewing a gasket or tightening a bolt and to be in a fairly good condition at the expiration of this time, it is evident that there must not or will not be any round house repair work on air pumps. In overhauling or rather assembling the parts of an air pump that is expected to meet requirements, as previously stated, the part to receive the most attention is the air cylinder.

The most important parts in this connection are: First, the fit of the air piston on the piston rod; second, the fit of the air piston in the cylinder; third, lift of air valves; fourth, the fit of piston packing rings. In qualifying this statement it is assumed that there are to be no air pump failures whatever, much less one that can be traced to the repair shop and the fit of the piston on the piston rod is absolutely essential if the head is to remain tight on the rod. If out of true 1/64 of an inch the air cylinder should be rebored and in fitting the air piston it should be turned to the size of the bore of the cylinder and touched lightly with a file until it can be forced into the cylinder.

The air valves, seats and cages must, of course, be in perfect condition and the bearing on the seats should not be too wide and the wings should not be loose enough in the cage or seat to allow the valve to "wobble" and the discharge valves should be given 5/64 of an inch lift. The outside diameter of the packing rings should be 3/16 of an inch larger than the bore of the cylinder, and should be filed to overlap slightly when placed inside of the cylinder and it may be added here that it requires experience as well as good judgment to overlap the rings slightly and not have them bound in the piston groove and care must be taken to see that they are free in the grooves before the piston is fastened on the rod. In giving more definite reasons as to why the importance of those parts should rank in the order given, first the fit of the piston on the rod, or rather a failure to properly fit is a prolific cause of 9½-in. air pump failures especially where careless or indifferent workmanship exists, and in addition to this it should be superfluous to say that after tightening the nuts on the rod some provision must be made to prevent the nuts working off the rod such as blurring the end of the rod or jamming the threads with a center punch, unless some patent lock nut is used.

Tightening the piston rod nuts is by no means an unimportant operation and it is safe to say that when they are improperly tightened it is nearly always because the nuts are drawn too tight instead of being not tight enough. How to correctly tighten these nuts must be taught by a practical demonstration or the repairman must learn from the school of experience which is always costly to the employer. The fit of the piston in the air cylinder is seldom if ever given the consideration it should have, to meet the conditions



TWO 9½-INCH COMPRESSORS IN SERIES.

mentioned here, the manufacturers recommend that the pump be run at a speed not to exceed 120 strokes a minute, while the speed it is usually run at is limited only by the size of the steam pipe and boiler pressure.

The advantage of the neatly fitted air piston is realized at the time the wear of the packing rings have opened them about ⅛ of an inch at the ends. If the air piston is 1/16 of an inch smaller than the bore of the cylinder and the rings have worn open ⅛ of an inch at the ends there is an opening of at least ⅛ x 1/32 in size through which air can leak from one side of the piston to the other during the entire stroke.

When working against 80 lbs. air pressure, the pressure in the air cylinder has an average between 14.7 lbs. atmospheric and 95 lbs. absolute or 40 lbs. gauge pressure and an opening of the size referred to will expand from a pressure of 40 lbs. per square inch, approximately 8 cu. ft. of free air a minute.

Assuming that the 9½-in. pump is being driven at a speed of about 145 strokes a minute, compressing about 35 cu. ft. of free air a minute when in good condition, should an opening of this size, ⅛ x 1/32 of an inch, occur past the ends of the piston rings and between the piston and wall of the cylinder it will reduce the pumps efficiency about 22 per cent. under the conditions stated and the volume of leakage will be constantly increasing.

If, however, the air piston is turned to a fit when applied to the cylinder there will be no perceptible leakage when the rings have worn open ⅛ at the ends, in fact the dirt accumulating on the ends and filling them out as they wear, proves that there is practically no leakage whatever past the rings until they are entirely worn out. All other parts being in good condition the neatly fitted air piston is a safeguard against an excessively overheated air pump.

It is unnecessary to go into detail while calling attention to the degree of heat that is generated as a result of the friction encountered in forcing the fine particles of air together during compression, as it is generally understood that a cylinder full of comparatively cool atmospheric air drawn in on each stroke is relied upon to counteract the effect of the heat generated in the act of compression, and regardless of the condition of the piston rings, during the first six months service, the neatly fitted air piston insures this up to the time the air cylinder becomes overheated from some disorder other than piston ring leakage. It is evident then that the properly fitted air piston will prevent an overheated cylinder due to piston ring leakage and will be the means of inducing a sufficient quantity of cool air to enter the cylinder on each stroke to preclude the possibility of the temperature becoming high enough to burn and shrink the piston rings.

Regardless of any fit of the air piston there still remains the possibility of the pump becoming overheated from some other cause and during the time it remains overheated it has a very low capacity due principally to the intense heat of the cylinder tending to repel the entrance of cool air and to the rapid expansion of the first small quantity of cool air that can enter, nevertheless if the air pump contains a neatly fitted air piston the pump will be found in a fair state as to efficiency after it has cooled to the degree of heat incident to compression.

Next in importance is the general condition and lift of air valves. The pump being in good condition otherwise, the excessive lift of air valves will cause the pound that tends to loosen the reversing plate bolts and piston rod nuts, pull the bracket loose from the boiler, brake pipe joints and eventually cause a pump failure. The object in allowing the discharge valves but 5/64 of an inch lift to begin with is to prevent the liability of a pump failure due to a broken air valve. If the lift of air valves is maintained at 3/32 of an inch the air valves cannot be thrown against the seats with sufficient force to break them is a statement based upon careful, personal observations.

A perfectly safe statement is to say that with the air pump fitted up as prescribed, the air valves cannot be broken if the lift is kept within the limit of 7/64 of an inch. Because of the volume of air that flows from the reservoir into the air cylinder while the discharge valves are seating, it is desirable that they should have but 5/64 of an inch lift to start with, so that by the time they have worn to a full bearing on the valve seat, the cylinder cap and the cylinder cavity, they will have approximately 3/32 of an inch lift. The air valve seat may have been screwed into its place when the cylinder was cool and slight leakage past it may necessitate drawing it down a trifle more when the cylinder becomes warmed up and thus increase the lift slightly which the 5/64 measurement would provide for without causing any perceptible slowing up in the speed of the pump.

Finally we will consider the operation which is generally supposed to be of paramount importance, that is, fitting the packing rings. To the mechanic of the old school this was the test of skill and to many of the train and engine crews of today the renewal of the piston rings in the air cylinder of the pump is the panacea for all the ills that range from the split gauge pipe to the open angle cock. While fitting a ring consists principally of a cut with a hacksaw, a few strokes of a file and a few taps on the inside of the ring with a hammer, it requires some experience if it is to be done properly. The reason the ring should be 3/16 of an inch larger than the bore of the cylinder is so that when the rings are pretty well worn, say, 3/32, off the outside which would cause them to stand apart about 5/16 at the ends, they would still set out firmly against the wall of the cylinder, while if the ring had been but 1/16 larger originally it would be loose and allow leakage past it.

Rings should be filed to form an airtight joint at the ends and when placed in the cylinder should overlap a trifle but not enough to bind them in the piston grooves and while wearing to a perfect bearing on the outside they will come together neatly at the ends. The outside of the ring must touch the wall of the cylinder all the way round otherwise the ring will open at the end before the ring is worn to a bearing. It is, of course, understood that rings cannot be fitted air-tight to a worn cylinder. It is not always considered economical to rebore a cylinder that is worn less than 1/64 of an inch and if it is worn but a trifle or scarcely enough to be noticeable, the rings should be placed in the cylinder so the ends come together on the discharge valve side of the cylinder. Thus the ends will tend to open and set out into the part of the cylinder that has begun to wear oblong. This occurs on the discharge valve side which receives the least lubrication and where the degree of heat incident to compression is highest.

Having touched upon the parts in the air cylinder that could cause a pump failure, it must be admitted that the breakage of some parts in the steam cylinder could also cause a failure. From the viewpoint of wear, the steam cylinder has an advantage as that end of the pump must be given a few drops of oil occasionally to keep it in operation and repairs to the steam cylinder need not be so accurate as in the air cylinder. The reversing plate bolts are riveted on the under side of the piston and the ends of the main valve stems are burred to prevent the nuts from working off. The sections of the top head which contain movable parts can be rebushed and exceptionally accurate work is unnecessary and it is not of much consequence whether the main valve bush and left main valve cylinder head are filed, scraped or rebored, so long as the pistons remain reasonably near the size of the chambers in which they operate and if the chambers are fairly true. After being fitted in a manner calculated to create as little friction or resistance to motion as possible, the main valve rings should be ground to a perfect bearing in the chamber or cylinders in which they operate.

The reversing valve rod and plate should be given a close inspection, the wear of the plate should be noted and plate renewed if necessary, the distance from the shoulder to the bottom of the valve rod should be carefully measured, or compared with a new rod and if the distance is increased over 1/32 of an inch it should be renewed so that there may be no pound in the pump due to wear or lost motion in the reversing gear.

In conclusion it may be advisable to repeat the statement that these recommendations are intended to cover extraordinary conditions. It is also assumed that the repairman will know why and for what purpose he is deviating from the manufacturers' standards.

If this system of air pump repair work is followed to the letter the pumps will give six months service without requiring any repairs in the meantime, and at the end of this time they should be removed from the locomotive for inspection as it is manifest that this quality of repair work cannot be done while the air pump is on the locomotive.

Vise Appliance.

It is sometimes difficult to hold taper work in the parallel jaws of an ordinary vise and a simple contrivance can readily be adjusted to one of the vise jaws. In a piece of metal, say 4 ins. by 3 ins., and 1 in. in thickness, a spherical cavity may be cast or cut in the flat center into which a plano-convex button of hard steel should be turned to fit the curve in the flat piece. It can be readily seen that the outer face of the button being flat will adjust itself to a moderate taper. This flexibility of adjustment is illustrated in the use of convex rings in steam pipe joints. In the vise contrivance the flat metal piece may be so constructed, that with attachments it could be hung on the vise jaw and if the convex button is magnetized, it will remain in place when the vise is loosened.

Electrical Department

Comparison of the Steam and the Electric Locomotive.

By A. J. Manson.

At the present time there are several railroads operating trains over certain sections of their line with large and powerful electric locomotives. Among these may be mentioned the Pennsylvania Railroad, New York, New Haven & Hartford Railroad and the New York Central Lines. In each case the electric locomotive couples onto a train which has been or will be handled by a steam locomotive, and which runs on as fast and sometimes faster schedule than would be obtained if electrification had not been installed. Here are then electric locomotives which are doing as much, and in many instances doing more work than the steam locomotive, handling both passenger and freight trains, and it will be interesting to know how these two distinct types of locomotives, the one carrying its own source of power and the other obtaining its power at a distance from a third rail or overhead wire, compare as regards horse-power, speed, tractive effort and operation.

P. R. R. ELECTRIC AND 8-CAR TRAIN.

Let us first consider the steam locomotive and the relations that exist between it and the electric. This type of locomotive consists of two distinct parts, the boiler and the engine, each of which is designed for the service in which the locomotive is to be placed. The boiler has its limits in size due to the design and railroad conditions and it is necessary to work the same at its maximum capacity so as to get the most power possible out of the locomotive. The engine is distinct from the boiler and the power it is capable of delivering at the driving wheels depends on its mechanical dimensions and the boiler pressure. This power at the driving wheels to propel the locomotive along the track, is called the Tractive Effort and is obtained as follows:

$$T = \frac{d^2 \times s \times 85\% \ P}{D}$$

where T = tractive effort
- d = diameter of cylinder in inches
- s = stroke in inches
- P = boiler pressure in pounds.
- D = diameter of driving wheel in inches.

From this formula it is noted that the only variable part is the boiler pressure, so that with full boiler pressure in the cylinders, maximum tractive effort is obtained. Owing to the clearances and the mechanical construction it is not possible for the steam locomotive to work throughout its full stroke, so that the mean effective pressure will be somewhat less than the boiler pressure. We have taken a value of 85 per cent., which is that given by American Railway Master Mechanics' Association. The tractive effort obtained from this formula is the power at the rim of the drivers and not the power available at the draw bar for pulling a trailing load. This latter is known as the drawbar pull and is always less than the tractive effort, by the amount of power necessary to move the locomotive itself.

The horse-power of the steam locomotive, which is really two separate engines, depends on the rate at which it is doing work—that is, on the speed and the tractive effort at that speed, and is obtained from the following formula:

$$H. P. = \frac{PLAN}{33.000}$$

where P = 85% boiler pressure
- L = 4 times the stroke in feet, for the 2 engines
- A = area of cylinder in square inches
- N = number of revolutions per min.

We have shown how to obtain the tractive effort and horse-power of the locomotive. Let us next consider what relation these have to the speed at which the locomotive is running. In starting a steam locomotive the lever is dropped in the corner so that steam is admitted into the cylinder through the greater part of the stroke, giving the maximum mean effect pressure, and which we have taken as 85 per cent. of the boiler pressure. With this position of the lever the maximum tractive effort that is possible with the dimensions of the engine is obtained. This maximum tractive effort in general corresponds to about 22 per cent. adhesion between the drivers and the rail. That is, with this coefficient of adhesion, if the locomotive had been designed with just power enough to slip the wheels, and in case the load was of such a weight as to require a greater tractive effort, it would not be possible with the steam locomotive to start this load, even if the coefficient of adhesion was raised by means of sand blown under the drivers, as the maximum tractive effort possible as we have supposed, with this design of the locomotive is obtained at the 22 per cent. adhesion. As the wheels turn and the speed begins to increase the reverse lever is notched up, less steam enters the cylinder at each stroke and the mean effective pressure falls. The drawbar pull, we see, depends on the dimensions of the engine, the mean effective pressure in the cylinders, and the size of the driving wheels. In order to get more speed from the engine it is necessary to use the power of the steam expansively. The tractive effort remains nearly constant in a passenger locomotive up to 10 or 12 miles an hour and for a freight locomotive up to 6 or 8 miles an hour. After these speeds it drops rapidly.

The horse-power just at the moment of starting is zero, although the locomotive is exerting its maximum drawbar pull, as there is no motion and, therefore, no rate of doing work. The horse-power increases rapidly as the speed increases and continues to increase after the drawbar pull begins to fall rapidly, due to the fact that the increase of speed is greater than decrease of drawbar pull. A maximum horse-power is reached at a certain speed according to the design of the locomotive and after this point is reached the horse-power decreases rapidly with increased speed.

The electric locomotive does not have the two distinct parts as has the steam locomotive. The boiler is at the power house, which may be several miles away. The power for operating the locomotive, corresponding to the steam, is brought to it over the wires or some such conductors and connected to the motors, which can be considered as the cylinders. The motors are connected to the driving wheels and deliver their power in the form of tractive effort and drawbar pull.

The tractive effort of the electric locomotive depends on the number of motors which may be connected to the driving wheels. As these motors are the same the total power is a multiple of what one motor is capable of doing and is obtained as follows:

$$\text{T. E.} = \frac{\text{T} \times 24 \times \text{G} \times \text{gear efficiency} \times \text{N}}{\text{D} \times \text{g}}$$

where T. E. = tractive effort
T = torque of motor
G = number of teeth in gear
D = diameter of driving wheel in inches
g = number of teeth in pinion
N = number of motors.

We have made this a general formula to take care of all conditions. In many designs of locomotives the motor is direct connected to the driving wheels and in this case the factors G and g and the gear efficiency drop out.

The power of the motor is the force it has to rotate, and has been reduced to the pull in pounds it can exert at one foot radius from the centre of the armature shaft—that is, at any point in a circumference of a circle of 24 ins. diameter whose centre is at the centre of the axle. This pull is known as the torque of the motor and always means the pull at one foot radius. The manufacturers of motors furnish with each a set of characteristic curves obtained from test, which show the relation between current, torque and revolutions per minute. From these curves the torque at any speed can be read directly. Since the diameter of the drivers is greater than 24 ins. the pull at the rim or tractive effort will be less than the torque of the motor and will be in the ratio of 24 to D.

Referring to the formula all the factors are fixed except the torque. This value is obtained from the characteristic curves of the particular motor used in the locomotive. The torque of the motor is entirely different from the power obtained in the steam cylinder, in that the value depends on the amount of current flowing through the motor. The amount of current to the motor is at the control of the engineer, so that within safety limits as large a torque as desired can be obtained from the motors, and the minimum power is not fixed as in the engine supplied with constant steam pressure. This large variation in torque means large variation of tractive effort and drawbar pull.

It is then practically impossible to be-

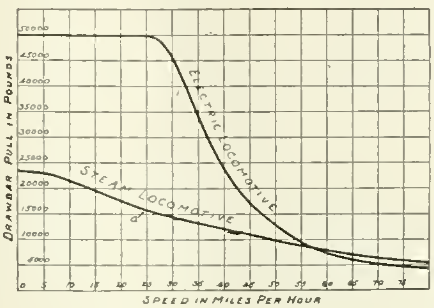


FIG. 1.—DRAW-BAR PULL STEAM AND ELECTRIC LOCOMOTIVE.

come stalled with an electric locomotive for the engine has power available to pull the train out of the trouble and is not limited by the maximum constant tractive effort which can only be obtained from the steam locomotive. It is therefore possible with the electric locomotives to take advantage of extra adhesion with the rail which may be natural or caused by application of sand. A coefficient of adhesion as high as 33 per cent. has been obtained. It is then a matter of having sufficient wheel load on drivers to take care of maximum drawbar pull required.

While the electric locomotive has this great advantage of being able to exert a large maximum tractive effort, it is not possible to maintain this tractive effort continuously, on account of the damage which would result to the motors. This takes us to what is meant as the continuous and hourly rating of an electric locomotive which does not enter into the calculation where the steam locomotive is used, as the latter is able to maintain its maximum tractive effort at slow speed as long as desired.

Since the torque depends on the amount of current passing through the motor, with this very large torque an equally large current is required which passes through the armature and field coils. These coils are made up of copper wires or bars covered with special tape or insulation, and have a certain resistance to the flow of the electric current. This resistance causes heat to be generated, which is conducted away by the iron and by radiation, and a certain constant temperature will be reached when a certain constant current is flowing through the motor continuously. There is a maximum temperature of about 70 degs. C. above that of the surrounding air which the motor should not exceed, for if this is exceeded, the excess temperature will damage the insulation around the coils, and later cause a failure of the motor. If this excess current is allowed to remain on too long the motor would become so heated that it would burn up. The value of the current which will give this maximum rise above the air determines the torque each motor can exert continuously and thus the tractive effort and drawbar pull of the locomotive.

We have taken the case where the maximum temperature is reached with continuous current. A very much larger current can be taken for a certain period before the maximum allowable temperature is reached without harm to the motors, and so it is possible to rate the motors at a much larger torque for a shorter time. It is customary to take one hour, and so with the same locomotive we are able to obtain much greater tractive effort, but the locomotive is not able to exert this tractive effort continuously or undue heating of the motors would occur.

It is now clear why it is possible to get a large tractive effort for starting or emergency conditions and why this same tractive effort cannot be used continuously. In specifying an electric locomotive the work this locomotive will have to do is studied carefully, and then it is fitted with motors of such size that the work in any one hour will not cause overheating. It is possible to work these motors for short periods at much higher currents, but it will be necessary to have coasts, stops or layovers so that the total amount of current in any one hour will not exceed the safe value of the motors. This is of vital importance in the operation of the electric locomotive but does not concern the steam locomotive, for as long as the boiler has water no harm can be done by operating it at its maximum drawbar pull continuously.

As with the steam locomotive the horse-power depends on the speed and tractive effort at that speed and we have a very simple formula for this, namely:

$$\text{H. P.} = \frac{\text{tractive effort} \times \text{miles per hour}}{375}$$

What relation exists between the tractive effort and speed in the electric locomotive? In starting up the locomotive it is not possible to connect the motors direct to the source of power for such a large current would flow that the motors would burn up. A resistance or equivalent apparatus is provided to cut this value of the current down to a safe value. This resistance can be reduced by steps, at the control of the engineer, so that the current required by the motors to give a certain tractive effort can be taken from the third rail or overhead wire. . As the locomotive speeds up the current value decreases and a step of resistance can be cut out to maintain the same current value. This constant tractive effort can be maintained until all of the resistance is cut out, when it will begin to fall off with the speed. This point where it begins to decrease is at a speed practically double that of the steam locomotive. This speed, however, depends on the particular design of the motor and can be increased if desired.

For actual comparison we will take a modern high-speed passenger steam locomotive of the 4-4-2 type and a Pennsylvania Railroad electric locomotive of the 4-4-4-4 type. The latter are now hauling trains through the tunnels in and out of the new Pennsylvania station in the heart of New York City and is shown in our illustration. The data for these two locomotives is as follows:

STEAM.

Boiler pressure, 205 lbs.; cylinder diameter, 20½ ins.; stroke, 26 ins.; diameter of drivers, 80 ins.; weight on drivers, 109,000 lbs; weight of engine and tender, 155 tons; total wheel base (including tender), 60 ft. 2½ ins.

ELECTRIC.

Voltage at collector, 650 volts, direct current; number of motors, 2; horsepower each motor, 2,000; diameter of drivers, 72 ins.; weight on drivers, 200,000 lbs.; weight of locomotive, 157 tons; total wheel base, 55 ft. 11 ins.

Fig. 1 shows the comparison between the drawbar pull at different speeds for the two locomotives, which, you will note from the data, are practically equal in total weight and dimensions. The electric locomotive has, however, nearly double the weight on its drivers that the steam locomotive has on its, and has, therefore, a chance to exert twice as much tractive effort before slipping the wheels. This would be of no benefit to the steam locomotive, keeping the same boiler pressure and mechanical dimensions, as the maximum tractive effort corresponds to about 22 per cent. adhesion of its weight, and any excess weight could not be made use of, as can be done with the electric locomotive, for the torque of the motor, and therefore the tractive effort, depends on the current which passes through the motor and this is under the control of the engineer.

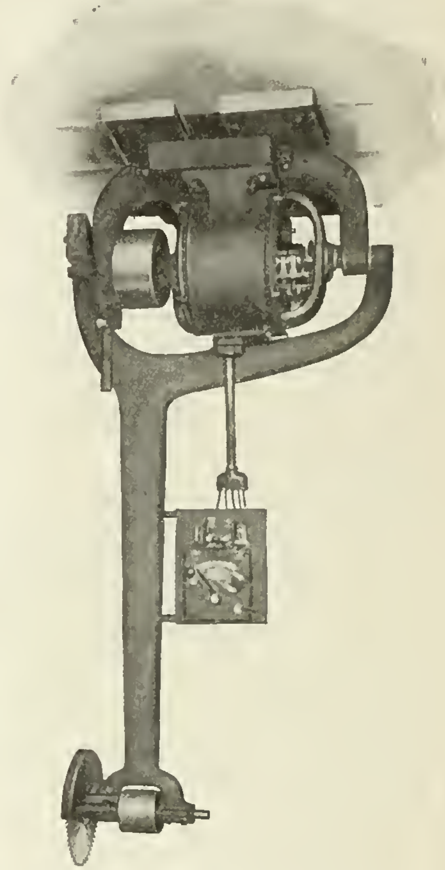
Referring to Fig. 1 the maximum drawbar pull of the steam locomotive in starting, which is zero speed, is approximately 23,500 lbs. The drawbar pull of the electric locomotive at start is 50,000 lbs. This is not the maximum by any means but is the drawbar pull which is obtained when the regular amount of current is flowing through the motor. This value of drawbar pull can be exceeded if the conditions require it, by increasing the current, but of course could not be maintained for such a length of time due to the motors heating up more rapidly. An actual maximum drawbar pull of 79,200 lbs. has been obtained when this locomotive was operating under test with a dynamometer car. The drawbar pull of the steam locomotive remains nearly constant to 8 m. p. h. but the electric locomotive maintains this constant drawbar pull to 25 m. p. h. At this latter speed the drawbar pull of the steam locomotive has dropped to the value (at point a, on the diagram) of only 16,000 lbs. The drawbar pull of the electric locomotive from this speed drops in value very rapidly, while that of the steam locomotive decreases very much more slowly, so that at the speed where the two curves cross, which is 57 m. p. h., the drawbar pull of each is the same, namely, 8,000 lbs. At any increase of speed above this point the drawbar pull of the steam locomotive is slightly greater than that of the electric. Although these curves shown in Fig. 1 are for the two particular locomotives we have taken for illustration, they are still general curves of the two distinct types of locomotives and give the best idea possible of characteristics of each.

The electric locomotive is really a transformer of power, for its engine part is separate from its source of power, which can be obtained in unlimited quantities from a main power house. It is not a prime mover as is the steam engine. Thus it is easily possible to design the electric locomotive for very high drawbar pulls. Another very important consideration is the running of electric locomotives in multiple. It is a very easy matter to connect electric locomotives together so that one man in the cab can control two or more, and the flexibility of operation, where trains extend over a large variation of weight, is greatly increased for it is then an easy matter to double head.

The power of electric locomotives can be increased greatly by gearing the motors to the drivers with less power taken from the line but the speed, of course, decreases. This type of electric locomotive would be used in freight service. With them it is possible to handle the freight at a much faster schedule speed, especially on mountain divisions where the grades are very heavy. Handling heavy trains on heavy grades at higher speeds means a large drawbar pull and this is easily obtained for the electric locomotive, as shown by Fig. 1, maintains its drawbar pull up to about 25 m. p. h. Moreover, nearly all of the weight is on the drivers, which gives proper adhesion for the large drawbar pull required and the power required can be taken care of by fitting the locomotive with the proper number and size of motors.

Motor-Driven Swing Saw.

The motor-driven swing saw shown in our illustration is manufactured by the Reno-Kaetker Electric Company, of Cincinnati, Ohio. It is a neat application of the electric motor to a cross-cut saw and especially adapted to the railroad car shop. The motor is mounted in the base of the saw. This makes the machine self-contained and capable of being installed in any otherwise inaccessible corner of the shop. To do this requires simply the running of a few wires to the motor. It can also be placed on a portable standard



MOTOR-DRIVEN SWING SAW.

and moved from one place to another. Besides being a very handy tool, its use means a saving of power, as the motor is only running while the saw is operating. As the saw frame consists simply of two castings, it combines strength with rigidity, which is important in this class of machine and, in the words of the manufacturer, "It is forced to follow its cut."

A gang boss on the Erie is noted for observing habits and keen wit. One warm afternoon, while walking along the line, he found one of his men placidly sleeping on the embankment. The "boss" looked disgustedly at the delinquent, and then remarked:—"Slape on, ye lazy spalpeen, slape on; fur as long as you slape you've got a job, but when you wake up you ain't got none."

General Foremen's Department

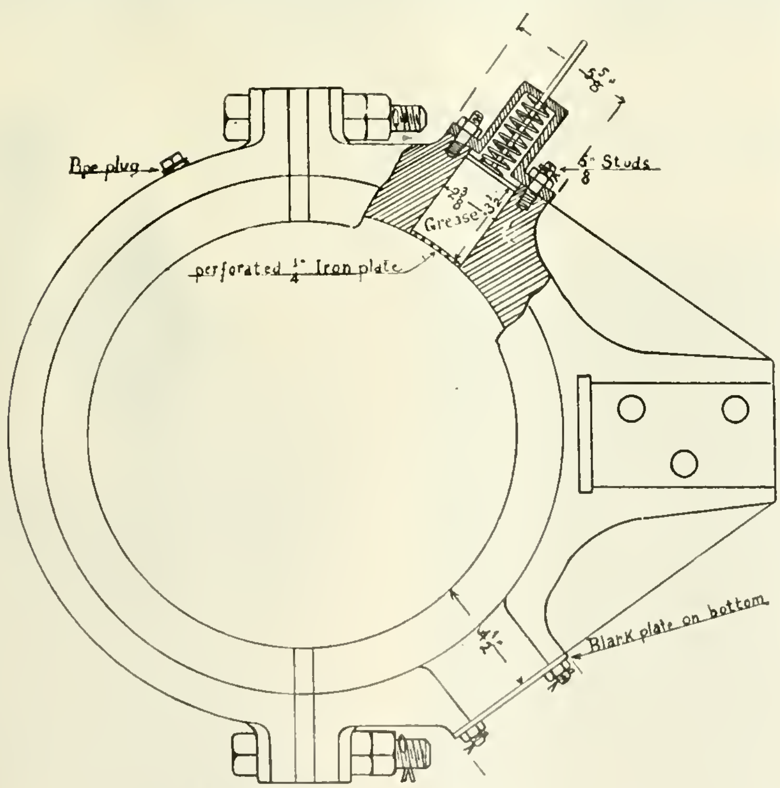
Grease Cup on Eccentrics.

By Charles Markel, Shop Foreman, C. & N. W. Ry., Clinton, Ia.

The reproduced blue print shows the method employed some time ago by the Chicago & North-Western Railway, at the Clinton, Ia. shops; to lubricate eccentrics automatically with grease. The idea was suggested by me and approved by Mr. H. T. Bentley, then master mechanic of the Iowa division at Clinton.

We used it on all four eccentrics of Atlantic type engine on a 200-mile division for over one year with perfect success and it was well liked by the enginemen. We calipered the eccentric and strap before going into service, and after one year's service the sizes were again taken and it was remarkable the slight amount of wear that was found.

To adapt the old strap to this method, we squared the old cored out oil and waste pocket in strap and made a cast iron cover of sufficient size to accommodate the coil spring and detector rod. This



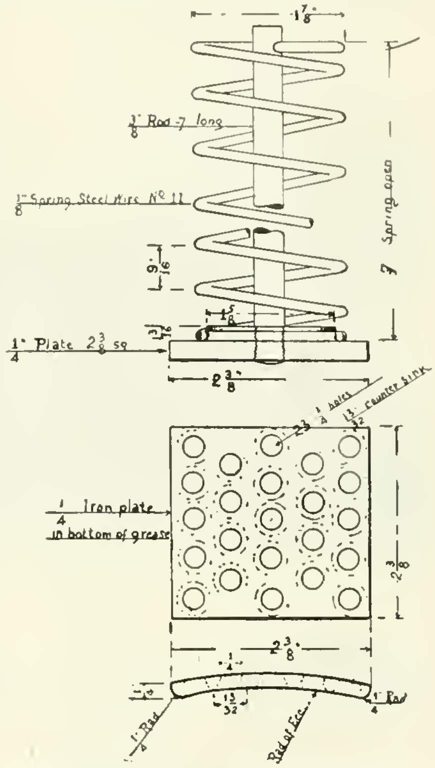
ECCENTRIC WITH AUTOMATIC GREASE CUP; C. & N. W. RY.

rod indicated the amount of grease at the bottom of cup and next to the eccentric was placed a ¼-in. iron plate formed to the radius of the eccentric. This plate had twenty-three ¼-in. holes drilled in it through which the grease was fed. Our illustration gives full details and will possibly interest some of your readers. For your information I will say that on some trips of 408 miles the indicator showed that no grease had been fed to the eccentrics and next trip it would probably show ¼-in. feed, but it never failed to properly lubricate during its years' trial. We also used grease automatically fed on this engine to the front end of main rod, rocker boxes, valve-rod pins and tumbling shaft boxes, with equal success.

Pickled Castings.

While the pickling of castings is not in such general vogue as it should be it is a notable fact that where the practice has been tried it is almost always continued. Tumbling is not a substitute for pickling, although tumbling before pickling is good practice, as it saves the pickle. The common process is to construct a lead-lined wooden tank, the size of which is determined by the size and quantity of castings to be handled. The tank should be sunk a foot or more into the ground, and a platform sloping towards the tank should be built at one side of the tank to accommodate the castings.

The pickle should consist of four parts of water to one part of vitriol. An excess of vitriol retards the action. The articles should be simply dipped in the pickle so that they are wet all over and then laid on the platform to dry. In the case of large castings the pickle may be poured over them. The castings should be left



DETAILS OF AUTOMATIC GREASE CUP.

for ten or twelve hours and then cleaned with hot water. A hot water tank with steam pipe connections is generally used in cleaning the castings. The acid should be thoroughly removed before handling. Some prefer a weaker solution of ten parts of water to one of vitriol into which the castings may remain for several hours. When taken out they should be rinsed at once in clean water.

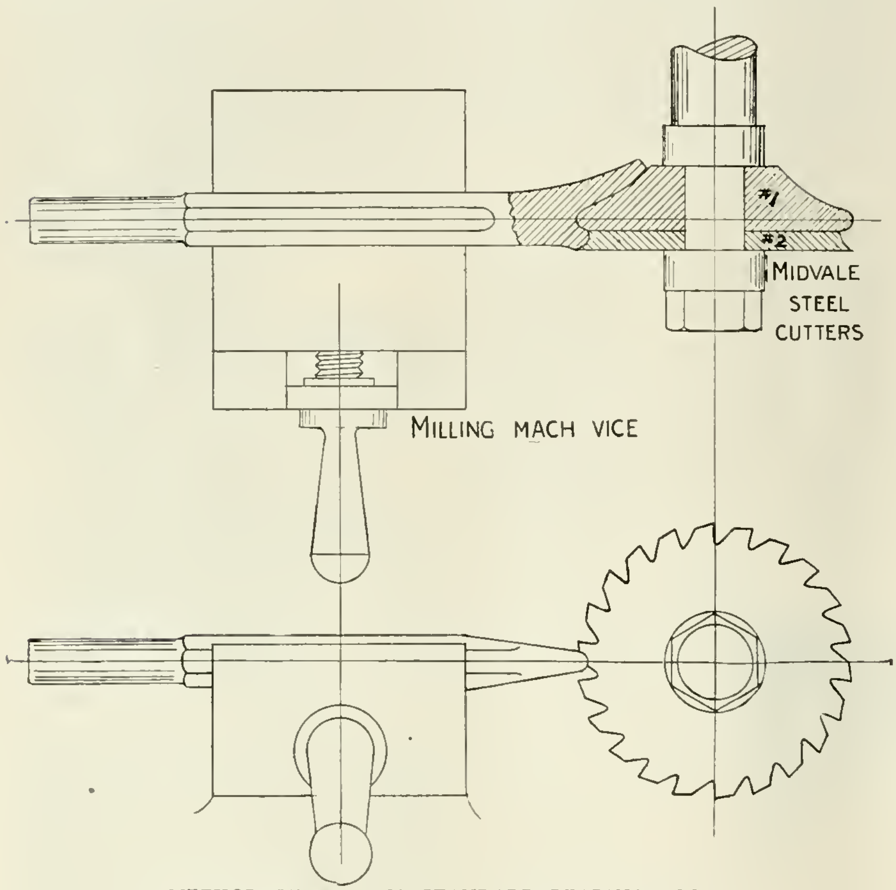
Malleable Cast Iron.

The tensile strength of malleable cast iron varies between 40,000 lbs. and 50,000 lbs. per square inch, with an elongation varying from 1 to 6 per cent. in a length of 6 ins. It has nearly twice the tensile strength of cast iron. In compression cast iron is, however, much the stronger. Malleable cast iron has the quality of wrought iron in permitting the closing of rivets, which cannot be done in the case of ordinary cast iron, hence the use of malleable cast iron has greatly increased in recent years, particularly in car construction where its lightness and malleability renders it very serviceable. It contracts more in the mold than cast iron, and in the process of annealing a slight swelling takes place. In straightening malleable castings that may be bent it is not necessary to heat them.

Making Standard Beading Tool.

Editor:

I am sending you a drawing which shows our method of making standard flue beading tools on the Chicago & North Western Railway. The tools are rough drawn out by the blacksmith, and are then held in the vise of the milling machine, and the milling cutter finishes the beading tool complete, excepting the corners, which are dressed off by a round file.



METHOD OF MILLING STANDARD BEADING TOOL.

The milling cutter is made in two halves, as shown by No. 1 and No. 2, so that the cutting edges can be sharpened without a special grinder. We have tried all kinds of methods to make these tools, and this is the most satisfactory of all, as it is rapid and makes them all absolutely duplicates of one another. This will interest anyone who has these tools to make.

CHARLES MARKEL,
Shop Foreman C. & N. W. Ry.
Clinton, Ia.

Coloring Metals.

Metals may be colored quickly and cheaply by forming on their surfaces a coating of a film of sulphide. In five minutes brass articles may be coated with any color, ranging from gold to copper-red, then to carmine, dark red, and from light aniline blue to a blue white, like sulphide of lead, and at last a reddish white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colors possess a very good luster, and if the article to be colored, have been previously thoroughly cleansed by means of acids and alkalis, they adhere so firmly that they may be operated upon by the polishing steel.

To prepare the solution, dissolve one-half ounce of hyposulphite of soda in one pound of water and add one-half ounce acetate of lead dissolved in half pound of water. When this clear solution is heated to from 190 to 200 degs. F., it decomposes slowly, and precipitates sulphide of lead in brown flakes. If metal is now present a part of the sulphide of lead is deposited thereon, and according to the thickness of the deposited sulphide of lead, the above colors are produced.

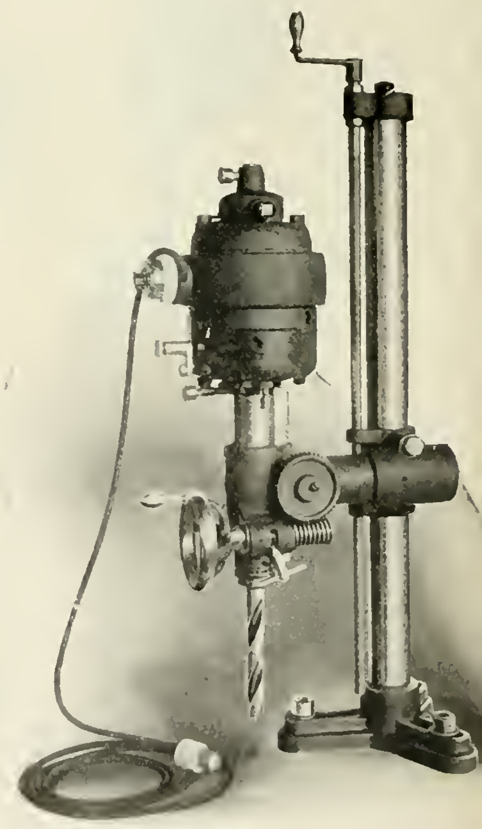
To produce an even coloring the articles must be evenly heated. Iron treated by the solution takes a steel-blue color.

Bell Making.

The best bell metal is composed of 78 parts of copper and 22 of tin. The use of silver in the manufacture of bells is purely imaginary. The theory grew out of a practice at the casting of church bells; pieces of silver were supposed to be mixed with the bell-metal. The foundryman had other uses for the silver and contrived means for the silver coins to fall through the grate bars into the ashpit. Nearly all bell makers have their own methods for determining the shape of a bell for a certain size and tone.

Portable Radial Drill.

The Lamb Electric Company of Grand Rapids, Mich., have recently got out a portable electrically-driven radial drill for use in railroad repair shops and similar establishments. Our illustration shows the general appearance of the tool, and its capacity in steel is 1 in. and smaller. It is operated in any position. Its extreme height is 40 ins. The greatest distance from spindle to base is 28 ins., but the tool can be made to order as far as length is concerned. The distance from the column to the center of spindle is 8¼ ins. The column is 2½ ins. in diameter and is made of steel tubing. The hole in spindle is No. 3 Morse taper. The travel of spindle is 5 ins., and is operated by rack and pinion, which in turn is actuated by a worm and gear, making a powerful feed. The spindle has a quick return when desired. There are two speeds, and the change from one speed to the other is instantly obtained by shifting a knob. The company have issued a folder which they will be happy to send to anyone who is desirous of having one.



ELECTRICALLY DRIVEN TWO-SPEED DRILL.

Latest Mallet Articulated Compound on the B. & O.

On page 283 of our June, 1904, issue we showed a heavy articulated compound for the B. & O., built by the American Locomotive Company. This month we are able to show a still heavier engine of the Mallet articulated compound class, which has just been delivered to the Baltimore & Ohio by the same builders. The former engines had cylinders 20 and 32 by 32 ins. The ones here illustrated are 26 and 41 by 32 ins. and with a steam pressure of 210 lbs. and with driving wheels 56 ins. diameter give a tractive effort of 105,000 lbs. The high pressure engine is as usual the rear one of the two and while Walschaerts valve gear is used on both engines, the high pressure main valve is of the piston variety and the low pressure valve is a large double ported D-slide, being set with 3/8 in. exhaust clearance, 6 ins. travel and a 1 in. steam lap. The high pressure valve has the same travel, 1 in. steam lap and an exhaust clearance of 5/16 in. The setting of high and low pressure valves is with a constant lead of 3/16 in.

The boiler has a straight top with conical connection. The diameter of the first ring is 90 ins. The firebox is of the wide type 126 3/16 ins. long by 114 ins. in breadth. One of these engines is equipped with the Crawford underfeed stoker, a description of which appeared in Railway and Locomotive Engineering for August, 1910, page 326. All the engines are provided with Schmidt firetube superheaters, single loop system. It consists of 38 flues 5½ ins. in diameter, 5/32 in. thick, made of seamless steel. There are 157 superheater tubes 1⅜ ins. in diameter and 5/32 in. thick. The regular tubes are 24 ft. long, they are ⅛ in. thick with ⅞ in. bridges between them. There are 277 of these tubes each 2¼ ins. diameter and with the superheater tubes, they provide 5205.5 sq. ft. The firebox contributes 321.4 sq. ft. so that the total comes up to 5526.9 sq. ft. The grate area is figured to be 99.9 sq. ft. which is so close to 100 that it may be called so for all practical purposes and this gives a ratio of grate area to heating surface as 1 is to 55.26.

The weight of the engine is 468,500 lbs. and all this weight is available for tractive purposes as there are no leading or carrying wheels in this design. The tank holds 9,200 gallons of water and carries 16 tons of coal. The tender frame is B. & O. standard and is built out of 10 and 15-in. steel channels and plates. Some of the principal dimensions are given below for reference:

Wheel Base—Driving, 40 ft. 8 ins.; rigid, 40 ft. 8 ins., total, 40 ft. 8 ins., total, engine and tender, 77 ft. 2¾ ins.

Weight, in working order—Engine and tender, 642,500 lbs.

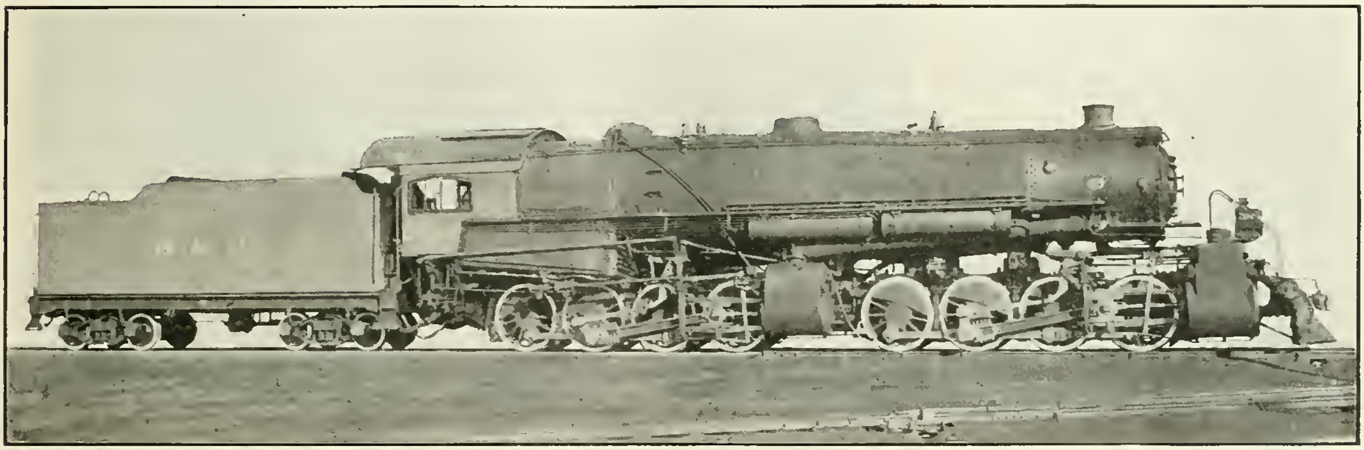
Axles—Driving journals, main, 10½ x 13 ins.; others, 10 x 13 ins.; tender truck journals, diameter, 6 ins.; length, 11 ins.

Boiler—Working pressure, 210 lbs.; fuel, bituminous coal.

Firebox—Water space, front, 5 ins.; sides, 4 ins.; back, 4½ ins.

Crown Staying—Radial.

Brakes—Westinghouse; pumps, two 11-in. left-hand; reservoirs, four 18½ x 96 ins.



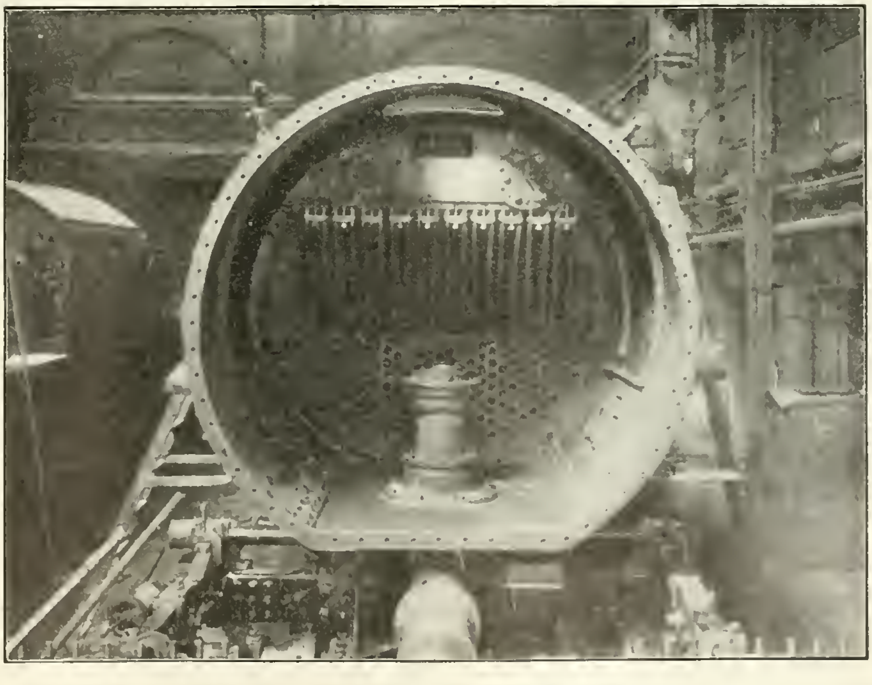
MALLET ARTICULATED COMPOUND FOR THE BALTIMORE & OHIO.

F. H. Clark, General Superintendent of Motive Power. American Locomotive Company, Builders.

Exhaust pipe—Cast iron, single; nozzles, 6½, 6¾ and 7 ins.

Grate—Style, Rocking Ry. Co.'s standard.

Piston—Rod diameter, 4¼ ins.; piston packing, 2 White's Bal. C. I. packing rings.



FRONT END SHOWING SCHMIDT SUPERHEATER.

Smokestack Diameter, 20 ins.; top above rail, 15 ft. 6 ins.

Tank—Style, water bottom.

Difficult to Diagnose.

In a public address by Dr. Sinclair delivered some time ago he gave two instances of how difficult it sometimes is to find out what is really the matter with an engine which gives trouble on the road. He said, "Many years ago a concern known as Scovill & Company, built locomotives in Chicago. They received an order from the Chicago & North Western Railway for one engine and they built it as like the McQueen engines as they knew how. These engines were then in high favor in the West. Great things were expected of this engine, but it was found when put into service that it would neither run nor pull. Several engineers tried to make the Scovill machine work properly but without success, and the engine was laid aside as worthless.

"At that time there was a general foreman named William Wilson in one of the shops who held, what was then a novel opinion, that one engine should work as well as another of the same dimensions when using the same pressure of steam. He solicited permission to make a thorough examination of the Scovill, and the request was granted. He first took off the dome cap and examined the throttle valve which was found all right. Then he removed the cylinder heads and steam chest covers to thoroughly examine the steam passages. There was nothing wrong there, so he proceeded to remove the dry pipe. When he got to the Tee-pipe he found inside a plate that had been used for centering the dry pipe. It had been left there by mistake and a one-inch hole in its center was all the opening left for the passage of steam. When that obstruction was removed the engine worked as well as other engines of its inches. Wilson was promoted for this act of good sense and was afterwards superintendent of machinery of the Chicago & Alton.

"I took part in a similar puzzling case. When James Meehan was superintendent of motive power of the Cincinnati Southern Railway, he conceived the opinion that a supplementary exhaust passage through the slide valve would reduce cylinder compression and relieve back pressure in high speed locomotives. He had a set of valves made to carry out his idea and applied them to an engine that pulled the fastest train over the road. The performance of the engine was very unsatisfactory. After fruitless investigation by master mechanic, general foreman and traveling engineer, Mr. Meehan decided to ask me to apply the steam engine indicator to the engine. I did so and the first indicator diagram taken proved that steam admission was very defective. Close examination showed that both supplementary ports were closed. The cores had been defective and permitted the metal when being poured to make a solid valve. The indicator solved that mystery as it has solved many others, when used intelligently. I commend the steam engine indicator to the favorable consideration of all railroad men who encounter any valve motion troubles."

FLORIDA EAST COAST RY. NEW STEEL VIADUCT.

FLORIDA EAST COAST RY. ROAD ON CONCRETE VIADUCT AT LONE KEY.

Among the Florida Keys.

A lady reader who sent us the pictures from which our half-tone engravings were made, of scenes on the Florida East Coast Railway makes some striking notes of what she saw during a trip over this marine railway. "I passed through these scenes," she writes, "on a magnificent moonlight night and gazed from the rear of an observation car. The fishing camp on Long Key, with its woodland and wealth of coloring, had been touched with a fairy wand and all the crudities hidden, the trembling lights in the houses were reflected in thousands of radiant beams on the waves that were churning against the bridges. The moon was in her most gracious mood, picking out most startlingly only the beautiful in outline, whether of fisherman's hut or grace in foliage. Once I remember seeing a poor naked palm tree stripped of its feathers by last fall's storms. I was trying to forget its penury of covering, when lo the tactful moon slipped under a cloud and behold there was no naked palm, only an erect wonderfully tapering monument, such an exquisite taper the hand of man had never fashioned."

N. Y. N. H. & H. Good Record.

It has been unofficially stated several times recently that the New York, New Haven & Hartford had practically no motive power delays in handling the entire passenger traffic of its New York end by Westinghouse electric locomotives and multiple unit trains, notwithstanding the change over from steam to electricity at Stamford. From reports of train operation in New York State during January, recently given out by the Public Service Commission, it appears that the New York, New Haven & Hartford made the best showing of any road in the State, with 90 per cent. of its trains on time. The report is especially interesting in view of the fact that the New Haven is extending its single-phase electrification to its Harlem division and another branch, and reported as planning extension to New Haven.

Items of Personal Interest

Mr. T. M. Moore has been appointed general storekeeper of the Virginian Railway, with office at Princeton, W. Va.

Mr. George Worling has been appointed master mechanic of the Gainesville Midland, with office at Gainesville, Ga.

Mr. I. N. Jones has been appointed road foreman of engines on the Dakota division of the Chicago & North-Western Railway.

Mr. D. Condell has been appointed car foreman of the Canadian Pacific, with office at Nelson, B. C., vice Mr. W. Fowler, resigned.

Mr. F. Hume has been appointed superintendent of machinery of the Fort Dodge, Des Moines & Southern, with office at Boone, Iowa.

Mr. F. J. Smith has been appointed master mechanic of the Chicago Great Western shops at Stockton, Ill., vice Mr. J. M. Robb, resigned.

Mr. John W. Wyke, member of Division No. 325, of the B. of L. E., has been appointed traveling engineer on the Union Railroad.

Mr. G. T. Duffey has been appointed master mechanic of the Lake Erie & Western shops at Lima, Ohio, succeeding Mr. F. H. Regan.

Mr. A. F. Heine has been appointed storekeeper of the Quincy, Omaha & Kansas City, and of the Iowa & St. Louis, with office at Milan, Mo.

Mr. Geo. W. Trout has been appointed signal engineer of the Pere Marquette, with office at Detroit, Mich., vice Mr. W. J. McWain, deceased.

Mr. F. J. Smith has been appointed master mechanic of the Chicago Great Western, with office at Stockton, Ill., vice Mr. J. M. Robb, resigned.

Mr. N. Kirby has been appointed master mechanic of the Alabama, Tennessee & Northern, with office at Panola, Ala., succeeding Mr. D. D. Briggs.

Mr. Robert L. Doolittle has been appointed superintendent of motive power of the Atlanta, Birmingham & Atlantic, with office at Fitzgerald, Ga.

Mr. S. A. McAlpine has been appointed master painter of the Quincy, Omaha & Kansas City, and the Iowa & St. Louis, vice Mr. A. M. Kain, resigned.

Mr. Edward Hughes has been appointed purchasing agent of the Lehigh & New England, with office at Lansford, Pa., vice Mr. J. B. Whitehead, resigned.

Mr. J. Leys has been appointed foreman erecting shop of the Grand Trunk Railway, with office at Battle Creek, Mich., succeeding Mr. A. G. McLellan.

Mr. Evan Bevan, work inspector of the Lackawanna shops at Scranton, Pa., has resigned to enter the service of the Armour Beef Company at Stamford, Conn.

Mr. Fred Rentchler, formerly with the Wabash Railway at Moberly, Mo., has been appointed boiler shop foreman on the St. Paul & Des Moines

Mr. H. D. Jackson has been appointed master mechanic of the Charlotte Harbor & Northern Railway with headquarters at Arcadia, Fla., vice Mr. S. B. Smith resigned.

Mr. R. C. Morris, member of Division No. 277, of the B. of L. E., has been appointed road foreman of engines of the Southern Pacific, with office at Portland, Ore.

Mr. John Ryan has been appointed superintendent of fuel department of the Missouri, Kansas & Texas, with office at Pittsburg, Kan., vice Mr. John Jopling, deceased.

Mr. W. G. Spencer has been appointed foreman of the machine shop on the Grand Trunk Railway, with office at Battle Creek, Mich., vice Mr. M. H. Westbrook, resigned.

Mr. R. J. McQuaid has been appointed foreman in charge of locomotive and car departments of the Rock Island Lines, with office at Rock Island, Ill., vice Mr. V. W. Ellet, resigned.

Mr. G. H. Gray has been appointed assistant superintendent of the Northern division of the Colorado & Southern, with office at Denver, Col., vice Mr. J. S. Evans, assigned to other duties.

Mr. George E. Cessford has been appointed district master mechanic of the Chicago, Milwaukee & Puget Sound, with office at Miles City, Mont., vice Mr. A. V. Manchester, resigned.

Mr. P. H. Rephorn, general foreman in the motive power department of the Delaware, Lackawanna & Western at Scranton, Pa., has resigned to accept a position with E. L. Post & Co., New York.

Mr. A. C. Adams has been appointed superintendent of motive power of the Spokane, Portland & Seattle, the Oregon Electric, and the United Railways Company, with office at Portland, Ore.

Mr. James Bell, of Division No. 218, of the B. of L. E., has been appointed road foreman of engines with jurisdiction over the Detroit division of the Wabash Railway, with office at Montpelier, Ohio.

Mr. J. H. Henley, member of Division No. 568, of the B. of L. E., has been appointed traveling engineer for the Choctaw, Muskogee, Shawnee, Oklahoma and Tulsa divisions, and Wilburton and Coalgate branches of the Missouri, Kansas & Texas, with office at McAlester, Okla.

Mr. J. N. Mowery, master mechanic of the Lehigh Valley, has been appointed master mechanic of the Western division of the New York, New Haven & Hartford at Waterbury, Conn., vice Mr. C. J. Stewart, transferred.

Mr. James A. Ellis, member of Division No. 96, of the B. of L. E., has been appointed assistant road foreman of engines on the Wisconsin division of the Chicago & North-Western, with office at Chicago, Ill.

Mr. Calvin A. Roenig, agent and dispatcher for the Lehigh Valley at Lizard Creek Junction, Pa., has resigned that position to accept the superintendency of works of the Prince Manufacturing Company of Bowmanstown, Pa.

Mr. C. J. Stewart, master mechanic of the Western division of the New York, New Haven & Hartford, at Waterbury, Conn., has been appointed master mechanic of the Boston division, with office at Boston, Mass., vice Mr. James Hocking, resigned.

Mr. J. L. White, purchasing and supply agent of the St. Louis, Brownsville & Mexico at Kingsville, Texas, has had his headquarters, removed to Houston, Texas, and his jurisdiction has been extended to include the St. Louis & San Francisco lines in Texas.

Mr. H. V. Rosing, mechanical engineer of the Missouri Pacific at St. Louis, Mo., who had been appointed assistant to vice-president and general manager of the St. Louis & San Francisco on April 1, has now been appointed assistant to Mr. W. C. Nixon, vice-president and general manager of the same road.

Mr. Victor W. Ellet has resigned his position with the Chicago, Rock Island & Pacific Railroad as general foreman at Rock Island, to accept a position with the Hunt-Spiller Manufacturing Corporation, of Boston, Mass. This concern it will be remembered, makes the air furnace gun iron castings which are used very extensively on railways.

Mr. Al. Brotherhood, long known to railroad men through his connection with Manning, Maxwell & Moore, has a ranch of 1,500 acres in Isle of Pines, Cuba, where he raises oranges and hogs. Al.

says they make a good combination and our own correspondent on the spot is incapable of deciding which fruit of the soil is preferable.

Mr. John C. Anderson, of Westinghouse, Church, Kerr & Company, of Pittsburgh, Pa., has resigned to take position as mechanical engineer in the sales department of the Pressed Steel Car Company in New York. Mr. Anderson is a graduate of the Sheffield Scientific School of Yale University, and has been connected with the Northern Pacific and Baltimore & Ohio Railroads. He is a son of the late Gen. Adna Anderson, formerly vice president and chief engineer of the Northern Pacific railroad company.

Mr. C. E. Gossett, who was appointed master mechanic of the Minneapolis & St. Louis Railroad some months ago, requests us to announce that his correct address is "Cedar Lake Shops, Minneapolis, Minn.," and not Cedar Lake, Minn. Owing to an error made in the circular announcing his appointment, much of his mail has been incorrectly addressed to Cedar Lake, Minn., and it has caused him a good deal of inconvenience, not only in loss of time taken by letters to reach him, but he has had to send postage to Cedar Lake P. O. for all second class matter. The shops where his office is are named after Cedar Lake, but he is in Minneapolis.

Obituary.

Edwin G. Rouse died at his home in Allentown last March. Over a year ago he underwent an operation, and since then his health has not been good. Mr. Rouse was a very successful business man and at the time of his death was president of the Cement Product Co. of Cementon. About twelve years ago he moved to Lehighton, having been made general superintendent of car repairs from Perth Amboy to Buffalo for the Lehigh Valley Railroad Company. He was connected with the company for over thirty years. After leaving railroad service he went to Fullerton, where he was made superintendent of the Lehigh Valley Car Wheel & Axle Company. Mr. Rouse was a member of Lehighton Lodge 621, F. & A. M. He was also a member of Rajah Temple at Reading.

Another veteran of the railway mechanical world has passed away. On April 2, David Brown, assistant superintendent of motive power of the Lackawanna, died at Scranton, Pa., from an attack of pneumonia, in the 73d year of his age. Mr. Brown received a mechanical training in an English railway shop. He emigrated to the United States in 1870 and went to work as a machinist in the Lackawanna shops at Scranton the same year, where he moved upwards by slow degrees until he reached the position filled at the time of his death. Mr. Brown was one of the best purely practical railway mechanical officials in the country, and he imprinted his views on a wide range of subjects in the discussions at the conventions of the American Railway Master Mechanics' Association which he joined in 1892. In 1898 a new type of consolidation locomotive was built to conform with Mr. Brown's ideas and the engine proved so successful that the form was made a standard. As a shop manager Mr. Brown had few equals and although a strict disciplinarian he continued to be highly popular with those under his supervision. He held an influential public position in Scranton and was captain of company No. 60 Uniformed Rank, Knights of Pythias, and a member of Otsening lodge No. 435, Free and Accepted Masons, of Binghamton, and for thirty-one years was keeper of record and seal of Roaring Brook lodge, Knights of Pythias.

Edward A. Moseley, secretary of the Interstate Commerce Commission, died at his home in Washington, April 18, after a long illness. Mr. Moseley was born in Newburyport, Mass., in 1846. In 1887 he was appointed secretary to the commission which position he held until the time of his death.

Case Hardening.

With the marked improvement in the manufacture of steel that has taken place in recent years the surface hardening of machine parts made of iron, although of no less importance than formerly, does not embrace so many of the parts, especially the smaller requisites of machine and locomotive construction. Undoubtedly it will continue to be largely used in certain classes of work where the elements of durability and elasticity are essential advantages. It is of much value in construction and repair work that machining and fitting can be done on soft and comparatively cheap metal, and then the parts hardened on their outer surfaces to a sufficient depth to insure the highest enduring quality.

In effect the process of case hardening consists in causing the outer surface of soft iron to change into a species of steel, and no small degree of skill and care is necessary to obtain the best results. It may be stated at the outset that the thinner the boxes are in which the articles are to be heated, the better the results will likely be. There is a tendency to have the boxes too large. Boxes of malleable cast iron are the best, and in the bottom of the box there should be a layer of the packing used, which may be of leather cuttings, hoofs, horns or bones, either in their raw state or after being converted into charcoal. Care should be taken to place the articles to be hardened sufficiently far apart from each other, so as to avoid any possibility of contact. During the process of placing the articles in positions in the box powdered prussiate of potash or potassium cyanide should be thinly shaken over the articles. The powder and packing, as well as the articles, should all be perfectly dry.

In the case of the threaded parts of bolts or heads of pins that may be desired to remain soft, a mixture of pipe clay or fire clay with the ashes from the boxes previously used, will form an adhesive coating that will prevent the covered parts from coming in contact with the carbonizing material. Lamp black is frequently used in packing, and where there is more than one layer of articles, a considerable portion of the packing should be in charcoal form. As the materials already alluded to are sometimes difficult to obtain in sufficient quantities, a formula for making case hardening mixture is often successfully used. It consists of sixteen parts of lampblack eighteen parts of sal soda, four parts muriate of soda, and one part of manganese.

The covers of the boxes should be pierced with holes in which testing wires should be inserted. These wires when withdrawn during the heating process, on being cooled and broken by a hammer, will give a good indication of the depth of the hardening which may be expected to occur in the articles when cooled. A steady temperature in the oven is a primal necessity. This should be about 1,700 degs. F. At this heat articles of iron will be of a bright cherry red color. This should be maintained from ten to twelve hours. Some authorities claim that the period of heating should be even longer, as the longer period has the effect of deepening the amount of the steel formed on the surface.

The cooling process requires some degree of care in inserting the articles in the water. The process should be as rapid and equable as possible. Articles that may be curved in shape are readily warped on cooling, but the shape and structure of each article readily suggests the best method of insertion in the water. Taking a locomotive guide as an illustration, if it was placed in the water in the horizontal position it occupies on the locomotive, it would invariably be found to be curved, the side first touching the water apparently slightly shortening. When plunged into the water vertically the guide will remain straight.

As is well known running water is the best for cooling. In workshops, however, it is rarely attainable. Solutions of salt, cyanide and other chemicals may be used to increase the coldness of the water. The hardened surface should penetrate at least one-sixteenth of an inch. Some articles that may be warped or bent in cooling may be straightened by careful handling, but it is well that a slight degree of heat be applied to the articles before attempting the straightening process.

A. S. M. E.

The sixty-third meeting of the American Society of Mechanical Engineers will be held in Pittsburgh, Pa., from May 30 to June 2, inclusive. The society has not met in this city since 1884. The American Society of Mechanical Engineers is one of the foremost organizations of technical and professional engineers in the world, with a membership of over 4,000 in this country as well as abroad.

The headquarters of the society are in New York City, and Col. E. D. Meier of St. Louis is president this year. The society has in the Pittsburgh district alone a membership of about 160. Last year the society held a joint meeting in England with the British society, known as the Institution of Mechanical Engineers. Mr. George Westinghouse, who was president of the A. S. M. E. last year, presented a paper on "The Electrification of Railroads," which aroused a great deal of interest. The British society through its local committees in Birmingham and London entertained the American engineers by showing them many things of professional interest as well as providing delightful social functions.

An Executive Committee consisting of Messrs. E. M. Herr, chairman; George Mesta; J. M. Tate, Jr.; Chester B. Albree; D. F. Crawford; Morris Knowles and Elmer K. Hiles, secretary, will have charge of the Pittsburgh meetings. It is expected that from 300 to 400 members and ladies will be in attendance. There will be professional sessions when papers will be read and discussed. There will also be inspection trips through the leading local industrial establishments, besides automobile trips through the parks, and a visit to Carnegie Institute Memorial Hall, etc.

UNION SWITCH AND SIGNAL COMPANY'S EMPLOYEES AT PENNSYLVANIA RAILROAD TERMINAL IN NEW YORK.

Air Pump and Main Reservoir Capacity for Freight Service.

Mr. P. J. Langan, of the D. L. & W., presented a paper on this subject before the seventeenth annual convention of the Air Brake Association. Mr. Langan's investigations covered a period of several years and the information derived from the tests conducted is of a thoroughly reliable character, that is commended by the association.

To the query as to whether the increased air pump capacity does not invite, to a certain extent, an increase of brake pipe leakage, Mr. Langan replies that the inspectors begin their work immediately after coupling the engine to the train and before the brake pipe pressure is great enough to develop leakage that would otherwise be remedied. Leakage that is noticeable at 70 to 80 lbs. pressure and would be remedied is not given any attention at 40 to 50 lbs. pressure, and on this assumption, brake pipe leakage can be reduced with the increased pump capacity in less time and to a smaller amount than if the engine is equipped with small capacity air supply. Another advantage in large pump capacity is cited in cases where due to picking up or setting out cars, brake pipe leakage increases more than double between terminals and in some cases is three times greater than when leaving the inspection point.

After a careful investigation of the results of the tests conducted, the following table of requirements were submitted by Mr. Langan and accepted by the association:

Per Cent.

Grade.	Pump.	Loads.	Mixed.
1¼	one 9½ in.	40	55
1½	" 9½ in.	35	50
2	" 9½ in.	30	40
1¼	two 9½ in.	65	75
1½	" 9½ in.	55	65
2	" 9½ in.	45	55
1¼	one 11 in.	60	70
1½	" 11 in.	50	60
2	" 11 in.	40	50
1¼	two 11 in.	80	90
1½	" 11 in.	70	80
2	" 11 in.	55	65

In this, the number of cars in a train as shown in the last two columns, descending a per cent. of grade as shown in the first column, requires a pump capacity as shown in the second column, if the necessary factor of safety is to be insured, and if the interstate law in regard to using hand brakes is to be obeyed.

These tests were also productive of a great deal of reliable information concerning proper methods of brake manipulation with special reference to grade work, and much light was thrown upon the subject of time required for the development of the expected results. While comparing the work done by the air pumps, it was found that the 100-car train used for the purpose could be charged to 70 lbs. pressure by the 9½-in. pump in 56 minutes; and by the 11-in.

pump in 22 minutes; and by two 11-in. pumps in 11 minutes. A further performance of the 9½-in. pump was noted in this connection, after 72 minutes brake pipe pressure reached 78½ lbs. and pump was allowed to run 90 minutes thereafter and could not increase pressure beyond this figure. Speed was 140 single strokes per minute.

As to main reservoir capacity, on level roads, a relatively small pump capacity and a large main reservoir volume can be used with advantage, but it is obvious that on grade work, increased main reservoir volume would by no means compensate for inadequate pump capacity.

This paper further states that in considering the best arrangements of pumps and main reservoirs, we should recommend pumps of sufficient size to handle the longest trains without having to crowd them to do the work. We can do without large main reservoir capacity, but pump capacity is indispensable.

Mr. Langan concludes that main reservoir capacity for freight service, should not be less than 50,000 cu. ins. or more than 65,000 cu. ins.

Valve Motion.

Questions frequently come to us as to the difference between direct and indirect valve motions, and while it is easy to answer that locomotives that are equipped with rockers, the end of one arm of which is below the top frame rail and the other end of the arm above the frames, the valve motion is necessarily of the indirect acting kind, yet this does not always answer the question. A description or illustration of the particular kind of locomotive should, if possible, accompany the question, and we could then answer the question fully. It can be readily understood, as we have stated, that in locomotives equipped with a shifting link and rocker, when the eccentric rod is moving the lower part of the rocker arm in one direction, the upper arm of the rocker is moving in the other direction and hence the word indirect describes that particular motion.

There are still a number of locomotives in existence, however, where both arms of the rocker are pointing upwards, the motion being imparted to the rocker by a transmission bar slanting upwards from the link to the rocker arm, the two arms usually deviating somewhat from the same vertical plane in order that the bar and valve rod bolts may be conveniently inserted or withdrawn. Hence, this combination forms a direct motion as the valve is always moving in the same direction as the eccentric that may be in operation.

In locomotives equipped with the Walschaerts valve gear, when the link block is in the bottom of the link or at any point below the center of the link, or in other words, when the locomotive is in the forward motion the gear is of the direct kind, because the radius bar which moves the valve rod is necessarily moving in the same direction as the eccentric rod. When the link block is above the center of the link the motion of the radius bar and connections is reversed and the motion becomes indirect.

Other peculiarities are to be observed in the Walschaerts valve gear. When slide valves or outside admission piston valves are used the radius bar is connected to the combination lever below the valve rod, and the eccentric crank is set at right angles ahead of the main crank, that is, with the engine moving forward. When the motion of the engine is reversed, of course the position of the eccentric crank is then at right angles, or 90 degs. behind the main crank. Where inside admission valves are used the radius bar is coupled to the combination lever above the valve rod while the position of the eccentric is reversed, that is, while the engine is in the forward motion the eccentric is set at right angles behind the main crank. It will be readily understood that these organic variations are necessary because of the fact that valves of the inside admission type are necessarily traveling in the opposite direction from what they would do if they were of the outside admission type.

In the Pilliod valve gear the same changes in regard to the location of the eccentric are observable as in the Walschaerts gear, that is, with outside admission valves the eccentric or return crank is set ahead of the main crank, while with admission valves the return crank follows the main crank. The combination lever in this valve gear also has its variation to accommodate the outside or inside admission valve. With the former the upper arm of the combination lever points backward while in the latter case the upper arm of the lever is so constructed as to point forward.

With these general variations in mind, the particular kind of motion—direct or indirect—or the kind of valve—outside or inside admission—may be readily known, and while the location of the parts and the variations in form may sometimes appear puzzling, the rocker in the one case, and the location of the return crank and connection or form of the combination lever in the others, will readily lead the intelligent observer to a correct conclusion.

P. R. R. Apprentice School.

A railroad school for apprentices has been established at Altoona, Pa., by the Pennsylvania Railroad, co-operating with the Engineering School of the Pennsylvania State College. This has been done for the benefit of regular apprentices in the railroad shops at Altoona. The object of the school is to give apprentices a knowledge of the fundamentals of mathematics, mechanics and drawing, thereby helping them to become better artisans. The large attendance at the school shows that the men are eager to make the most of their opportunities, and the company are more than repaid by the actual increase in the efficiency of their workmen and by the practical assurance of loyalty from the men who have received their training in the service. Systematic work in English is carried on with special reference to writing business letters, filling out order blanks, time cards, and other details.

The work is arranged to cover three "years" consisting of forty-two weeks each. An apprentice receives four hours instruction a week, or a total of 504 hours for the three so-called years. The subjects taught include the elements of many of those in the mechanical engineering course of the best universities; they are mathematics, physics, mechanical drawing, mechanics, mechanism, strength of materials, machine design, experimental tests and shop management. A monthly report of grades is made out by the chief instructor and is submitted to the general office of the company and to the Pennsylvania State college. These monthly reports, with the annual reports concerning each member of the classes, when taken in connection with the regular records of the shop foremen, form an accurate basis on which to select men for particular kinds of work.

Still Older.

An old citizen was proudly exhibiting some of his most valued possessions to a friend who had called to see him. "That table," he said, with the pride of a connoisseur, "is five hundred years old." "That's nothing," came the startling reply from the visitor's son, who was accompanying his father; "we have one at home which is three thousand years old." "Impossible, my dear boy—impossible. What kind of a table is it?" asked the old citizen. "The multiplication table."

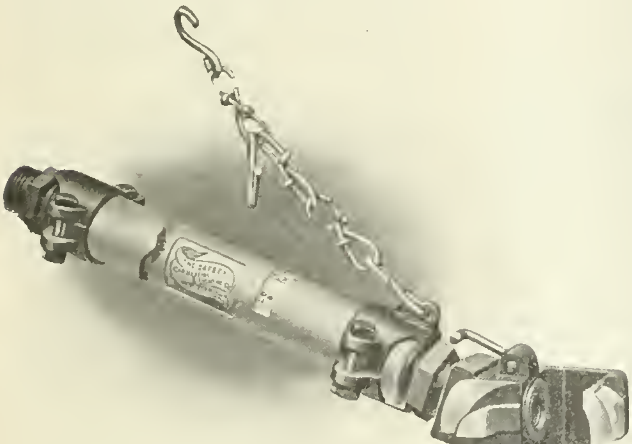
Change of Office.

The American Locomotive Company announces that on April 8, 1911, their Chicago office was moved from the Railway Exchange Building to suite 907-912 McCormick Building, Michigan Boulevard and Van Buren street.

A well-known mechanical engineer, wishing to pay a compliment to a machinist he had known, said, "Wilson always did the most valuable work of which he was capable."

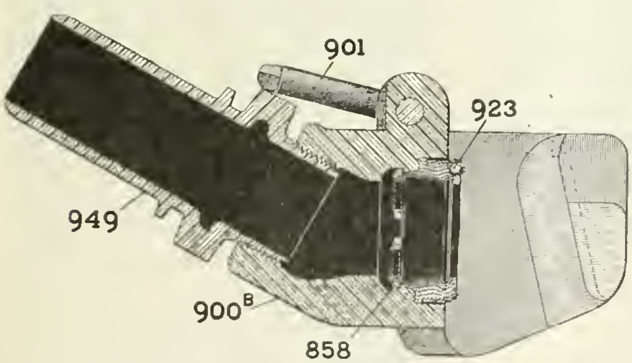
Safety Steam Hose Couplers.

Steam couplers are today so widely used that all railroad employees, who handle such appliances, are quite familiar with their merits. However, there are features concerning the design and use of some couplers, the advantages of which may not be entirely understood by railroad men.



NO. 920-B. S-4 TWO-PIECE COUPLER.

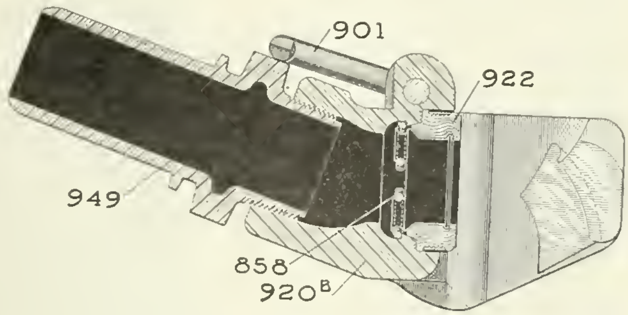
The Safety Car Heating and Lighting Company's coupler head castings are made of malleable iron, having all its guiding lugs, faces and gasket recesses machined with great accuracy, thereby assuring at all times perfect interchange and accurate alignment of gaskets. This results in minimum steam leakage, and guarantees the highest efficiency in the transfer of steam through the train pipe. The gasket is made of special composition, which expands slightly with the heat of the steam, thereby assuring a tight joint. The composition is so tough that many gaskets in constant service last through an entire heating season without renewal. This gasket is very simply retained in the coupler by means of a spring ring, requiring no special tools to apply or remove, and is absolutely secure against falling out by accident. The gasket has a full 1½ in. opening.



SECTION OF 900-B TWO-PIECE COUPLER.

In recent years the trend of railroad practice has been toward larger train pipes, consequently, larger diameter steam hose and gaskets. Among the first to recognize this was the Safety Co., and they at once adopted a positive lock, which would entirely overcome the tendency of the larger diameter of hose to raise the couplers, involving leaks when cars were moving around curves. By means of this lock, which is of the simplest construction, the couplers are securely held together. This feature together with accurate machining and the gasket design have demonstrated their worth for a period of years on many railroads where they are in constant service. There they have shown themselves to have given an exceedingly high percentage of tight joints as was ever accomplished by any known design of straight port steam hose coupler. This is the one and all important function that a railroad requires of a steam coupler. It means safety, economy and comfort. Another feature of this coupler, the Safety Company's design of which was the first to be put on the market, is the construction of the two piece feature. A two piece coupler head which is still in good condition but upon which the steam hose has failed, may be easily re-fitted. By this construction renewals are made with greater facility and the equipment maintained at highest efficiency with minimum investment for repairs.

Another advantage of this coupler is embodied in the nipple and hose band which is so designed that it is impossible for a hose to blow off the nipple and also facilitates the removal of the nipple from the hose when necessary. This coupler has a full 1½ ins. port. the largest diameter in use, and will also interchange with couplers of smaller port area. It has the highest percentage of interchange of any make or pattern of straight port coupler.



SECTION OF 920-B, S-4 TWO-PIECE COUPLER.

We illustrate herewith their No. 920-B S-4 two piece coupler in section and fully assembled with hose, hose bands, nipples, chains, etc., and their No. 900-B coupler which has all the features of the No. 920-B, but made with its guilding lugs on larger lines to couple with the largest couplers in service. Further information may be obtained direct from their New York office at No. 2 Rector street.

NO. 900-B TWO-PIECE COUPLER.

Where They Used To Be.

A Scot who was not celebrated for the sweetness of his disposition was so ill that he needed the attention of a trained nurse. During the last few days of his illness when the nurse was seeking to place a hot application to his feet, and not seeing the outline of them very readily in the darkness of the room, she said as she groped for them, "Dear me, Mr. Crabtree, where are your feet?" "I dinna ken where they're noo," said the sufferer, "but they used to be at the end o' my legs."

Track Scale with Mechanical Hump.

The new standard 52-ft. track scale, the first of which was installed at West Brownsville Jct. on the Monongahela division of the P. R. R., is in many respects quite original, the unique features being the suspension bearings supporting the platform, the mechanical relieving gear which eliminates the dead rail, and the mechanical hump, which provides for proper control of the movement of cars over the scale. All wooden substructure has been eliminated. The main bearings are of the suspension type, providing greater freedom of action of the platform, in that they get rid of the gyration of the knife-edges across the face of the hardened steels. They also provide greater freedom of action of the platform, due to the greater arcs of motion from the point of platform suspension to the base of the scale rail.

In analyzing this bearing it will be understood that the main lever is rigidly supported from the bed-plate castings and that a saddle block, with compensating steel inserted, engages the knife-edge. From this, in turn, two links are suspended, supporting the yoke casting at eight different points, it being a four-section scale. These yoke castings are bolted to Bethlehem section I-beams, forming a metal bridge from which the scale rails receive their direct support.

It will also be understood that with this form of construction it is possible to secure for the platform in a longitudinal direction an oscillating motion, the "cradle principle," with this sliding friction at the supporting ends of the links. Transversely however, an undisturbed pendulous motion is secured, while uniform stresses are obtained at all times for the links by the compensating steels in the saddle blocks. All of the main lever stands and the extension lever stands supported from the four main bed-plates are provided with self-compensating steels wherever a pivot contact is made. The scale is provided with a full capacity beam reading to 300,000 lbs., and is equipped with a poise operated on specially designed ball bearings, which reduces the resistance.

In this type of scale, wind pressure or the effect of snow and ice on the platform will not affect the empty balance of the scale, as the surface platform is supported entirely independent of the scale mechanism.

The tipping of the platform and the overhang at the ends of the scale have been eliminated, and all the vitals of the scale are accessible. The lever system in connection with this 52-ft. scale has been scientifically worked out, and 100 per cent. has been allowed for impact, so that the stresses are entirely within the field of experience. When considering the design of this scale with special reference to the length of the knife-edge and pivot contact, a maximum load of about 4,000 lbs. was provided for each lineal inch of knife-edge. All of the friction steels and contact points in this scale are made of special mixture vanadium steel, it being claimed for this steel that it is less susceptible to corrosion, and that it will give longer life and more enduring accuracy as the result of the greater resistance to frictional wear.

P. R. R. AUTOMATIC TRACK SCALES.

Probably the most interesting feature is the relieving gear, which takes the place of the dead-rail system. It also eliminates the second track over the scale, as well as the approaches and switches at either end, leading to and from the scale. The primary construction of the relieving gear consists of a series of eight toggle lever jacks, supported in pairs by the universal bed-plates. These jacks are operated by the tension shaft with suitable link connections at each of the four sections. This shaft is, in turn, operated by a double-ended cylinder controlled by the weighmaster in the scale office. The controlling power used is either air or water, air pressure being preferable. In case the power gives out, the arrangement is provided with a hand-operating mechanism that can be quickly connected.

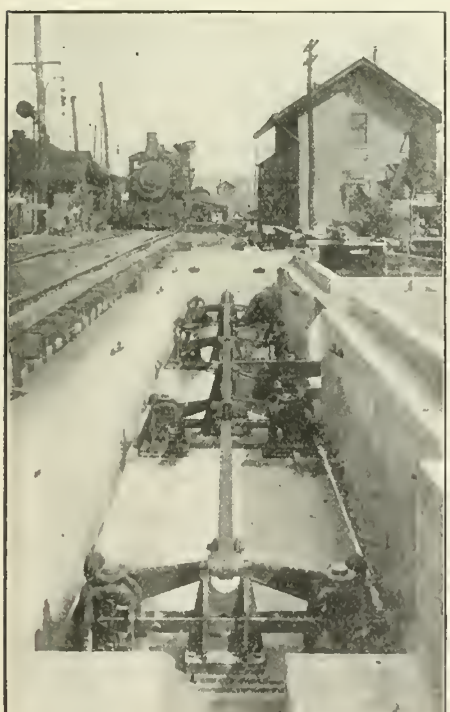
When it is desired to make a dead track out of the scale track, the weighmaster simply operates a four-way control valve, which causes the four pairs of toggle jacks to be put in operation, so that the vertical pistons or plungers travel upward against the I-beams supporting the metal bridge. This section raises the platform from a position of repose on the suspension links by taking all weight off the knife edges without causing the knife-edge contact on the bearing steels to be disturbed. When the jacks are operated for the purpose of making the scale track a dead track, the semaphore arms at either end of the scale (which are indirectly connected to the torsion shaft) are simultaneously operated, the position of the arms indicating when the scale can be used for weighing or when the dead-rail is set for the use of engines, etc.

The total weight of the platform is about 38,000 lbs., and with about 80 lbs. pressure per square inch in the cylinder the bridge can be raised so that a class "H-6" engine loaded will not show any weight on the beam when going over the scale. The track over which the cars pass to the scale platform is provided with a hump having a fixed apex at a short distance from the adjacent edge of the scale platform, and the slope is so proportioned at the side of the hump adjacent the scale to the distance of the apex from the scale platform, and the rate at which it is desired to weigh the cars, that when the cars are pushed at a uniform rate up the side of the hump remote from the scale, and are uncoupled from each other, before or while being pushed up the hump, each car will run down the hump and onto the scale platform with the proper velocity to permit it to be accurately weighed.

It is a matter of common knowledge that the cars passing over a railway scale located at the head of a classification yard are not of one pattern, and in particular that the distances between the front and rear wheels vary in different cars. With the advent of the mechanical hump, however, this variation in wheel base length is, in a measure, automatically compensated for. When the side of the hump adjacent the scale platform is short, as it should be, the increase in velocity acquired by the cars running down that side of the hump varies inversely with the length of the wheel-base of the car, other things being equal. For rapid and accurate weighing, it is desirable to have the scale platform and the adjacent side of the hump as short as possible, and in practice it has been found advisable to make the side of the hump adjacent the scale platform about equal to the distance between the centers of the wheel trucks of the cars having shortest wheelbase.

The construction of the hump provides for two sets of box chords or girders. These two sets of box chords are supported at the center, which forms the apex of the hump, by rigid steel castings supported by abutments on either side, to which bed plates are bolted. These same abutments also support on either side, directly under a vertical center line through the rails, two toggle lever jacks of the Sampson screw type, which are universally connected by an extension socket, and which are operated by a hand ratchet with lever arm at the center.

At the four ends of the box chords are bolted pivotal castings which are also supported by bed-plates on the abutments. Surfaced hardwood ties are bolted to the box chord system, to which in turn are bolted square cast iron columns which project through the platform covering the top of the enclosure, and to these columns the rails forming the track over the hump are bolted with rail slips. The

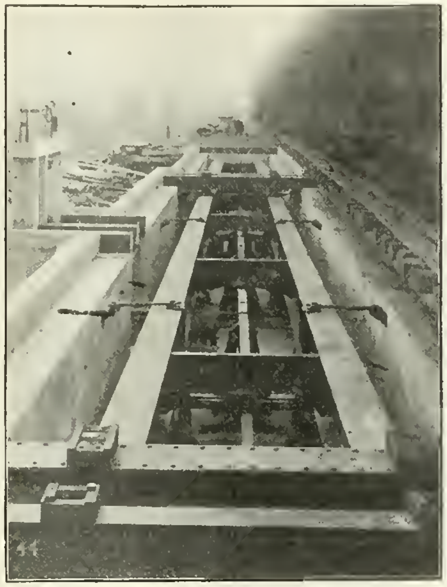


ARRANGEMENT OF LEVERS.

present design of hump provides for a vertical rise of eight inches at the apex, the latter being located about twenty-five feet from the scale. Most of the features in this scale are covered by patents, which were taken out by Mr. A. W. Epright, scale inspector of the P. R. R.

First Aid on the P. R. R.

Follownig the lead of the Canadian-Pacific Railway in giving instruction in first aid to the injured, the Pennsylvania Railroad officers are extending



TRACK SCALES WITH CARRYING GIRDERS.

their methods of giving instruction. To this end demonstrations are given to employees and a card circular has been prepared for distribution to employees at the lectures delivered by medical examiners of the company.

The printed instructions that will be distributed to all employees of the Pennsylvania Railroad are entitled, "Hints on First Aid to the Injured." "Keep Cool" is the first admonition. Employees are then advised to send for the nearest physician after which the injured or ill person should be placed on a standard stretcher, a number of which are provided on cars, in stations, shops, and other places. "Keep the Crowd Away" is the next heading on the circular, which also warns employees against touching open wounds with their hands.

The "First Aid" packet is described in the circular. It contains two aseptic compresses in oil paper, one cambric bandage, one triangular bandage and two safety pins. The details of dressing a wound are then gone into. Following the general instructions the circular deals with accidents and ills which are most frequent, giving specific and detailed instructions for first aid. An important part of the first aid work of the Pennsylvania Railroad is in instructing employees in methods for resuscitation from electric shock. The use of electricity on the New York Improvement and the West Jersey Seashore Railroad has made it necessary to lay stress on this.

Since the Pennsylvania Railroad undertook to instruct train, station and shop employees in methods of giving first aid to the injured, practically every such employee on the system has attended lectures by the company's medical examiners. Last year 228 lectures were given to no less than 6,854 employees. This year it is the intention of the management to prosecute this work even more vigorously.

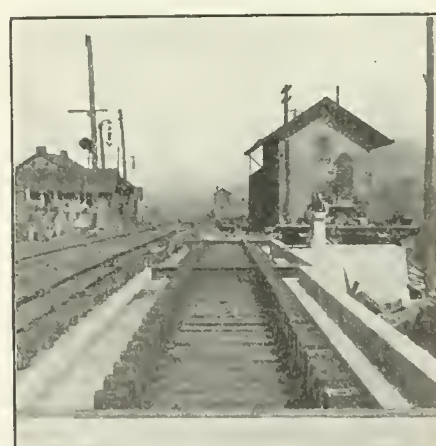
Irish Mixed Metaphor.

Some of the Irish members of parliament have caused much amusement by the mixed metaphors they used in their speeches. A famous perpetrator was Sir Boyle Roche. Sir Boyle was once dilating upon the unsettled condition of Ireland and stated that his house was attacked by a band of ruffians, but they were so hotly received that not a soul escaped except two who were drowned in a bay.

A modern Irish politician on the stump before last election said: "Gentlemen, I say they'll keep cutting the wool off the sheep that lays the golden eggs till they pump the well dry. I venture to say, fellow-citizens, that there is not a man, woman or child in this building who has attained the age of fifty years but who has felt these mighty truths thundering in their ears for centuries. (Applause.) The young men of Ireland are the backbone of the Empire. What we have to do is to train that backbone and bring it to the front."

Improved English Railway Methods.

The English railways in the last ten years have increased earnings per goods train mile from 71d. to 94.78d.,



SCALES WITH TRACK SUPPORTS.

or nearly 34 per cent. The advance made in the last decade is due to improved methods of working, more scientific loading of cars, and the readjustment of rates have been adopted by the English railways during the last ten years, and the results have justified the changes. During this time 14.3 per cent. increase in goods train receipts has been brought about, while 14.5 per cent. decrease in goods train miles has been achieved.

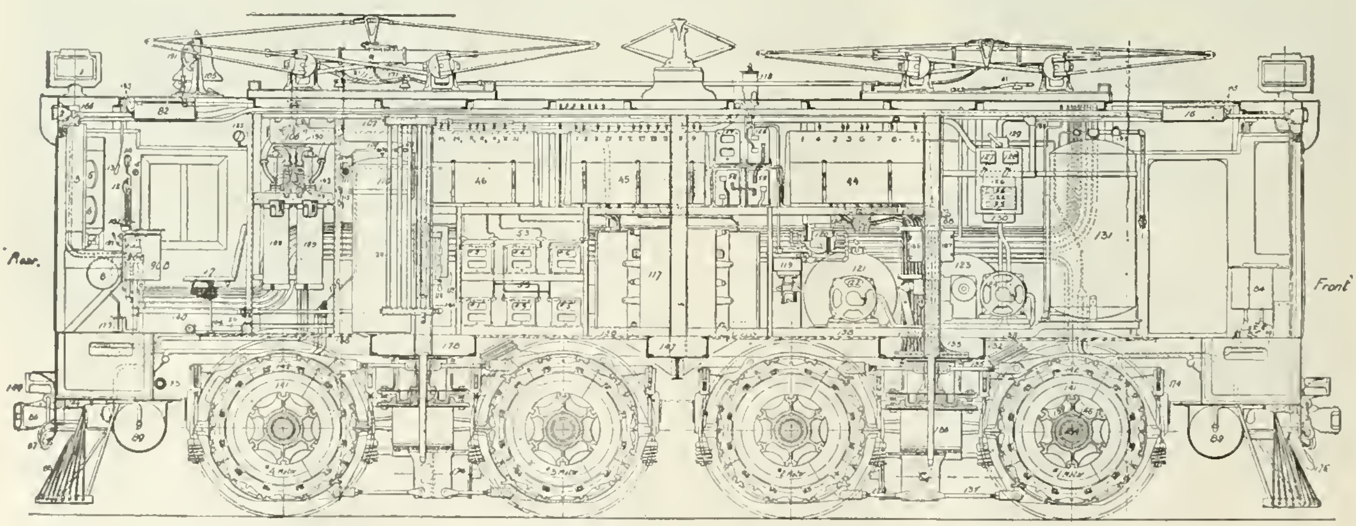
Electric Locomotives.

A correspondent of ours, Mr. C. B. Chaney, has sent us a photograph of the Pennsylvania electric that drew the first scheduled passenger train through the tunnel on Sept. 8, 1910, the day the Long Island Railroad end of the New York

PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVE.

Tunnel was opened. The train was No. 204, the Greenport express, leaving New York at 8:25 a. m.

There are twenty-four of these engines, the electrical parts being built and assembled by the Westinghouse Electric & Manufacturing Company, while the wheels, rods, frames, cabs, etc., or the locomotives proper, were built at the Pennsylvania Railroad shops at Altoona, Pa. The workmanship and finish of these handsome machines are remarkably fine, and they run very smoothly. As will be seen from our illustration each



SECTIONAL VIEW OF N. Y., N. H. & H. ELECTRIC LOCOMOTIVE WITHOUT LEADING WHEELS.

locomotive consists of two half units, coupled back to back, each half unit being, as far as running gear is concerned, a standard 4-4-0 type locomotive. These engines were designed to start, from a state of rest, a 550-ton train on a 2 per cent. grade and accelerate to sixty miles an hour. That is excellent work. A 2 per cent. grade equals 105.6 ft. to the mile.

The principal dimensions of the electric locomotive are as follows: Diameter driving wheels, 72 ins.; diameter armature, 56 ins.; driving wheel base (half unit), 7 ft. 2 ins.; total wheel base (half unit), 23 ft. 1 in.; total wheel base (whole locomotive), 55 ft. 11 ins.; extreme length, 64 ft. 11 ins.; weight on drivers (half unit), 111,600 lbs.; weight on drivers (whole locomotive), 223,000 lbs.; total weight, complete locomotive, 328,800 lbs.; voltage, 600; maximum h. p., 4,000; maximum tractive power, 69,300 lbs.

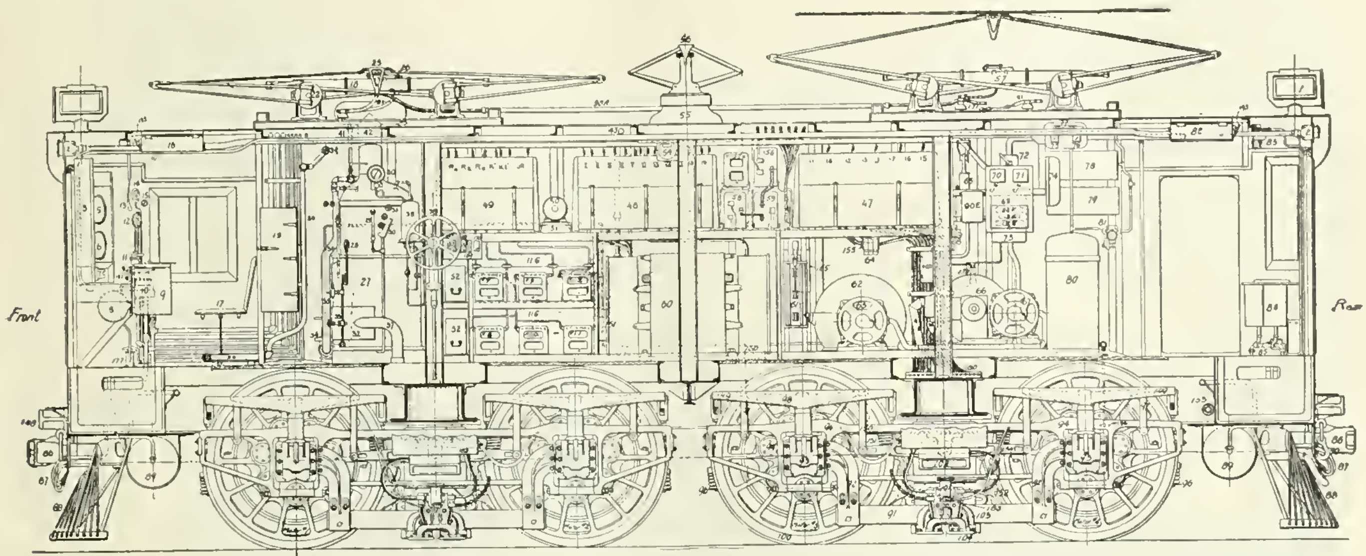
Looking at these fine specimens of the locomotive builders' and electricians' art, it is interesting to compare them with the N. Y., N. H. & H. electrics, two sectional line illustrations of which we give. The Pennsylvania locomotives are practically two half units coupled together. The New Haven electrics, which were more fully described in our April, 1910, issue, page 149, are built so that the general plan of trucks and running gear were worked out in accordance with a patent granted to Mr. S. M. Vauclain July 6, 1909. This patent covers an articulated locomotive in which the truck frames are connected by an intermediate drawbar. One truck has only a rotative motion about its centerpin, while the other has a fore-and-aft as well as a rotative motion, in order to provide for the angular positions of the trucks and drawbar when the locomotive is traversing curves. The tractive force is transmitted through the truck frames and drawbar instead of through the main frame.

Unexpected.

"This is so unexpected," she said. He gave her the necessary time, and she finally decided that he fulfilled all the requirements of the situation. Then they reached a point where they could discuss matters calmly. "Of course," he said, jokingly, "it wasn't really unexpected at all." "Oh, yes, it was," she replied. "Absurd!" he exclaimed. "A girl always says that. She knows what's coming, because she is naturally an expert in such matters." "I thought I was, but you fooled me," she insisted. "And it was a complete surprise?" "It was." "I don't understand it," he commented. "Well," she explained, ingenuously, "you had overlooked so many splendid chances that I gave you for a proposal that I had begun to think nothing ever would give you nerve enough to speak out; so it really was unexpected."

Interstate Commerce Report.

The twenty-fourth annual report of the Interstate Commerce Commission has just been issued from the Government printing press at Washington, D. C. The report covers 360 pages and presents the fullest details that has yet been presented of the work of the commission. The bulk of the volume is taken up by reports of suits tried in various courts, particularly in regard to the question of rates. The difficulty of measuring the fairness of charges for transporting particular classes of freight in certain localities becomes very apparent in looking over these reports. The subject of safety appliances is treated with marked brevity, considering its importance. There is an interesting item in regard to the ash-pan law. In the report it is stated by the commission that complaints have been received that some railway companies have sought to fulfill the letter of the law by introducing small apertures in the sides of the ash-pans, very often in such positions that they are obstructed by the driving wheels. The time and labor necessary to clean an ash-pan through these openings is so great that the workmen often prefer to crawl under the locomotive and clean the pans through the front and rear openings, thereby being induced to evade the spirit of the law. In other locomotives the ash-pans are partially cleaned out by jets of steam, but it is finally necessary for the men to go under the engines in order to dislodge the residue after the blowers had done all that they are capable of.



SIDE VIEW OF ELECTRIC LOCOMOTIVE N. Y., N. H. & H. AS FIRST BUILT.

Different When Coupled.

An Irish couple whose married life was far from blissful once received a homely lecture from their spiritual adviser on the subject of their frequent quarrels. "That dog and cat of yours," said his reverence, "agree far better together than you do." "Shure, an' that's true," agreed the husband, but tie thim together yer riverince, an' see what'll happen thin, begorra."

Two of a Kind.

"My good man," said the kind old lady to the ex-convict who had called begging, "what were you in for?" "Robbing the guests in a hotel, mum." "Ah! were you the proprietor or the head-waiter?"

Collins Flange Lubricator.

The Collins Metallic Packing Co., of Philadelphia, have on the market a wheel flange lubricator which is reported to be doing good service. An adjusting device permits it to be set at any desired angle after being attached to the frame. It may be set to avoid sand pipes or other parts, and the efficiency of the lubricator is not diminished in the least. It may be set at either the front or the back of wheels, but preferably on front of leading driver and rear of back driving wheels, but should always be set slightly above centre line of wheel. The Collins company inform us that after being so adjusted, an engine will make an average trip of 200 to 300 miles without further attention.

Flange lubrication when properly carried out saves the ball of rail on curves and when the flange strikes the ball of the rail the lubricant becomes operative and the coating, removed by the contact, is replaced immediately. It does not interfere with the tractive power of the engine, as it is applied only to the flange. The heating of the tire, due to excessive braking, does not affect the lubricator. Write to the Collins company for a copy of their illustrated folder on the subject.

THE ELECTRIFICATION OF A MODERN RAILWAY.

The Chicago office of the Atlantic Equipment Company were on April 8, 1911 moved from the Railway Exchange Building to suite 907-912 McCormick Building, Michigan Boulevard and Van Buren street.

New Clearance Registering Car.

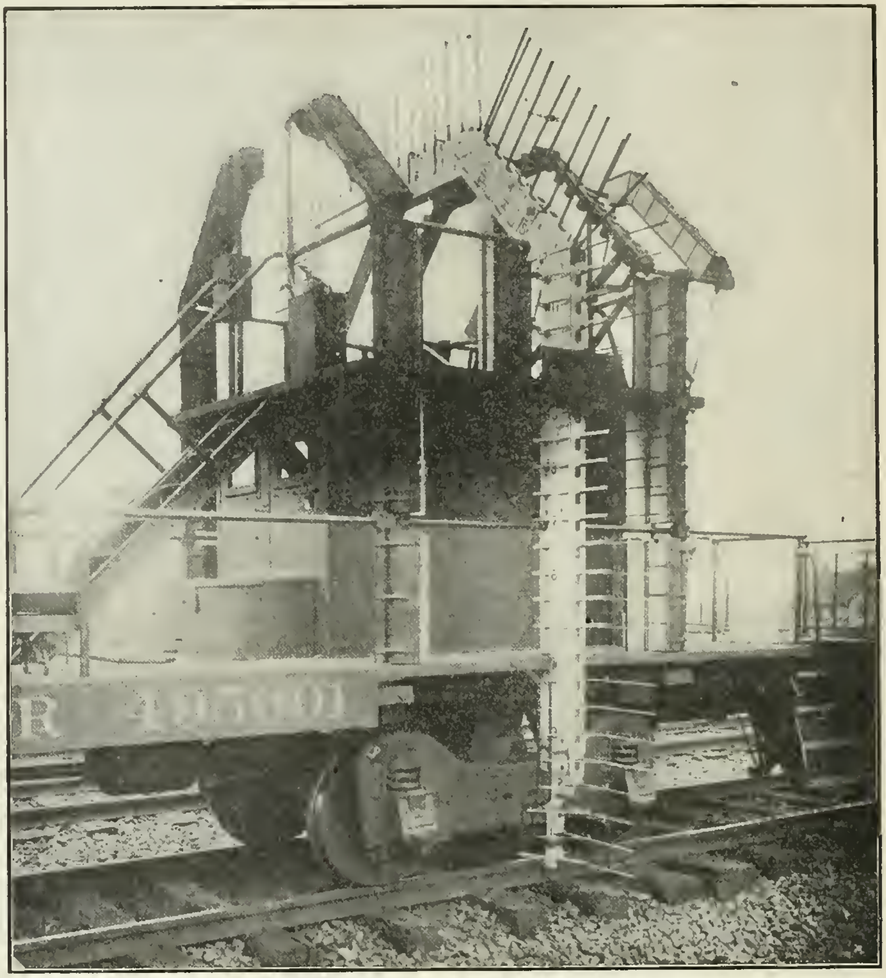
A new clearance car has just been placed in service on the Pennsylvania Railroad Lines east of Pittsburgh and Erie. This car was designed in the office of the Engineer of Maintenance of Way and built at the company's Altoona shops and is being run over every division as rapidly as possible in order to secure correct measurements of the distances from the track to projecting portions of station buildings, tunnels, bridges and other objects. It is also designed to indicate automatically while moving on curves the elevation of the rails and the degree of curvature.

The car, which is 54 ft. 8¾ ins. long over all, and 30 ft. between truck centers, is built entirely of steel, and is equipped with air brakes, steam fittings and electric lights. The main floor is 4 ft. 5¼ ins. above the top of the rail and at the front end of the car where the templets are placed is a second floor at an elevation of 9 ft. 8 ins. above the top of the rail Both floors are for use of those taking measurements from the templets. The second floor is reached by steel stairways on each side of the main templet.

All measurements are taken at the center of the steel truck, from which clearances are computed. The main templet, which is erected directly over the center of the truck, has a width of 10 ft. between elevations, 2 ft. and 12 ft. above the top of the rail, exclusive of the fingers or feelers attached to the sides. From an elevation of 12 ft. above top of rail, the templet recedes towards the middle of the car at an angle of 45 deg., reducing the width of the templet to 4 ft. at the top, at an elevation of 15 ft. above top of rail.

CURVATURE AND RAIL ELEVATION INDICATOR.

Immediately in front of the main templet is an auxiliary templet, designed to measure overhead bridges, tunnels, roofs and other objects between elevations 17 and 20 ft. above top of rail. This auxiliary templet has the same dimensions as that part of the main templet between elevations 12 and 15 ft. It is supported on a center shaft enclosed in an upright cylinder and is capable of being raised to a height of 18 ft. by a crank and ratchet arrangement on the floor of the car. Enclosed in steel cylindrical boxes with translucent glass fronts facing the templets is a series of electric lights which extend from the floor of the car on each side thereof to a height of 15 ft. above top of rail. The well-diffused light thus obtained makes it possible to take measurements both day and night, as well as in dark tunnels.



P. R. R. CLEARANCE CAR; VIEW OF MAIN TEMPLET.

The fingers or feelers attached to the sides and the top of the templets are 2 ft. long and are spaced 6 ins. apart. They are hinged to the templets and held in the different positions by friction. Attached to the feelers and the sides of the templet are graduated scales which indicate automatically the distance from the rim of the templet to a side or overhead object. In addition, a small board equipped with a set of feelers spaced 1 in. apart has been provided, to measure cornices of roofs, of shelter sheds, or other irregular objects close to the track. This board is detachable and can be fastened to the side of the templet at any point desired.

As the car passes over a curve, an attachment on the rear truck of the car indicates the degree of curvature on a scale inside of a cabinet which has been erected in the middle of the car. In this cabinet is also an instrument consisting of a long pendulum suspended vertically which indicates automatically the elevation of one rail of the track over the other. The side of this cabinet facing the main templet has been provided with a plate glass window, which enables the operator of the car to read the degree of curvature, or the elevation of the rail at any time.

With all of the attachments working automatically, it is possible to take clearance measurements while the car is running at a speed of four miles per hour; this is necessary at times in order to keep out of the way of regular trains. Though two men can operate the new clearance car, one taking the readings of the scales and the other recording them, where clearances are close and irregular it requires the services of three men.

Forearmed.

"With all your wealth are you not afraid of the proletariat?" asked the delver in sociological problems.

"No, I ain't," snapped Mrs. Newrich. "We boil all our drinkin' water."

Safe Travel.

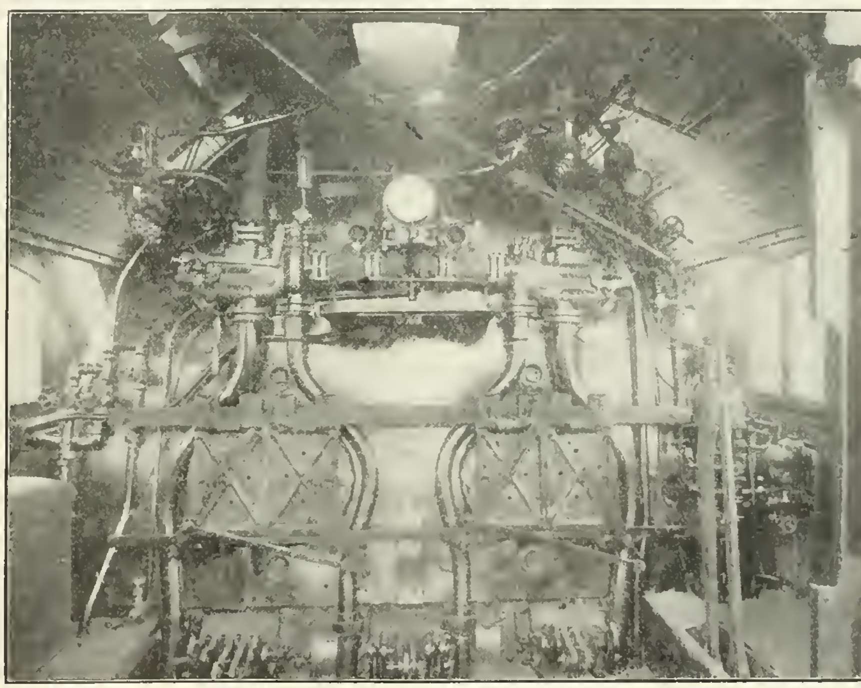
Records compiled by the Vandalia Railroad Company show that in 1908, 1909 and 1910 not one passenger out of a total of 9,800,030 carried on that road was killed in a train accident. The Vandalia is a part of the Pennsylvania system, and operates 923 miles of line. In the past three years the equivalent of 330,348,935 passengers have been carried one mile, and not a single passenger was killed. Counting all passengers injured in the three years, however trivial, there were only 67. These figures are taken from reports made to the Interstate Commerce Commission by the Vandalia Railroad, and show that the accident record of the Vandalia has even exceeded that of the Pennsylvania Railroad east of Pittsburgh, which, it was recently announced, carried over 300,000,000 passengers in the past three years and had only one killed as a result of a train accident. The Pennsylvania, however, equaled the Vandalia in having a clear record in 1908 and 1910.

Crandall Packings.

Catalogue No. 6 of the Crandall Packing Company, of Palmyra, N. Y., is a very well illustrated and comprehensive description of the products of that well-known concern. Their packings are fibrous, semi-metallic and metallic, and are adapted for every service, including steam, water, air, acids, gas and ammonia. The catalogue, which contains 144 pages, is illustrated with half-tones showing the general appearance of the many varieties of packing made and in a number of instances sections of the packing are shown and this reveals the construction and composition of the packing so as to render the letterpress almost unnecessary. The styles are all numbered for the purpose of ordering, and a description with price follows. The Crandall Company will be happy to send a copy of this catalogue to anyone who is interested enough to apply for one.

Catalogue No. 4815.

The General Electric Company, Schenectady, N. Y., have just issued a fine catalogue, No. 4815, describing and illustrating a number of their varied systems of motor drive for metal working machinery. The application of either alternating or direct current drive to machines of the kind referred to has come to be looked upon not only as the most economical in method, but in many respects the most flexible and efficient. There are about 80 illustrations presented, ranging from the lighter type of drill presses equipped with one horse power motors to heavy planers and lathes of twenty horse power. A marked improvement in the placing of these motors on the various machines is shown in the fact that nearly all of them may be said to be almost hidden in the frames of the machine. The elimination of countershaft drive preserves the head-room necessary for cranes and hoists used in serving the tools, while the greater cleanliness, purer air and better surroundings of the motor-driven shop increases the comfort and activity of the workmen. The work of the General Electric Company in these directions have been eminently successful, and it looks as if the days of the slipping



INTERIOR OF CAB OF B. & O. MALLET COMPOUND. (See Page 217.)

belts, with all the dangers that method implied, were coming to an end. Copies of the catalogue may be had on application to the company at Schenectady.

Fuel Association Meeting.

The third annual convention of the International Railway Fuel Association will be held at Chattanooga, Tenn., Hotel Patten, on May 15, 16, 17 and 18, 1911. The hours of session are from 9 A. M. to 1 P. M., daily, excepting May 17, when there will be morning and afternoon sessions. The subjects of papers at the convention are: 1. Fuel Investigations Under the Bureau of Mines, Dr. J. A. Holmes, chairman; director Bureau of Mines. 2. How to Organize a Railway Fuel Department and its Relations to Other Departments, Mr. T. Duff Smith, chairman; fuel agent, Grand Trunk Pacific Railway. 3. The Testing of Locomotive Fuel, Mr. F. O. Bunnell, chairman; engineer of tests, Rock Island Lines. 4. Standard Locomotive Fuel Performance Sheet, Mr. F. C. Pickard, chairman; assistant master mechanic, C. H. & D. Railway. 5. The Railway Fuel Problem in Relation to Railway Operation, Mr. R. Emerson, chairman; engineer track economics, A. T. & S. F. Railway. 6. Petroleum, its Origin, Production and Use as Locomotive Fuel, Mr. E. McAuliffe, chairman; general fuel agent, Frisco Lines. A trip has been planned for members and their families to Lookout Mountain, also to Chickamauga Park. On the evening of May 17 a banquet will be given at Hotel Patten, for members, their wives and invited guests. Mr. D. B. Sebastian is secretary of this association and any further information may be obtained from him. His address is 721 La Salle Station, C. R. I. & P., Chicago, Ill.

Mistaken Identity.

The officials of the Panama Railroad were troubled by the number of unauthorized passengers on the freight trains. In spite of the most rigid efforts to solve the problem, the situation was not improved, and finally a number of native patrolmen were stationed along the track with strict orders to arrest any person jumping on or off a moving train.

Something less than a day later one of the guards stumbled into the Culebra station in a much ruffled condition, dragging after him a vainly protesting captive. Both had evidently been through a rough-and-tumble fight, and there were unmistakable signs that it had not been finished to the satisfaction of either.

A crowd gathered on the run as the guard explained to the station official, "Caught dis man hoppin' on dat train about a mile down de road, sah."

The prisoner endeavored frantically to make himself heard, but the patrolman threatened him into silence with his stick. "He was half way to de roof when I grabbed him, sah."

Again the prisoner struggled, and again his captor produced the club. "But I yanked him to de ground, sah, just as you told me, and here he am, sah."

With a desperate effort the prisoner finally jerked himself free. He was the brakeman.—*Youth's Companion.*

Rural Summer Homes.

The department of the Erie Railroad which is presided over by Mr. R. H. Wallace, general passenger agent, has recently issued a most artistic pamphlet with the title, "Rural Summer Homes." It is an illustrated guide to homes adjacent to New York on the Erie Railroad and its branches and those on the New York, Susquehanna & Western. The illustrations are in colors and many are the charming views of this "summer homes land." Every town or hamlet reached by the railroad is given, the names of the hotels or private houses in the vicinity are listed, with name of proprietor, the number of guests that can be accommodated, the rate charged per week. The railroad fare is also given and there is a most excellent map of the entire region at the back of the book so that all the information requisite for picking out a pleasing summer resort is before the reader and any further information concerning the subject may be had by writing to the general passenger agent.

Hardening a Hammer.

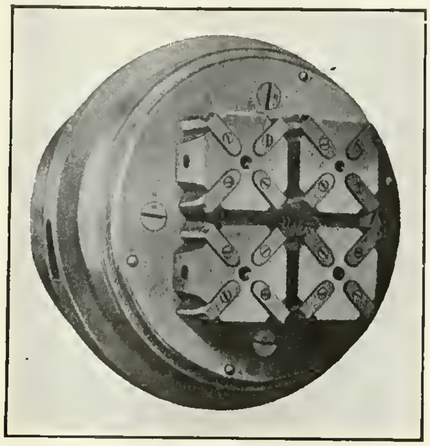
When the hammer has been heated slightly more than what might be considered a good uniform hardening heat, dip the small end almost up to the eye and cool as quickly as possible by moving it around in the hardening fluid or dip, as it is called in the shop. Then dip the large end, which in the meantime will have cooled to a slight extent. It will be noted that the heat remaining in the eye of the hammer will draw the temper quicker in the small end of the hammer so that it will be too hard The operation requires quickness and carefulness. The result will be that the hammer is hard where it should be, and also free from the danger of cracking in the eye.

Troubles of Honest Poverty.

A lady who once was poor, and now is rich, writes:—I say the blessings of poverty simply don't exist, and I speak whereof I know, for when I was a girl all the energies of our family were spent in keeping ourselves alive in that position of respectability in which it had pleased Providence to place us. Some women in my position would be dishonest enough—or stupid enough—to profess to regret the loss of the days of "careless liberty," when they were free from the cares and responsibilities wealth brings, but whenever these subjects are discussed I frankly confess that I shudder at the recollection of my days of poverty, and then people say that I am worldly.

Multiple Die Heads.

A multiple automatic die head for bolt threading machines has been got out by the Newton Machine Works of Philadelphia. In the die head, the



DIES CLOSED.

chasers are of a standard form made by one of the largest manufacturers of automatic die heads. They are interchangeable and are of the "hobbed" type as purchasers sometimes desire to re-hob them and make new chasers. The chasers are ordinarily made of carbon steel, but can be made of high speed steel where preferred.

The die holder is of 50 point carbon steel and the chasers are fitted into a slot milled from the solid, having a bearing on two sides and the bottom, and each is held in place by one screw. The four chaser blocks are operated together and each is independently locked in its position by a special arrangement, which prevents any movement whatsoever. The head is arranged for automatic opening and closing or can be operated by hand, the construction of the head being such that when opening automatically it does not leave a "finn" or "burr" the length of the chaser at the end of the thread because of its radial action.

Too Bad.

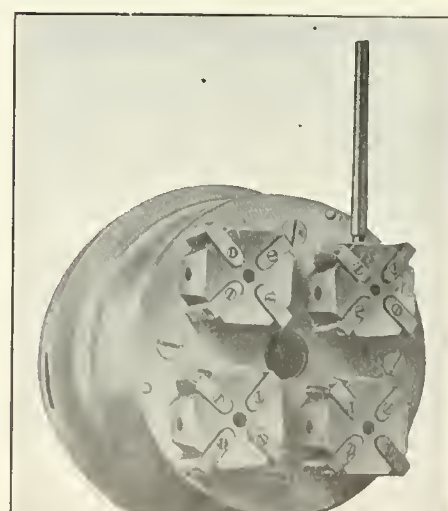
Mr. Dooley says: "What I object to is whin I pay ten or fifteen cents f'r a magazine expectin' to spind me avenin' improvin' me mind with th' latest thoughts in advertisin' to find more than a quarther iv th' whole book devoted to lithrachoor."

Electrification.

Railroad Electrification is the title of an elegant 32-page pamphlet containing a reproduction of a series of talks and illustrations sent to the technical magazines by the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., and now collected in catalogue form. The work conveys a striking impression of the important steps that have been made in the progress of the electrification of railroads in the vicinity of the larger cities, and is, in brief, an epitome of the important work already accomplished in this comparatively new department of motive power. The three established systems of railway electrification and the Westinghouse Company's apparatus for any plan which may be considered best suited are described. These systems are the direct current apparatus, single-phase alternating current, and three-phase alternating current apparatus. These various systems are now all in operation under the most favorable circumstances and the pamphlet, which is described as Circular No. 1517, presents an excellent resumé of the work and methods used. Copies may be had on application to the company at Pittsburgh.

Purdue University.

The Bulletin of Purdue University, Vol XI, No. 3, gives a very interesting description of the shops and engineering laboratories of this noted educational institution. As is well known the equipment is the best and the admirable illustrations presented in the bulletin gave one a good idea of the vast and substantial architectural and mechanical features that



DIES OPEN.

distinguished the establishment. In regard to the work done in the workshops, the greater number of patterns and castings are the product of the shops, and the greater part of the machinery and equipment has been manufactured there. The interior views of the shops have a business look about them that is stimulating. The railway laboratories are the most complete in America and embrace the entire department of motive power, while the Master Car Builder's apparatus used in every kind of car work is located there. A copy of this Bulletin might well be in the hands of students who anticipate taking up a course of study.

His Hobby.

Our friend, Billy Wilson, readily admitted that he was stuck on valve motion. "I can't help it," he remarked. "It is my principal pleasure. It's my one hobby."

Billy was like a man I met in an insane asylum who was riding round on a broom that he was dragging around as fast as he could make it go.

"That's a magnificent horse you've got," remarked a visitor.

"I am not riding a horse," said the inmate. "If it was only a horse, I would jump off. This is a hobby that I am riding, and the devil won't let me get off."

Air Brake Convention.

The eighteenth annual convention of the Air Brake Association will be held in the convention hall of the Auditorium Hotel, Chicago, beginning Tuesday, May 23, 1911. A very full attendance is expected. Mr. Fred M. Nellis (58 State street, Boston, Mass.), is the secretary, and from him any information may be had concerning the meeting, transportation arrangements or hotel accommodation. Mr. T. L. Burton, general inspector on C. R. R. of N. J., is president this year.

Change for the Worse.

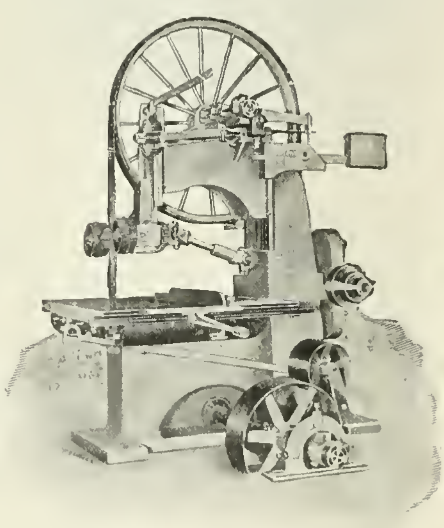
A story from Harry Lauder: An acquaintance of his keeps some big drug stroes in Glasgow, and is now a most successful man. "I remember, however, when he first started things went badly for a time with him," said Lauder, "and one day I found him in despair. 'Have only had two customers all day,' he said. 'The first spent twopence, and the second, a little girl, nothing. All she wanted was change for a threepenny-bit,' as she said, 'my granny's feared it's no a gude ane.' "

Heavy Band Rip Saw.

There is hardly a woodworking shop in existence that does not have lumber to rip, from the smallest wheelwright shop to the largest car shop. This latter class of mills, for a long time used circular saws, and these saws, of course, answered the requirements as long as no better tools could be procured. The band rip saw has now come and is quite revolutionizing lumber ripping. Its thin blade saves a tremendous waste in saw kerf, and this soon amounts to a big sum, especially when fine lumber has to be cut. It is everywhere replacing the circular saw by doing the work at a much greater saving with economy, efficiency and greater output.

Some of the credit for this improvement in ripping machinery is due to J. A. Fay & Egan Co., Cincinnati, O., the largest individual firm in the world making standard woodworking machinery. For a long time they recognized the demand for a machine that was capable of answering the most exacting requirements in mills having large quantities of lumber to rip, and after the most patient and painstaking experiments, getting out new and original inventions, and having a long experience they furnished a tool that is now without doubt one of the best in this class.

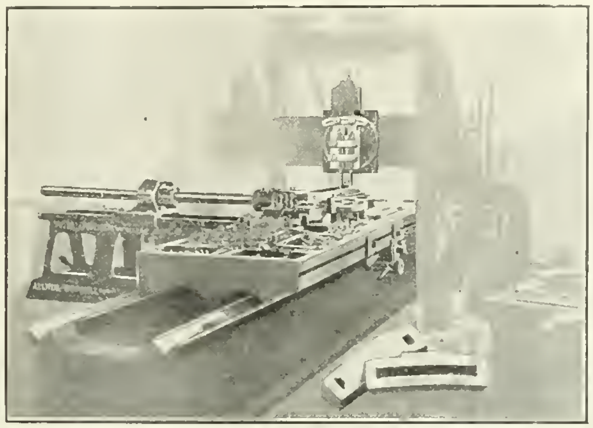
It is a pleasure to present the picture of this No. 109 Band Rip Saw. The saw is designed for doing any kind of ripping in large and heavy timbers. It will rip with facility and thickness from half an inch to 14-in. and 28-in. wide. While it is adapted for heavy work, it is equally efficient for ripping the finest lumber into small strips, and it is here that the thin blade of the saw will be appreciated better than at any other time. It presents such an array of original features and improvements that only circulars can adequately describe them, but this one will serve as a guide to many others. The patent straining device on the saw blade is hung solely on a knife-edge balance, and this gives a continual uniformity in the strain and prolongs the life of the blade very much. You are invited by the manufacturers to write for large illustrated circular.



HEAVY BAND RIP SAW.

Allner-Boswell Radius Attachment.

For machining motion links and obtaining the proper curve in the slot, various machines and several methods have been tried at different times. A review of practically all of the devices and a careful study of their construction with a view to obtain something that would permit of rapid work, accuracy and of such construction that wear would not interfere with the exactness of the work has led to the design and satisfactory application of this radius planing attachment.



THE ALLNER-BOSWELL ATTACHMENT.

Studying the matter carefully, there appear at least six points which must be covered in securing a device that will best suit the requirements. 1st. An absolute correct circle radius. 2nd. A rigid construction permitting of strong cuts to keep pace with up-to-date tool capacity. 3rd. A wide range in adjusting the rigging to any radius occurring on motion links. 4th. Absolute absence of wear on all parts that may impair the accuracy of the curve. 5th. An easy adjustability to radii of any length and of changing and rechanging straight planer work with radius cutting. 6th. A concentrated method of curve cutting in order to finish the whole operation in one setting. These points have been covered in the Allner-Boswell radius attachment.

A square block which is integral with the bottom plate, that is fixed to the planer table, transmits the driving power to the top plate always in the direction of the reciprocating movement without giving a resulting force with the tool resistance other than parallel to it. The oscillating component of the mechanism is allowed through an enlarged pin that surrounds the square block kept down by a cover plate. An enlarged eye engages around the pin and with a retaining ring forms on its top side the setting table. All the parts, subject to stress have ample dimensions. For setting up, the link is lined up to a center line marked on the chuck.

Owing to the very small amount of stress, the radial bar is a tube and being comparatively light, is easily handled. It permits of adjustment to radii of different lengths by means of a guide that is double pivoted in a post sliding on a foot plate perpendicular to the planer direction.

This radius attachment allows very strong cuts and stands up to the work required. After the link has been planed, milled around the edges, the end clearances drilled and slotted, it is set up on the chuck table and the center block removed by parting with two tools simultaneously. This parting operation including setting up the link and lifting out the block after parting has been done on a 15 h. p. planer in 35 minutes, the link being made of hammered steel 3½ ins. deep. After parting, the slot is finished by side tools kept steadily in the other tool heads of the planer. The advantage of this method consists in having one belting for blocking out and finishing both sides and in the absolute correctness of inside and outside radius. The attachment can be used not only on links, but also on dies, quadrants, curved stone, etc. It is made by H. B. Underwood & Company, of Philadelphia.

A Business of Detecting Mistakes.

The teacher was giving the school a little lecture on good conduct and how to get on. "Let me caution you on another point, children," she said. "Avoid criticising. Don't make a practice of finding fault with other people or picking flaws in what they say or do. It is a very bad habit to form and will make your own life unhappy." "Why, teacher," spoke up a little boy, "that's the way my father makes his livin'?" "You surprise me, Georgy. What is your father's occupation?" "He's a proof-reader," ma'am." The teacher coughed. "Well, Georgy," she said, "I will make an exception in the case of your father."

Tube Tonnage Record.

The assistant manager of the Detroit Seamless Steel Tubes Company points with pride to some complimentary words written of his company in the *Detroit Journal* of April 6. Here are the words: "For the month of March the Detroit Seamless Steel Tubes Company estab lished a new production record, the tonnage manufactured being 24 per cent. larger than in any previous month in its history. A large percentage of the production of this company is used by the railroads for locomotive flues, and the product for the month of March, if placed end to end, would represent a tube about 175 miles long. This looks promising for a return of prosperity in the iron and steel industry."

McKeen Motor Cars.

We are informed by the McKeen Motor Car Company, of Omaha, Neb., that on March 28 a 70-ft. motor car was shipped to the Southern Pacific Company, at Sacramento, Cal. This makes the thirtieth car to be received by the Southern Pacific Railroad, all of which are in daily service on the lines of that company in California and Nevada. A 70-ft. car for the Sand Springs Interurban Railway Company, Tulsa, Okla., was shipped from the motor car works on April 15.

Acme Uncoupling Device.

The Acme Railway Equipment Co., of Philadelphia, inform us that their Acme universal uncoupling device, which is applicable to all kinds of cars and may have single or double handle as desired, is now being applied to 450 N. Y., O. & W. hoppers at Berwick, Pa.; 2,150 P. S. & N. miscellaneous cars at McKees Rocks and Berwick; 1,000 N. Y., N. H. & H. miscellaneous cars at Sagamore, Mass., and 300 L. & N. E. box at Berwick, Pa.

Purifying Petroleum.

As is well known the great bulk of the best lubricating oils are manufactured from American petroleum. The most common method of purifying the mineral oil is by distillation. The crude oil is run into a still and heated, and the water and other low, boiling-point liquids are driven off. The heat is increased and finally the still contains a mass of semi-solid pitch. The heavier distillates are purified by the action of acid and alkali and an amber yellow oil results. The oil procured in this way is well suited for the lubrication of cylinders where the heat is not great.

Another method which is coming more rapidly into favor is after the first portions of water and light oil are driven off, small quantities of superheated steam are blown through the mass, and at the same time a partial vacuum is produced in the still. The effect is that the light bodied oil comes out of the still at a great speed. The residue in the still is of a vaseline consistency, and is filtered warm through animal charcoal and the finest cylinder lubricant is produced.

POSITIONS WANTED.

GENERAL MANAGER small road, or Superintendent. During the past eight years has had charge of construction and operation. Address L. M., RAILWAY AND LOCOMOTIVE ENGINEERING.

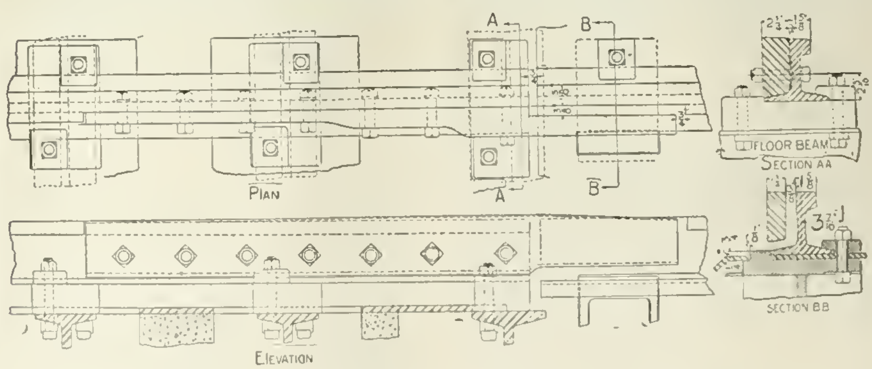
SUPERINTENDENT MOTIVE POWER or Master Mechanic, by one having had experience. Best of reference. Address C. G., RAILWAY AND LOCOMOTIVE ENGINEERING.

A Use for Graphite Grease.

Taper fluted reamers have a tendency to choke and refuse to cut and stick fast or, if forced to move, a piece invariably breaks out of the teeth. This is particularly true of reamers used in holes of any considerable depth. Engine or lard oil does not end the trouble. A grinding of the reamer may help somewhat, but the lubrication by tallow and graphite or graphite grease invariably smooths the way for the cutting teeth of the reamer.

Seldom Happened.

A little Scottish boy was up the other day before the examiners for the Navy; the examination was *viva voce*, designed to discover signs (if any) of "general intelligence." They asked the boy what he knew about the battle of Flodden. He said, "Nothing." "What!" they said. "Don't you know anything about that battle in which the English beat the Scotch?" "Well," he said, "I know it must have been verra exceptional."



PLAN, ELEVATION AND SECTION OF EASER JOINT. (See Page 192.)

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, June, 1911. No. 6

Westinghouse on the Giovi Line.

Recently received information as to the tests of the three-phase locomotives built for the Giovi line of the Italian State Railway by the Societe Italiana Westinghouse make it timely to present to our readers the results of these tests and a brief description of the locomotives. The Giovi tunnel is situated between the stations of Pontedecimo and Busalla on the line between Genoa and Milan. The traffic is very heavy, this being the most important line between Genoa, the greatest shipping center, and Milan, the greatest manufacturing center of Italy. In addition to general freight and passenger traffic, hundreds of cars of coal are daily sent over the Giovi line from Genoa to Milan. Electrification became necessary on account of the impossibility of coping with the increase in traffic with steam locomotives.

The Italian State Railway after ten years of experience has chosen for the electrification of railway lines the three-phase system at high potential, 15 cycles, as adopted in the Valtellina lines and Simplon tunnel. The first order from the Italian State Railway to the Italian Westinghouse Company was for 40 locomotives for freight service, 25 of which were for the Giovi line, and 15 for the Savona San Giuseppe line from Savona to Turin, which is being electrified at present. The first locomotives were completed at the Westinghouse Vado Ligure Works.

The new Giovi locomotive is built for freight service and has a normal operating speed of 28 miles per hour. It can also be used for passenger service, as its speed capacity is as high as it is considered safe to use on the Giovi line. The locomotive has also a 14 miles per hour speed, which is intended for switching purposes and for regenerating power when the train is running down hill. The apparatus that requires little care has been placed in the lower cab extensions on either end. The apparatus that requires more frequent inspection is in the center of the cab. The cab has been provided with windows all around. The locomotive weight is not more than 60 tons, but the mechanical construction is such that the weight can be increased 75 tons by means of ballast.

THREE-PHASE ELECTRIC LOCOMOTIVE AND TRAIN ON THE GIOVI LINE, ITALY.

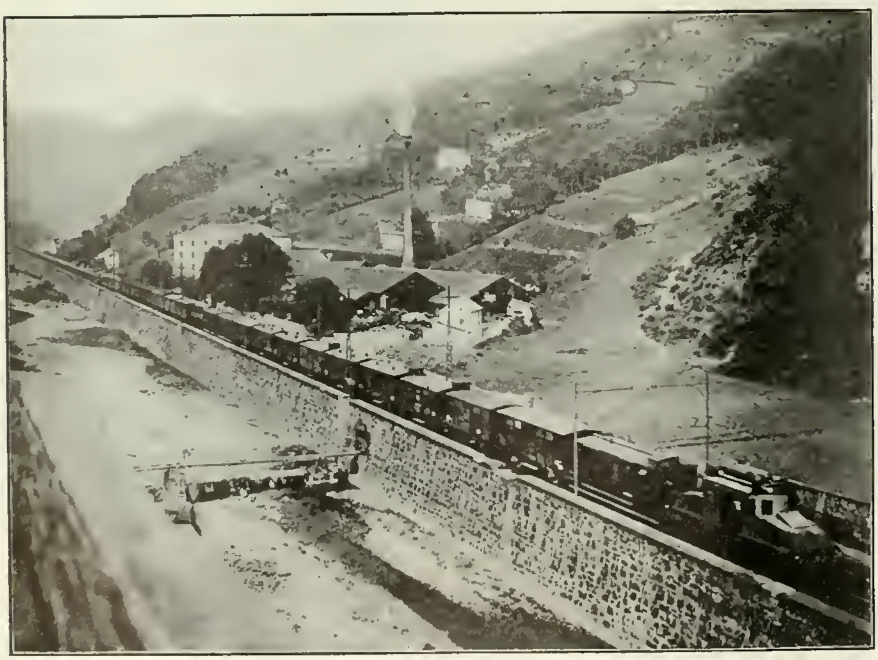
During the tests a train of 418 tons, exclusive of locomotives, was taken with a speed of 28 miles per hour from Pontedecimo to Busalla, a distance of 6½ miles with a maximum grade of 3.50 per cent., an average grade of 2.70 per cent., and a minimum curve radius of 1,200 ft. After this the train was taken back at a speed of 14 miles an hour, the locomotive being connected for regenerating power. The time allowed for one round trip is 140 minutes. After 20 hours of such continuous operation, one round trip without forced ventilation of the motors was made with a temperature rise of considerably less than 75 deg. C.

The motors are three-phase, 3,000-volt, 15-cycle machines arranged to run in cascade and in parallel, giving two synchronous speeds of 112½ and 225 r. p. m., intermittent speeds are obtained by inserting rheostats in the circuit. The motors have double bearings, the outer of which is built into the main locomotive frame and carries the reactions of the frame; it also takes the thrust of the connecting rods and is provided with springs to take up all motion or change of positions due to shocks, ballast on locomotive frame, etc.

The inner bearing carries the rotor and has for its function only the maintenance of the air gap, so that the motor itself is entirely independent of any motion of the locomotive frame. The mounting of the motors on the locomotive is accomplished from below by means of an hydraulic lift. The complete changing of a motor, including the connections to the side rods, may be easily done in two hours.

The control system contains a number of excellent features. Since the starting resistances are of water rheostat type it was necessary to design the secondaries of the motors for low potential; this was also desirable in order to have a low potential on the slip rings. The use of the water rheostat is one of the main advantages of the control system. It eliminates all metallic resistance parts, which are more or less subject to burn-outs and mechanical breakage. A further advantage of this control lies in the fact that it does not increase the current by steps, but allows for the finest possible regulation. The water receptacle is a tight tank so mounted as to extend below the cab for air cooling. Receptacles for the electrodes extend from below the water level, through the cover and up into the lower parts of the locomotive, the electrodes being supported in the upper portions of these receptacles or cylinders. In operation the height of water in the cylinders is regulated by air pressure in the upper part of the tank which forces the water up into the cylinder and the regulating mechanism extends into the cab proper and can, therefore, be conveniently inspected after the removing of a protecting cover.

STEAM, PETROL AND ELECTRIC LOCOMOTIVES, GIOVI LINE.



ELECTRIC LOCOMOTIVE HAULING TRAIN ON GIOVI LINE.

The master switch is arranged for two levers. One of the levers has four definite positions corresponding to the two speeds, to move forward and backward. The second lever regulates the current consumed by the motors. Every position of this lever determines positively the certain maximum current to be taken by the motors; any time the motor tends to take the current larger than corresponding to the lever position, resistance is automatically inserted into the secondary. The fact that each locomotive can be set for a maximum current would make it possible to use the locomotive in multiple without a special multiple control; nevertheless, a multiple control arrangement is provided for. The special controller allowing for all desired conditions is provided in connection with this system. The multiple control system not only permits the operation of locomotives of different wheel diameters in multiple and equally loaded, but also permits the loading of them differently with any desired ratio of load distribution. This is advantageous, as it is frequently desirable to keep the drawbar pull of a pulling engine within certain limits and let the pushing engine take care of the greater part of the load.

The pantagraph arrangements are very simple. The single bow with two bronze cylinders insulated from each other and revolving in ball bearings engages both overhead wires. The use of the rolling contacts is very favorable for the contact wire, and has given very good results on the Valtellina lines, where it has been in use for over 10 years. On this line the rolling contacts were changed after an average of 25,000 loco. Km. On the Simplon tunnel, where sliding contacts are used, they were changed after 2,700 loco. Km. average. This great difference is due to the fact that the contact point on the rolling type is changing very rapidly, so that the melting of the metal which reduces the life of the contact on the sliding type is not possible.

An important feature of the three-phase installations is found in the utilization of regenerated power, which reduced the cost of operating the line, and also reduces, by proper arrangement of the schedules, the peak of the load in the generating station and does not require the use of mechanical brakes when the train is going down grade.

Old Time Railroad Reminiscences.

By S. J. Kidder.

It is a fact pretty generally known among old-time railroad men that for a series of years following the advent of the air brakes it was very sadly neglected and apparently looked upon, when once attached to an engine or car, as a device needing no further attention. During the first twenty years of its existence few of the railroads made any active effort in the way of an air brake organization or the maintenance of the brake equipment, and it was not until the famous Burlington brake trials that such organization and maintenance really began to receive the consideration this important apparatus demanded. It may even be said that as a rule it was only when an object lesson occurred, the result of a serious accident, which emphasized the importance of efficient brakes that any special effort was made to put them in a condition to reasonably meet requirements.

When the so-called air brake expert dropped round, bent on seeing what was going on, he found no one who pretended to know very much about the apparatus; but his listeners were always in a receptive mood and as time passed the seed he sowed gradually took root and developed.

During these pioneer days of the air brake when a pump or any portion of the apparatus required repairs, such work was usually assigned to a first-class machinist and handy man in the shop or roundhouse, who with his limited knowledge made such repairs as appeared desirable; then, not infrequently, without being subjected to any test the device was replaced on the engine or car from which it had been removed. Finally when steam had been raised on the engine preparatory to going out on its run, or the car with the repaired triple valve had been made up into a train the repaired apparatus was tested and if not found in operative condition a delay to the train and possibly a change of engines, or if car equipment, a brake cut out over the road was not an infrequent result.

The testing of brakes, too, before leaving a terminal or when changing engines, was not as a very general rule governed by any specific regulations, if done at all, and many were the instances where grave chances were taken as a result of such negligent practice. Air brakemen were almost as scarce as the proverbial "hen's teeth" at the time the writer got into the air brake business, there being but three in my bailiwick, constituting more than one fourth of the railroad mileage of the United States, these being known as air brake instructors. One of these constantly traveled over his road, carrying a kit of tools with him and whenever a recalcitrant pump or triple valve was found he proceeded to make the necessary repairs then and there. It was not the mechanical department alone that moved slowly in instituting air brake reform, for among the higher officials there seemed to be a lack of realization that the air brake if maintained in a high state of efficiency would be a most potent factor in the protection of lives and property, as well as materially facilitate the movement of trains.

Among the self-imposed duties of the air brake man was that of endeavoring to impress upon the railroad fraternity the importance of good brakes in promoting safety to train operation, though instances were not rare when his efforts were for the time being in vain, and it was only after an accident, which might have been avoided, had the brakes been properly maintained and tested, that the railroad instituted more active measures to guard against future accidents from a similar cause.

Among the roads I visited was one having quite an extensive suburban service. The engines in this service were of the "double ender" type, the tender being supported on the extended frame. The engines had four driving wheels and a four-wheel truck supported the tender end, the brakes on both the driver and truck wheels being operated from a single auxiliary reservoir and triple valve.

On my first visit to the Chicago roundhouse, a number of the engineers complained that when handling a train with one or more quick action triple valves—at this time the plain triple very largely predominated—the brakes applied in quick action when a service application was attempted.

Upon investigation I found the angle fittings had been removed from the D-8 brake valves and in some instances an improvised angle fitting substituted made up of a one-quarter-inch nipple and elbow. These engineers had endeavored to make the service application of the brakes more prompt by enlarging the service exhaust port, normally restricted by the standard angle fitting, and had accomplished the purpose intended, but at the expense of losing proper control of the brakes. It was explained to these engineers that the angle fitting, rather than the piston valve, controlled the flow of air from the brake pipe, and that had a more rapid flow been permissible an angle fitting affording a more rapid discharge of air would have been furnished with the brake valve.

Permit me to digress for a moment to say that every portion of the brake apparatus is designed to accomplish a specific purpose, and the proper opera-

SWISS PASSENGER TRAIN AT CLARENS.

tion of all, from which the moral should be drawn: Never change the size of a port in any part of the brake equipment.

Another engineer stated he could get no action on the brakes unless the brake valve handle was moved to emergency position. His brake valve, by the way, had a stop cock in the service application port, a standard part of the brake valve at the time and which I noticed was closed. In reply to my queries I was informed he had tried everything he could think of, but could not get the valve to operate in service position. By close questioning I ascertained that the sum of his experiments had been to plug up the preliminary exhaust port and finally inquired if he had ever tried the brake valve with the stop cock open and to which he replied he had not. The opening of this cock corrected the trouble. In looking over these suburban engines it was observed that the air discharge pipe from the pump connected to the pipe extending from the main reservoir, located back of the cylinder saddle, to the brake valve.

In the latter pipe was a pocket preventing any water which was carried through the discharge pipe from reaching the reservoir. This accumulation of water was carried to the brake pipe when the brakes were released and a sufficient quantity of it found lodgment in the triple valve to freeze, thus putting the triple out of commission. This I called to the attention of the superintendent of motive power, who expressed his gratitude and promised to have the pump discharge pipe carried direct to the main reservoir. This was done on two engines, but others following went through the back shop with no change in piping. It had been observed, too, that no pretence was made to test brakes before starting out from the terminal and such had been called to the attention of the general superintendent, who, while acknowledging "the testing of brakes was a good thing, his suburban trains did not have the time when they came in and immediately went out again." One cold day not very long after while on my way downtown, I heard of a serious railroad accident in which one of these suburban trains was involved at a crossing less than a mile from the terminal and I immediately repaired to the scene of the wreck. Two freight trains were moving in opposite directions over the crossing as a suburban train rounded the curve and crashed into them at an angle of about 75 degrees, the whole making a most imposing pile.

A careful investigation as to the cause of the wreck revealed the following facts: The engine had been in daily service for some three weeks with a broken driver brake cylinder head, and although the defect had been reported a number of times the head had not been replaced. As a consequence during this time the brake had been cut out on both the driver and truck wheels. Shortly before the accident the engine had brought in a train of ten cars arriving somewhat late and after the train had been switched to an adjoining track the engine was attached to the opposite end, seven cars cut off and the train of three cars pulled out, allowing no time for testing the brakes. The brakeman who coupled the engine to the train coupled the air brake and signal hose, but failed to open the angle cock on the end of the car next to the tender. The engineer knew nothing of this failure to open the angle cock until when rounding the curve approaching the crossing he endeavored to make the crossing stop, only to find there was not an operative brake on the train. The outcome of saving the minute or two, which would have been consumed in testing the brakes, was a wreck, the tying up of traffic on these very busy railroads for several hours and a damage bill of many thousands of dollars. This dearly bought object lesson proved a salutary one, for immediately after a complete system of testing brakes was inaugurated and the motive power department got busy in seeing that the engine equipment was properly applied to the locomotives and maintained in a serviceable condition.

Another instance and at about the same time occurred to a train which had departed from the same terminal. At about 10.30 in the forenoon the passenger train ran into a standing freight on a straight, level piece of track. The train was running at its usual speed when the engineer observed the caboose nearly three-fourths of a mile away. The brakes were immediately applied, but the train went into the caboose at a speed of eighteen miles an hour. The following morning I inspected the companion train to the wrecked one before it left the terminal. The engine had no driver brake and the tender brake was useless owing to the absence of a lower brake rod which had been missing a sufficient length of time to permit the pin hole in a truck lever to become filled with dirt. At my suggestion the brakes of this four-car train was tested with 40 lbs. auxiliary reservoir pressure, the leaving time of the train being too near to permit the obtaining of maximum pressure. The piston of one brake cylinder had a travel of 7½ ins., one 11½ ins., the others full stroke, leaving the brake shoes loose on the wheels, but the brakes were quickly put in serviceable condition by taking up slack with the dead levers. It by no means follows, however, under the conditions obtaining in these early days of the air brake that with brakes in serviceable condition they were in a condition to stop a train promptly. Braking power on the average train was low, it being very frequently found that the low leverage gave a braking force of from 50 to 70 per cent. of light weight of passenger equipment cars. Instances have come under the writer's observation of trains, the running time of which for three hundred miles averaged thirty-six miles an hour, with an average railroad or station stop each twelve miles, having a braking power of 31 per cent. of the total weight of the engine and train. Enough has perhaps been said to give an idea of what the altogether too common air brake practice was twenty or more years ago and to clearly draw a comparison with what we have at the present time. Now every railroad has a finely organized air brake department presided over by a supervisor who has made a special study of the business in all its branches and the organization is composed of men each familiar with his assigned duties. The rules of the road are such as to require proper maintenance and tests of each detail of the apparatus to insure the efficiency.

For the Good of the Service.

On a recent tour on the Erie Railroad made by Dr. Sinclair for the purpose of inspecting the apprentice schools he says in a letter to the Vice-President:

"While at Port Jervis, I attended a meeting presided over by Mr. O. Day, road foreman of engines, which was a novelty to me, and which I think is worthy of imitation by every railroad company. The meeting was composed of several officials and about fifty engineers, conductors, firemen, brakemen and others. I should call it a 'conference for the good of the service.' The discussions turned to a great extent upon the movement of trains and what appeared to me very sensible and practical suggestions were made, all the classes represented having been quite ready to express their views.

"I could not help contrasting that experience meeting with things I had heard said to practical men who ventured to make suggestions intended for the good of the service. I was for some time a clerk in the locomotive superintendent's office. One day a passenger train driver came in and said, 'Mr. L. S., something ought to be done to screen the Aberdeen light-house red light, which stares us in the face as we leave the Portlathen curve. Every driver on the road has to violate the rule that requires us to stop when approaching a red signal.

"The L. S. looked up and said, 'since when were you appointed signal inspector, David Simpson?' 'I only thought it would be in the interest of safety,' replied David. 'You are not paid for thinking,' was the reply. 'You are paid for driving an engine and getting the train in on time.'

General Correspondence

Superheat and Drawbar Pull.

Editor:

There is no doubt that the claim is made that engines using superheated steam develop a higher tractive effort than engines using saturated steam at the same pressure as the superheat machines. If it is so, and I believe it is, it means that a car or two more than the regular load may be hauled by the superheated engine.

The development of a greater drawbar pull by the superheater engine, if true, may perhaps be accounted for in one of two ways. If the superheater engine is able to develop a greater mean effective pressure in the cylinders than the saturated steam engine does then the extra car or two credited to the superheater engine is, of course, very easily explained, because in the tractive effort formula the size of the cylinders, the diameter of the driving wheels and the mean effective pressure are the factors. If wheels and cylinders are the same in superheated and saturated steam engines, while the mean effective pressure is greater in the former than in the latter, it follows that the superheater engine will have the greater tractive effort, and will pull more cars.

If, however, the mean effective pressure in the cylinders of both engines is exactly alike, there must be something not included in tractive effort formula which is competent to produce the result. It may be simply the almost complete elimination of the invisible slip which is one of the working conditions of all locomotives. Where high initial steam pressure is used and short cut-off employed there may be considerable invisible slip with the loss of power which is not noticed until the gain by reason of the elimination of the invisible slip becomes apparent. The superheater engine with lower steam pressure and longer cut-off probably gives a more even turning moment to the crank pin, and by so doing eliminates slip and so gains in power. This would hold true if the mean effective pressures in the cylinders of superheater and saturated steam engines were equal.

Here is a point upon which we require more information. I am sure that the Editor of Railway and Locomotive Engineering would welcome reliable data from any responsible railroad officer who could send some in. Has there been a case where a superheater engine of given dimensions was tested against a non-superheater engine of similar dimensions on same division with exactly equal steam pressure and amid practically identical conditions? If this has been done the results cannot fail to be of the greatest value to all mechanical department men. If any such data exists it ought to be published, and if such a test has not been made it ought to be undertaken at once and the drawbar pull recorded by a dynamometer car. Hoping that something will come of my appeal, and that those who have had practical experience in these matters will let us all know, through the columns of your valued magazine. H. G. S.

Washington Heights.

[This is a very interesting and live topic, and we shall be very glad to hear from anyone who can give information on this subject. You don't need to have conducted a test, if you know something about it let us hear from you.—Editor.]

"OILING ROUND" BEFORE THE FAST, FLYING RUN.

Valve Strip Blow.

Editor:

On page 191 of your May magazine the question with reference to valve strip blow was referred to any subscriber for discussion. The gentleman that asks the question signs "Three Times Seven," and wants to know if there is any way to determine which side the blow is on while engine is laboring, by watching the crosshead.

This blow is different from other blows as it has a singing or whistling sound, and can best be located while engine is standing.

I would just place one engine on the quarter and place the reverse lever in the center notch of the quadrant. To cover all ports on that side admit a little steam and keep all cylinder cocks closed, except those you wish to raise with your hand while testing, and the noise from the cylinder cocks will not interrupt you. Raise both cylinder cocks on the side that has port covered, and if no steam escapes we know the valve seat is tight on that position, then go to the opposite side and lift the cylinder cock valve on the end of the cylinder that is not taking steam, and if no steam escapes we know the cylinder packing on that side and the valve seats are not the cause of the blow. Then change the reverse lever to one of the corner notches in the quadrant and go back where you started. The exhaust cavity of the valve will then be over the bridge, and if the strip is down on that side steam will pass through the hole in the top of valve to the exhaust cavity and into the admission port and exhaust port also and by raising the cylinder cock valve on the end that is open to the exhaust cavity steam will escape and the sound will correspond with the blow.

The blow will be heavier when the valve is on mid-position and by changing the reverse lever from front to back is another good test, as you will notice the blow will weaken each time the valve makes a port opening, and the side that is on the dead center cannot change the sound as the valve will not shift. I would try the opposite side in the same manner to be sure, even if I was satisfied the blow was on the other side, for something else might show up after changing the position of the engine. I have often found these blows, and go to the opposite side and raise the cylinder cock valve that was under the exhaust cavity and the vacuum from the blow on the opposite side would suck a small piece of waste into the cylinder cock if held close to it.

There is only one way to detect this blow while engine is moving, and that is to move slowly and watch the rocker arm, and if the heaviest part of the blow occurs while the rocker is plumb it is pretty sure to be on that side, and another indication is the valve rod will quiver on the defective side while engine works steam.

I have known enginemen to report both sides in order to hit the right one, and then, again, they would report one side, and if the trouble was not there they would report the other side at the other terminal; but this is bad practice as well as very expensive to the company.

Then, again, if the shop force finds out that the man is not sure his report is correct they are liable not to examine the valve at all, when the trouble was just as he reported it. I am anxious to hear from others on this subject, as their remedy might be far better than my suggestion. F. E. Patton.

Columbus, Miss

Journal Boxes.

Editor:

All the recent discussions on rigid vs. non-rigid freight trucks have not been clear as to whether they were based on the idea of the trucks being rigid or non-rigid in a vertical or a horizontal plane. A few years ago trucks, rigid in the horizontal plane, as well as in the vertical plane, had considerable vogue, but there are not very many of them purchased at this time.

Trucks rigid in the horizontal plane were condemned because of the fact that it takes only three points to determine a plane, so that when the fourth wheel found a low spot in a track it was relieved of carrying its proportion of the load because the other three wheels determined the horizontal plane of the truck. We may assume, therefore, that all the recent discussion on rigid or non-rigid trucks referred to the vertical plane, that is, whether a truck should be so constructed as to hold the axles perpendicular to the side frames.

The recent very excellent report of Prof. Louis E. Endsley of Purdue University shows that the total movement of some of the non-rigid trucks that ran out of square was as much as 5 61/100 ins., half of which, 28/10 ins., is the amount the truck ran out of square, since we have found trucks with a total movement of 6¼ ins. of the side frames or 3⅛ ins. out of square. To determine the position of the M. C. B. parts, such as brass, wedge and journal in the journal box, and in an effort to determine how much of a part was played by the journal box and contained parts in resisting the trucks running further out of square, we laid out the plan view of journal box and contained parts with the truck 5¼ ins. out of square, as shown in the illustration.

It will be noted that there is not room enough in the M. C. B. journal box for the M. C. B. contained parts with a truck so far out of square. The distance between the centers of the journals as measured on a line perpendicular to the side frame is reduced about ¼ in., due to the angularity of the axle. This causes the brass to take up the play allowed between the rear of the wedge and the flange on the brass, which forces the wedge towards the front stops. You will note the wedge laps over the front stop G at point J about 1/32 in. The brass laps over the collar of the journal at point D about 1/16 in. by the side lug on the brass binding the side stop T of the box at point B. Both wedge and brass bind on side stop T at N and B and on side stop U at C and O. The lines EE and FF of the brass are considerably out of parallel with the lines of the journal.

We determined from this that a truck would not run so far out of square without something in the journal box yielding

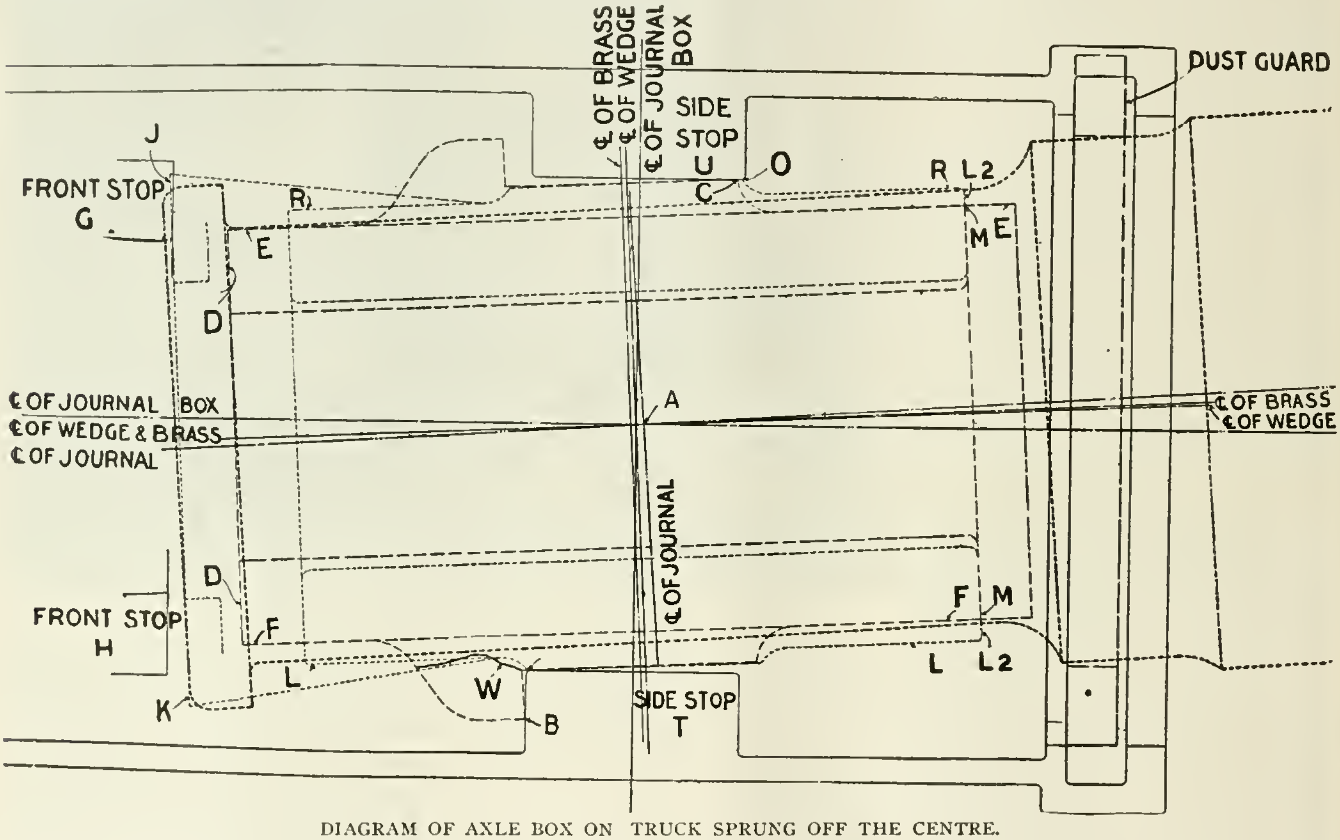


DIAGRAM OF AXLE BOX ON TRUCK SPRUNG OFF THE CENTRE.

by springing or breaking, and from the information gained through laying out the drawing as illustrated, we concluded if these trucks really ran out of square excessively, and if the truck depended on the cramping of these parts to resist its running more out of square, the parts that were called upon to resist this excessive movement must indicate same by excessive wear or breakage. On inspecting a number of these trucks we found the brasses in a high percentage of cars with lugs broken off as shown on line marked W. Some of these trucks seemed to have no other means of holding them square except by the angularity of the journal causing a binding of the brass and wedge on the front stop G of the box. This, if the brass or the wedge or the front stop of the wedge does not break, must cause excessive end wear of the journal collars and brass, and a diagonal wear of the brass or bearing on the journal, all of which must tend toward the increased liability of hot boxes and excessive frictional resistence. From the number of brasses found with broken side lugs, it is fair to assume that a high proportion of these trucks depend on this resistance in limiting the distance they run out of square.

It is interesting to note that on inspection of a large number of cars whose trucks were constructed in a manner that was meant to hold them square, that there was only one brass found with the side lug broken off, and that was on a truck, the spring plank of which was made of two angle irons securely rivetted to arch bar columns, and in this truck one of the angle irons had broken, which made of it a flexible truck.

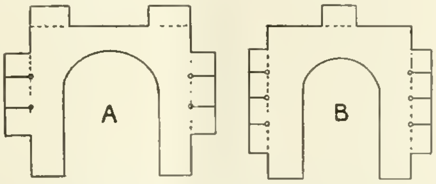
McCord & Company,
Per W. J. Shlacks.

Chicago, Ill.

Iron Hub Plates.

Editor:

I take considerable interest in reading the articles in your publication regarding the different expedients used to get out of tight places when short on power and something has to be done. My experience has compelled me at different times to resort to expedients that are not in general practice, and some of these may possibly be of interest to others and serve to help a brother in distress. I will attempt to describe a remedy for lateral motion in drivers that I have used and am using successfully, keeping engines in service for 8 to 10 months after it would ordinarily be necessary to drop drivers and apply hub plates. The hub plate used is made of boiler iron of any required thickness, cut similar to sketch attached, care being taken to make a good allowance for clearance off journal and a sufficient amount larger than box all around to allow for crimping after being put in place, plate should crimp at top, bottom and both sides, being cut out at lower corners so as to be independent of cellar bolts, the upper corners need not be cut out where spring saddles are used, but will be necessary to do so where equalizers go over boxes. In some cases it will be found that plate can be flanged on top and both sides before putting in place, leaving only the bottom to be crimped after being in place. The notches in sides of plates are to facilitate the bending of plates.



OUTLINE OF HUB PLATES.

We accomplish the flanging when plates are in place very easily, removing cellar, wedging engine over from opposite side to clamp the plate and then heating portion that flanges to the proper heat with a crude oil burner laying flange up closely to box with a sledge or sledge and bar. With underhung springs it is not necessary to crimp under box, but let the flanges go under the hangers, offsetting hangers a trifle if necessary. I have one eight-wheeler on which plates were applied last December, taking up 1½-ins. in back drivers and 1-in. in main drivers, back wheels now have ½-in. lateral and main wheels ⅜-in. lateral. I have applied altogether about 60 of these plates and only had two to come off. These plates will not injure the boxes or hubs and will certainly do the business.

I have seen several attempts made at a readily applied and reliable hub plate, but never saw a successful one until I hit upon this kind. I have seen many a good engine tied up when needed badly on account of too much lateral. With these plates on hand they can be applied all round to a ten-wheeler or consolidation engine in a very few hours or even to a pair of wheels at a time without letting the engine miss a single trip.

Sketch A is for boxes with equalizers over top of box, and Sketch B is for engines with underhung springs with hook hangers. The dotted lines show points of flanging, dimensions to be made to suit sizes of boxes, ⅜ or ½-in. steel will be found very satisfactory. Since using this plate I have known three other roads to try it and save engines from the shop. X. Y. Z.,

Texas.

Mast. Mech., K. C. M. & O.

No man of sense, who has generally improved, and has improved himself, can be called quite uneducated as to anything.

News From Queensland, Australia.

Editor:

It is with the deepest regret that I am forwarding to you *The Brisbane Courier*, with account of the death of our railway commissioner, Mr. I. F. Thallon. He will be greatly missed by all classes of railway men, for he was the father to the many, and the enemy to the few. Knowing that this will be of interest to your valuable journal, and information to your many subscribers, one of whom I can lay claim to be, for the last 11 years. Wishing your journal every success it so richly deserves.

James Sanderson,
Engineman.

Woolloongabba, Queensland.

[Writing about Mr. Thallon the *Courier* says: "No man connected with the Queensland railways has so largely impressed his personality upon them. Among railway men in Australia he stands high. It is interesting to recall that he was a strenuous advocate of the 3 ft. 6 in. gauge which rules in Queensland. For the needs of a young country which has long distances to traverse, he considered it the only possible gauge, and in support of his contention that it was a serviceable width he always pointed out that the South African railways carried all the required traffic in war time." This quotation gives his life's work in brief.—Editor.]

H-5 Valve on No. 6 Equipment.

Editor:

I notice an article in your May, 1911, magazine under head "Wrongly used air brake valves." The H-5 brake valve used on No. 6 equipment. Without quoting the article here I would like to say, I believe this trouble can be overcome and brake valve used satisfactorily by putting blind gasket in application chamber pipe just under automatic brake valve. Brake valve will now work same as No. 6 valve, only in emergency position of brake valve handle you will not have maintaining feature of distributing valve.

J. M. Boyd.

Spokane, Wash.

Cost Then and Now.

Editor:

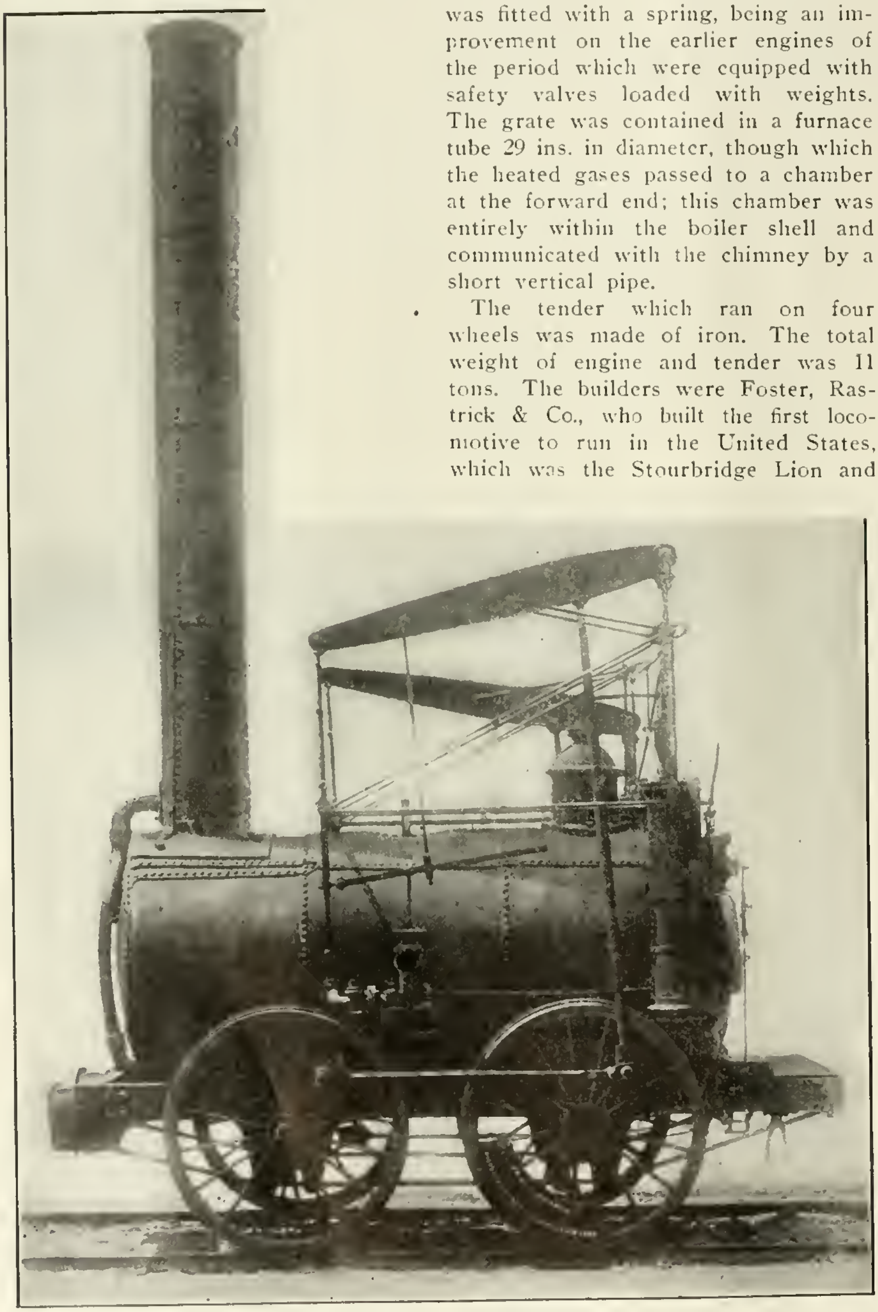
In regard to the statement of Mr. John Cassell, retired engineer of the Pennsylvania Company, Columbus, Ohio, comparing $65 per month for an engineer 45 years ago with the wages of today, I would like to say that I wish he would state the size of engines and amount of tonnage hauled, also the prices of living at that time. I would, also, like to have him state how long he had to fire for promotion and what kind of an examination he had to pass, and what order he belonged to, and I would like to see the answer in your July magazine. I am a subscriber to RAILWAY AND LOCOMOTIVE ENGINEERING, and a member of A. R. Cavner Lodge No. 356, Lorain, Ohio, B. of L. F. & E. READER.

Massillon, Ohio.

The Agenoria 1829.

Editor:

This old engine possessed many interesting features, one being the remarkably tall chimney, 14 ft. 4 ins. in length. It ran on four coupled wheels



THE "AGENORIA," BUILT IN 1829.

having a diameter of 4 ft. with a wheelbase of 5 ft. The cylinders which were placed vertically had a diameter of 8½ ins., with a stroke of 36 ins., and the outside crank pins were set at right angles to each other. The crossheads were guided by grasshopper parallel motion and the connecting rods were attached to intermediate points of the beams in front of the cylinders. The slide valves were of the ordinary flat type and were driven by loose eccentrics, controlled by stops fixed to the axle, which retained them in correct position for forward or backward motion; hand gear provided for the working of the valves when reversing until the eccentrics should attain their correct positions against the stops. The safety valve was fitted with a spring, being an improvement on the earlier engines of the period which were equipped with safety valves loaded with weights. The grate was contained in a furnace tube 29 ins. in diameter, though which the heated gases passed to a chamber at the forward end; this chamber was entirely within the boiler shell and communicated with the chimney by a short vertical pipe.

The tender which ran on four wheels was made of iron. The total weight of engine and tender was 11 tons. The builders were Foster, Rastrick & Co., who built the first locomotive to run in the United States, which was the Stourbridge Lion and sent to America in 1828. The "Agenoria" is now preserved in the South Kensington Museum, London.

A. R. BELL.

London, Eng.

Traveling Fireman.

Editor:

Referring to page 192 of your May issue, in which reference is made to the "Traveling Fireman," I would advise that I have had a good many years of experience in dealing with traveling firemen, and I would like to state that I regard them as a class of the most important subordinates on my staff on the Minneapolis & St. Louis Railway. In fact, in some cases, better results are obtained by the traveling fireman than by the road foremen of equipment. This varies to some extent, on account of local conditions, as for instance, where it is difficult to obtain good, bright, intelligent locomotive firemen; where inferior grades of coal are used and where the condition of power is not of the best.

In selecting a man to fill the position of traveling fireman, the first consideration should be the rate of pay. This should be from $100 to $125 per month and expenses, as the salary feature of the position must be attractive to such an extent as will enable a selection of men who have had not only four or five years' experience firing, but who have had at least two years experience running an engine.

The traveling fireman should be thoroughly familiar with the composition of the different kinds of coal; practical methods of drafting locomotives; he must also be skillful in the way of handling the fire; must be possessed of qualifications that will enable him to approach and address in an intelligent manner all classes of employees engaged in handling locomotives, from the cinder pit man to the road foreman.

A traveling fireman of this calibre, with duties confined to road work, should be able to manage from eighty to one hundred locomotive crews, and by having traveling firemen possessing this experience and these qualifications, as much benefit is derived from his services as from the services of any road foreman that could be selected, as you will find that only about one road foreman in thirty is physically competent to fire heavy freight locomotives over a one hundred-mile division, and I regard a demonstration of proper firing as a better education to the fireman than any other demonstration that can be rendered.

I have experienced no trouble on account of friction between engine men and traveling firemen. Generally speaking, engine men take kindly to the position.

C. E. GOSSETT,
Master Mechanic.

Minneapolis, Minn.

[If any other reader of our magazine can throw any further light on this interesting subject we will be very happy to receive a letter. We would like to get a list of the roads where traveling firemen are employed.—EDITOR.]

Engine With Vestibule Cab.

Editor:

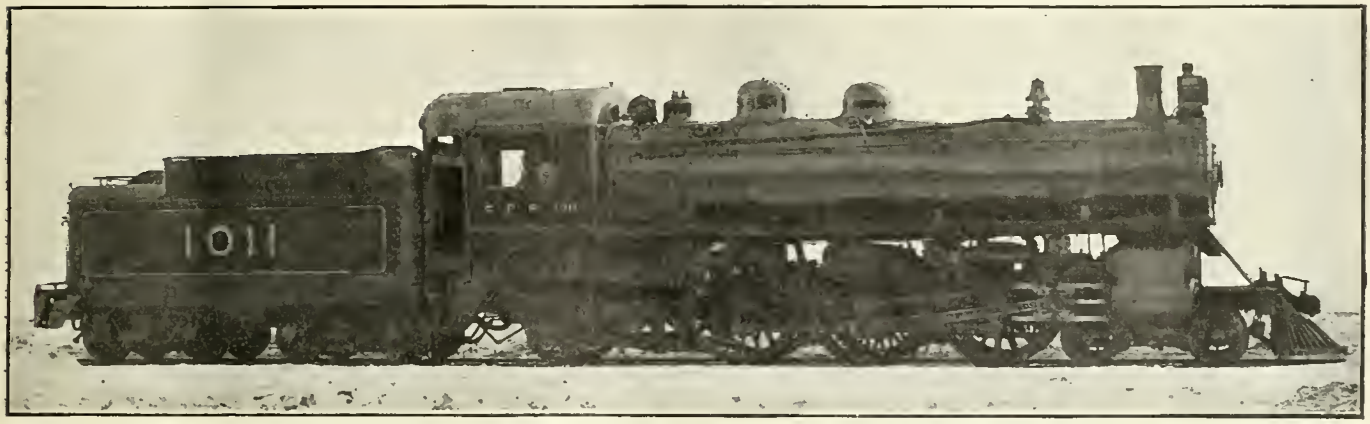
As I promised, I am sending you photograph of Canadian Pacific Engine No. 1011, with the side entrance cab and the coal pusher arrangement on the tender. The cab was converted from an ordinary cab with a peak extending over the tender, and is so arranged that the peak of the cab extends a sufficient distance from the front of the tender to allow of the diaphragm being applied to take up the movement of the engine and tender. The diaphragm is of the standard passenger car type, one end of which is bolted to the tender, and the other end to the friction plate, which is kept up by means of coil springs and slide on cab. Above the diaphragm is a deflector which extends from cab to coal space to prevent the coal getting into the folds of the diaphragm. This design of cab affords much more room and is more accessible from the side of the engine, owing to the door opening directly into the cab.

The engine is equipped with deeply flanged running boards made of ¼-in. plate rivetted to the running boards by means of angle irons, which gives three beneficial results. First, it makes the running board rigid; second, it gives a better hold for the piping, which is hidden from view; third, it conforms to the general design of the tender.

The coal pusher is located at the rear section of coal space on top of the tank, being hinged at the front, and is operated by means of air cylinder which is located in center of tank. A piston rod is connected to the rear end of the pusher, the object of which is to force the coal close up to the coal gate. This is very beneficial, especially in going up heavy inclines, where the coal would not otherwise slide down to where it can be easily got at by the fireman.

LACEY R. JOHNSON,
Asst. Supt. M. P., C. P. R.

Angus Shops,
Montreal, Que.



CANADIAN PACIFIC RAILWAY SIMPLE 4-6-2, WITH VESTIBULE TENDER.

Disconnecting a 2-8-C.

Editor:

In a past number of RAILWAY AND LOCOMOTIVE ENGINEERING you ask for the proper method of disconnecting an engine with eccentrics on one axle and the main rods connected to another pair. Enclosed you will find clipping from *The Pilot, and Philadelphia & Reading Railway Men*, a periodical published monthly in the interest of Y. M. C. A., which will explain the procedure taken in this case, except the time is not given which was thirty minutes.

I send the extract to you for the information of those who take RAILWAY AND LOCOMOTIVE ENGINEERING and because you invited your readers to co-operate with you through the general correspondence columns in spreading whatever is good and of value, which any of us may know or can pick up. Here is the extract:

"While working at Chester, Pa., January 25th, Engine 1442, of the eight-wheel connected or 2-8-0 type, with the eccentrics on the front axle, broke the front section of one of the side rods. Through a mishap of this kind enginemen in many cases have simply asked to have the engine towed to the shop, because they knew if they removed the corresponding rod on the opposite side, the engine would be disabled. But in this particular case there was very little delay to the work, because engineman Howard Voorhees realized the length of time it would take to send another engine from Philadelphia, and engine 1442 being out of service, he, with the assistance of fireman William Tomkins, removed the two back sections of the side rods, applied one in place of the broken rod and worked the engine as a six-wheel connected engine the rest of the day. The broken rod was repaired at Twentieth street engine house the same night and returned to him in the morning, when he applied it, together with the two back sections, to the places from which he removed them, which then placed the engine in proper repair without coming to the shop. The engineman and fireman were both given credit for the good judgment used in this case, which demonstrates their interest in the welfare of the company."

SUBSCRIBER.

Chester, Pa.

[This is a good practical letter from a practical man. We wish our readers would take up this subject and let us hear from them. Look at page 191 of the May issue, General Correspondence.—Editor.]

Tests for Dry Pipes, Etc.

Editor:

I am writing to ask for information in regard to the methods used in testing steam pipes, throttle valve and dry pipes in locomotives. I will give you the simple and effective way which we use at any station on the Southern Railway and I would be very glad to have any of your readers write to RAILWAY AND LOCOMOTIVE ENGINEERING and give any other good way they may know of for doing this kind of work. Your correspondence columns are useful to many for the interchange of ideas and for bringing methods of doing work to light.

I have always tested for leaky steam pipes by filling the boiler with water under pressure and blocking the exhaust nozzle and opening the throttle and sometimes under steam pressure.

I also found what I think is a very simple and inexpensive way to do this work is to put water under pressure through the steam chest by removing the relief valve and connecting pipe fittings, then block the exhaust nozzle and close the throttle. If steam pipes leak it will show very quickly.

You can also test the dry pipe in same manner if the throttle is closed and does not leak and if the boiler is emptied of all water it will show, if dry pipe is leaking at the blow-off cock of boiler, by reason of the water dripping down into the boiler and running out of the open blow-off cock.

L. A. STRADER,
Round House Foreman.

So. Richmond, Va.

Catechism of Railroad Operation

By Angus Sinclair

Second Series (Continued.)

60. Why is it necessary to provide extra support to a crown sheet?

A. The crown sheet, being flat or nearly so, has little resisting power to the steam pressure on top that tends to push it downward.

61. In what way is the crown sheet generally supported?

A. Generally by stay bolts that tie it to the outside shell of the boiler. Some boilers have the crown sheets supported by crows bars that extend across the crown with stay bolts securing the sheet to the bars. The bars are double, set on edge with space between through which the stay bolts pass.

62. What objection is there to using crown bars instead of radial stays?

A. The crown bars add considerable weight where it is not wanted and causes accumulation of mud and scale difficult to remove.

63. How are the side sheets and the front and back sheets of a fire-box which are all flat prevented from bulging under the pressure of steam and water inside?

A. By being bound to the outside sheets by stay bolts.

64. Can you tell when a stay bolt is broken?

A. No. To find broken stay bolts is the duty of a boiler inspector or boilermaker, who has acquired special skill in doing that work.

65. For what purpose are small holes drilled in the outside of stay bolts?

A. To detect breakage of the stay bolt. When a stay bolt so drilled breaks water will leak through the hole.

66. What are the principal causes of leaky flues?

A. Rapid changes of temperature is the most fertile cause of leaky flues. That may be produced by irregular boiler feeding or by defects of firing, such as leaving holes in the fire that admit cold air direct to the flues. This is made worse by reckless use of the blower when the damper is open. The rapid change of temperature that is most destructive to flues generally happens upon the cinder pit. When drawing the fire the blower is frequently kept on at full force, drawing a great volume of cold air into the fire-box, causing leakage of flues and fire-box sheets.

67. How would you act to make the best of an engine having leaky flues?

A. Keep up as bright a fire as possible, feed the boiler regularly and avoid the use of the blower and keep the fire door closed as much as circumstances would permit.

68. What causes scale to form upon the heating surfaces of a boiler?

A. Generally the solid matter held in solution in the feed water. Muddy feed water may also increase the scale.

69. What is the effect on the economical operation of a locomotive to have the heating surfaces coated with scale?

A. Scale on the heating surfaces prevents the hot fire gases from imparting full vaporating service to the water inside the flues and the fire-box sheets, so that they pass into the smoke-box at a higher temperature than they would if the heating surfaces were clean. In short, scale leads to waste of fuel.

70. How much water should be in the boiler when an engine is given up at the engine house?

A. Three gauges or more.

71. When should the boiler be filled with water at the finish of a trip?

A. While the engine is working its train. Rushing water into the boiler when engine is running from train to engine house is bad practice.

72. What is the effect of leaky steam pipe joints inside the smoke-box?

A. Leaky steam joints in smoke-box are very detrimental to free steaming.

73. What is the source of power in a locomotive?

A. Steam generated by the fire in the fire-box.

74. How is steam generated, and in what manner does it transmit its power energy to the locomotive.

A. Steam is generated by the heat of the fire boiling the water in contact with the heating surfaces. As evaporation of the water goes on the steam accumulates and the pressure inside the boiler increases. When the time for use comes, the engineer puts the reverse lever in gear, opens the throttle gently, and the steam passes through the dry pipe and branch pipes to the steam chests, thence through the valves to the pistons. Pushing these, the force of the highly pressed steam is transmitted through the main rods to the driving wheels which it turns, thereby providing the means of doing useful work.

75. Is there any difference in the quality of steam used by steam engines?

A. Yes; there are two qualities of steam, saturated and superheated.

76. What is saturated steam?

A. The steam which contains just sufficient heat to keep it vaporized. When the least quantity of heat is abstracted from saturated steam a proportionate part of the steam becomes water.

77. What is superheated steam?

A. That is steam holding more heat than saturated steam. To explain: Saturated steam at 200 pounds gauge pressure has a temperature of 388 degs. Fahr. If anything happens to abstract heat from that steam, such as the chilling effect of a cool steam chest or cylinder, some condensation of the steam takes place, and part of the heat energy is lost, for the water to which the steam has fallen has no power to do work. But had the saturated steam been given extra heat sufficient to raise it to, say, 488 deg. Fahr. at 200 pounds gauge pressure it would have 100 deg. Fahr. to draw upon before condensation began.

78. What are the principal proportions of a locomotive?

A. Boiler capacity generally expressed in square feet of grate area and heating surface, steam pressure carried, size of cylinders, size of driving wheels, weight on drivers and total weight of engine.

79. What are the principal dimensions of the engine you are firing?

A. Give these dimensions. They are particulars which every intelligent fireman ought to keep in his memory.

80. How many pounds of coal per train mile does the engine you fire usually burn?

A. Answer according to facts. To keep noticing things of this kind increases a man's interest in his work.

81. About how many pounds of water does your engine evaporate for each pound of coal burned?

A. Answer according to facts. To get at the information a good plan is to keep a stick graduated for the water represented in each inch of the tank's depth. Count the number of scoopfuls of coal used between two water stations and gauge the number of inches to water used. A simple calculation then shows about how many gallons of water have been evaporated for each pound of coal burned.

82. Why is the water gauge glass

unreliable when the water level ceases to move up and down?

A. That condition indicates that the connecting passages are becoming choked, a condition that is liable to show a false level of water.

83. Name the different appliances in the smoke-box that regulate the draft through the flues.

A. The exhaust nozzle, the diaphragm, the lift pipe and the netting.

84. Explain what adjustments can be made and the effect of the same upon the fire.

A. The exhaust nozzle can be made larger or smaller. The smaller the nozzle the greater will be the velocity of the escaping steam, and the more intense will be the draft. The position of the diaphragm regulates the flow of air through the flues. Raising the diaphragm tends the draft to burn the fire most brightly in the rear of the grates; lowering it has the opposite effect. Raising and lowering the lift pipe has the same effect as raising or lowering the diaphragm. Demands are frequently made for smaller nozzles when the desired effect could better be secured by adjusting the regulating appliances.

85. What does it indicate when the exhaust issues stronger on one side of the stack than on the other?

A. That the exhaust nozzle or the lift pipe is out of line with the stack.

86. If on opening the fire door you found the fire to be burning a dull red what might be the cause?

A. The fire would be suffering from want of air necessary to promote good combustion.

87. What would be the ready remedy?

A. Sharp shaking of the grates.

88 What are the leading objections to permitting the fire to burn in the dull, inactive fashion referred to?

A. The supply of air being limited the product of combustion is carbon monoxide, which produces 4,500 heat units per pound of coal burned in comparison with 15,000 heat units produced when the same quantity of coal is burned to carbon dioxide. (See question 29 of this series.)

89. What is the objection to opening the fire-box door to prevent steam frm blowing off?

A. Opening the fire door to restrain loss of steam through the safety valve is bad practice, for the cold air rushing into the fire-box is liable to cause leakage of flues and of sheet seams. Starting the injector or blowing the steam into the tank is the better way, but really the best remedy is regulating the firing so that popping of the safety valves will not happen. This may not be very easy of accomplishment just at first, but it is possible to do it very satisfactorily after some practice.

The Theory of Superheating.

The theory of superheating contains several important points, and without going into the realm of thermodynamics we may glance at the advantages which are claimed for superheated steam. In the first place, superheated steam contains a greater amount of energy per pound than dry, saturated steam does if both are at the same pressure. This increased energy is in the form of heat units, which enables the superheated steam to do more work in the cylinders than saturated steam could do if both were exhausted at the same pressure.

The reason for this is that dry, saturated steam is always on the point of giving up some of its heat and turning into water. Such a loss not only reduces the volume and pressure in the cylinder, but it gives up the store of latent heat contained in the particles of steam which are thus turned to water, and as the latent heat of steam is 970.4 British thermal units, it is evident that the loss owing to condensation is very considerable. If now, by superheating, we give to the steam, which is so ready to fall back into the form of water, a temperature greater than that due to its pressure, condensation will not take place until the superheated steam has given up the whole of the heat represented by this extra temperature. There is, of course, a reduction in temperature when superheated steam strikes the comparatively cool walls of a cylinder, but there is no condensation. This is practically where the principle upon which the value of superheating depends.

The increase of temperature in superheated steam augments its volume and all the moisture which is sure to be contained in saturated steam and any particles of water which may have been entrained as the steam entered the throttle valve, are evaporated and thus the action of the steam in the cylinders, that is, its expansion, follows the laws which apply to a perfect gas. Superheated steam also possesses a higher velocity than saturated steam at the same pressure, this results in the hotter steam more rapidly passing through the steam pipes and ports, and reaches the piston, if one may say, with increased striking force, which is an advantage in high-speed service.

In writing of this subject in their catalogue, No. 10,037, the American Locomotive Company says that "actual experience, as well as theory, proves that these advantages are obtained to the fullest extent only by the use of high degrees of superheat, hy which is meant from 150 to 175 degs. F. and above." The table published in connection with these remarks shows that for the lower ranges of superheat, such as 25, 50 and 75 degs. F., the economy is small.

A very satisfactory reduction in the amount of water consumed is evident when superheating is carried out. This amounts to from about 15 to 25 per cent. for superheated steam receiving 150 to 200 degs. F. of superheat. A reduction of the fuel used is also one of the advantages of superheating, which follows from the fact that less water has to be evaporated to do a given amount of work.

Incidental advantages are also secured by what Dr. E. Von Garbe, of the Prussian Railway Board of Administration, calls "hot steam" locomotives. A lower boiler pressure can be used with superheated steam and the cost of boiler maintenance is reduced, together with less time the engine is out of service, owing to fewer boiler troubles. The heat of the flue gases, which would otherwise be wasted, is taken advantage of and applied in the interests of economy to the steam as it circulates through the pipes and flues of the superheater.

In describing the principle of superheating one might almost say that it is utilizing waste heat to change high pressure fog into a perfect gas.

Horse Power.

There is a belief among those that have little or no technical training that when horse power is referred to in relation to engines, that it is a comparison with the tractive effort that could be made by a live animal, and on this reasoning an engine said to be ten horse power could do the work of ten average sized horses. The mechanical horse power, however, has no relation whatever to the actual horse. An ordinary horse can, and frequently does, exert a force equal to eight horse power, but this would not be a sustained effort. This has been frequently proved by dynamometrical tests. James Watt established the equivalent of a mechanical horse power at 33,000 ft.-lbs. per minute, and it is on this calculation that the power of engines are reckoned, and not on the spasmodic and necessarily short period efforts that a horse may make.

Why Frost Fractures Pipes.

Water expands upon freezing. One volume of water at 32 degs. Fahr. becoming by freezing into 1.0908 volumes of ice at the same temperature, which is that water increases about one thousandth of its bulk in freezing. The quantity of heat required to melt one pound of ice from the state of ice at 32 degs. Fahr., to that of water at 32 degs. Fahr., is 142 times as great as the quantity of heat required to raise the temperature of one pound of water from 32 degs to 33 degs. Fahr. The specific heat of ice near the temperature 32 degs. Fahr. is about 0.50.

Baldwin Mallet Articulated Compound for the Southern Railway

The Southern Railway have recently placed in service two Mallet articulated locomotives, with the 2-6-8-0 wheel arrangement. These engines were built by the Baldwin Locomotive Works, and are generally similar in design to a locomotive constructed by the same builders in 1909 for the Alabama Great Southern Railroad. The tractive force exerted by the new engine is 72,500 lbs., working compound.

In this design, there is a continuous equalization system for each group of wheels. In the front group, yokes are placed over the leading driving boxes, and from these yokes is suspended a transverse half-elliptic spring, on which the rear end of the forward equalizer rests. This arrangement has been used by the builders on previous Mallet engines. In the case of the rear group, yokes are placed over the boxes of the second, third and fourth pairs of driving wheels, and the frames are supported on half-elliptic springs, hung between the yokes. The location of the firebox, immediately above the driving wheels, necessitated this arrangement. The main frames are vanadium steel castings, and the articulated joint has a single hinge connection.

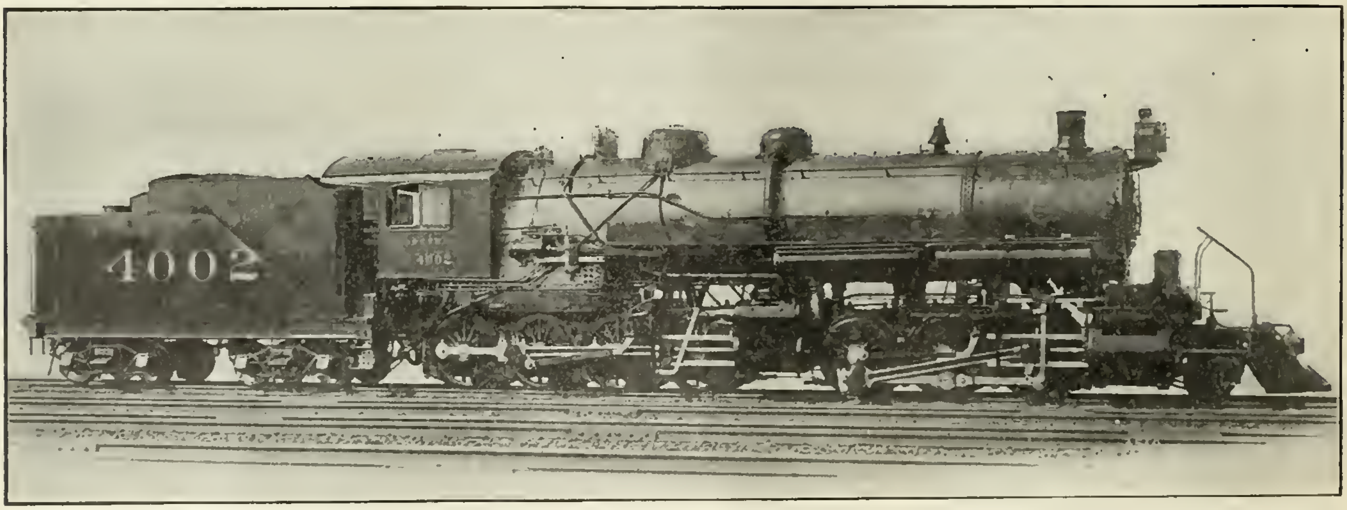
The cylinders are all lined with hard bushings, ⅝-in. thick. The high and low pressure pistons are of cast steel, the low pressure having tail rods. Steam is distributed to the high pressure cylinders by inside admission piston valves 13 ins. in diameter, and to the low pressure cylinders by balanced slide valves. The low pressure ports have a width of 24 ins. The valves are driven by Walschaert's gear, and the radius rods balance each other, the high pressure rods being down, and the low pressure up, in forward motion. The combining levers of the high pressure gears are pinned directly to the valve rods, which are supported in brackets bolted to the steam chest heads. In the case of the low pressure engine, each combining lever is pinned to a crosshead having an inwardly projecting lug. To this lug the valve rod is attached. This arrangement was adopted because, owing to the width of the low pressure ports and the restricted clearance limits, it was not found practicable to place the steam chest center and the combining lever in the same vertical plane. In accordance with the usual practice of the builders, the front and back reverse shafts are connected by a jointed reach rod, and the Ragonnet power reverse mechanism is applied.

The arrangement of the steam piping calls for no special comment, other than that a smoke box superheater, used as a reheater, is connected into the piping system between the high and low pressure cylinders. Passages for conveying the steam from the flexible receiver pipe to the low pressure steam chests, are cored in the front frame casting. To this casting the low pressure cylinders are bolted. The construction here is similar to that used on heavy articulated locomotives previously built at these works.

The boiler, apart from its large size, presents no unusual features of construction. The shell has a diameter of 84 ins. at the front end, and the tubes are 21 ft. in length. The firebox is radially stayed, and approximates to the Wootten type in shape. The crown is supported, at the front, by two inverted T-bars hung on expansion links; while 399 flexible staybolts are placed in the throat, sides and back. The dome is of cast steel, and contains a balanced throttle valve which delivers steam to external steam pipes. The mud ring is horizontal, and is supported on sliding bearers at the front and back.

The tender trucks are of the arch-bar type, with cast steel bolsters and chilled cast iron wheels. The frame is composed of 12-in. steel channels, with oak bumpers. The tank is of the water bottom type, and has a capacity for 9,000 gals. of water and 13 tons of coal. The principal dimensions of these engines are given below:

Cylinders, 23 and 35 x 32 ins.
Boiler—Type, straight; material, steel; diameter, 84 ins.; thickness of sheets, ⅞ in.; working pressure, 200 lbs.; fuel, soft coal.
Firebox—Material, steel; length, 117 ins.; width, 96 ins.; depth, front, 78½ ins.; back, 75 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.
Water Space—Front, 6 ins.; sides, 5 ins.; back, 5 ins.
Tubes—Thickness, 0.110 in.; number, 437; diameter, 2¼ ins.; length, 21 ft. 0 in.
Heating Surface—Firebox, 221 sq. ft.; tubes, 5,380 sq. ft.; total, 5,601 sq. ft.; grate area, 78 sq. ft.
Driving Wheels—Diameter, outside, 56 ins.; journals, 10 x 12 ins.
Engine Truck Wheels—Diameter, 30 ins.; journals, 6 x 10 ins.
Wheel Base—Driving, 34 ft. 5 ins.; rigid, front, 10 ft. 0 in.; back, 15 ft. 0 in.; total engine, 43 ft. 4 ins.; total engine and tender, 71 ft. 6½ ins.
Weight—On driving wheels, 332,700 lbs.; on truck, 30,800 lbs.; total engine, 363,500 lbs.; total engine and tender, about 535,000 lbs.
Tender—Wheels, diameter, 35 ins.; journals, 5½ x 10 ins.; service, freight.



HEAVY MALLET ARTICULATED COMPOUND FOR THE SOUTHERN.

A. Stewart, General Superintendent of Motive Power and Equipment. Baldwin Locomotive Works, Builders.

Coal Is Coal.

To the ordinary purchaser, coal is coal just as salt is salt or sugar is sugar, with no difference worth mentioning. Yet there is a wide difference in the character of the various coals on the market and a considerable variation in the quality of the coals sold under the same general trade name. These differences make it difficult to secure the most economical coal for a given plant without an intimate knowledge of the various coals and of the engineering problems connected with their combustion.

Pullman Cars Built in the British Isles

By Aubrey F. Inglefield

The history of Pullman cars on British railways is most interesting, starting in 1875, when cars were ordered for the London, Brighton and South Coast. Two years later, 1877, the Midland Railway followed suit. Pullman sleeping cars were used also on this line. Two sleeping cars were also used on the East Coast route to Scotland. Eventually these Midland and East Coast cars were sold to the respective railway companies, as British companies prefer to run their own coaches. Owing to the comparatively small size of the British Isles, and the fast non-stop schedules in force, sleeping cars are not required for use as day cars, carriages with single fixed beds in separate compartments have been built, and have very successfully met the conditions.

The year 1906 was the turning point in British Pullman annals, for in this year the British Pullman company was formed as an independent British concern, having been formerly a branch of the American concern. At its inception the company found twenty-nine cars in service, distributed thus: Twenty-four on the Brighton and South Coast, three on the London and South Western, and two on the Highland (Scotland) Railway, sleeping cars. Prior to the year 1906 all cars were constructed in sections at the Pullman Works in the United States, and erected at the works of the railway they were intended for. In 1906 the first cars were built in England. These cars of 1906 were seven in number, and form a limited train which runs twice daily in each direction between London and Brighton, 51 miles. Four parlor, one buffet and two brake-parlor cars are used. This train is known as the "Southern Belle."

The first thing which would strike an American on observing these cars is the elliptical roof, which has superseded the deck or clerestory roof. It will also be observed that there are no steps to the doors; this is due to the fact that in Great Britain the station platforms are on a level with the car floors. The English method of coupling cars together is by a turnbuckle over a hook at the end of each car; the cars being kept apart by spring buffers. In our illustration Fig. 1 of the "Grosvenor" it will be observed that the buffers are drawn back and an automatic coupling used. This coupling is fitted over the hook and is kept up by a pin, the coupling hanging down when the hook is used. This system is also used on the Great Northern. Other railways, however, use the turnbuckles and a longer gangway. Short-distance trains in England have no gangways between the cars as a general rule, but this does not apply to the "Southern Belle."

The interior appointments and general construction of these British built cars follow well-known Pullman principles, which will be doubtless familiar to all readers of this magazine. The sides are stayed with longitudinal struts. The framework of the upper panels is blocked in, all the wood used for this purpose being carefully glued in. The weight of the car is taken on the side struts, the car being therefore practically a suspension bridge. The flooring is made of two thicknesses of wood with felt between, supported by cross-battens of sufficient strength. The cars are warmed by steam from the engine, and are also fitted with Baker stoves. They are lighted by Stone's patent self-contained system. Self-contained systems are very popular in England. Warm air is introduced through ducts, seen in the cut and are just below ceiling. Owing to the British love for privacy, these cars are divided into no less than five compartments, having two drawing rooms holding respectively eight and ten persons, fifteen others being accommodated in compartments of the usual British style at the ends of the car. There are also two lavatory compartments.

The seven cars composing the "Southern Belle" are magnificently finished in various styles of decoration, viz.: Adams, Pergolesi, French Renaissance, etc. Fig. 2 shows the interior of the "Alberta" and the "Verona" cars (Renaissance), The woodwork is polished wainscot oak, beautifully figured and inlaid with decorative panels, moldings, pilasters and friezes of holly wood, giving the effect of bas-relief. The ceilings, wall-brackets, door moldings, and even the baggage racks over the windows, have all been specially designed to retain the characteristics of the Renaissance style. The extremely decorative effect of the ceiling permitted by the use of the elliptical roof, is very effective. The sofas and chairs are upholstered in golden-brown piqué velvet, while the carpet is a deep green pile, and the blinds, specially woven of finest damask the shade of the carpet, exactly match. The decoration and equipment of the other cars of this train are no less complete, each, as has been mentioned before, being in its own particular style.

Fig. 3 shows the interior of one of the buffet cars which were built last year for the Metropolitan. These cars, the "Mayflower" and the "Galatea," are of the same general design as the cars just described, but are very small, being only 12 ft. from rail to roof, as the loading gauge of this road is small. These cars are hauled through one of the tubes into the city of London, which corresponds to the old part of New York. For example, imagine the business man's early morning train being hauled through the Interborough subway so that he may get out of his Pullman at Fulton street or the Battery.

Ten cars were built for the South Eastern and Chatham in 1910, and a dining car is just approaching completion for this road. These are all very similar to the Brighton cars. This will make forty-nine cars in service altogether. The British

FIG. 1. BRITISH BUILT PULLMAN "GROSVENOR." LONDON, BRIGHTON AND SOUTH COAST.

Pullman cars are painted a dark umber with white upper paneling, lined with gold, except the South Eastern cars, which are a purple lake, similar to Pennsylvania Railroad cars, lined with gold.

FIG. 3. PULLMAN BUFFET "MAYFLOWER." METROPOLITAN RY.

Bearing in mind the history of Pullman enterprise in England, there remains to be answered the question, Are Pullmans popular in England? I would answer that where they have been introduced they have, in the majority of cases, done well, perhaps on account of their refreshment buffets, and I believe that now that hotel life is becoming almost as great a feature in Great Britain as it is in the United States and as the Englishman is overcoming his natural diffidence, these cars will become more popular. I should add, however, that railway chairmen, or, as you would say, presidents, are, in the majority of cases, rather set against Pullmans, but perhaps they will overcome their prejudice in time.

East Somerville Shops B. & M.

A new and valuable addition has been made to the equipment of the Boston and Maine Railroad in the vicinity of Boston by the addition of another locomotive repair shop. There are already extensive shops and roundhouses at Charleston, East Cambridge and East Somerville, all within a short distance of each other, and the latest addition is the furthest of the number removed from Boston. It is a very substantial building of steel and reinforced concrete, the floor capacity being 180 ft. by 200 ft. There are ten pits, the arrangement being of the transverse kind. A travelling crane of 135 tons capacity traverses the entire length of the building. The runway of the crane has a clearance of 50 ft. from the floor, so that the locomotives can be conveniently conveyed from one pit to another. A 5-ton crane runs along the centre of the building and conveys the wheels and other material to and from what may be called the machine side of the shop.

FIG. 2. INTERIOR OF PULLMAN "ALBERTA." L., B. & S. C. RY.

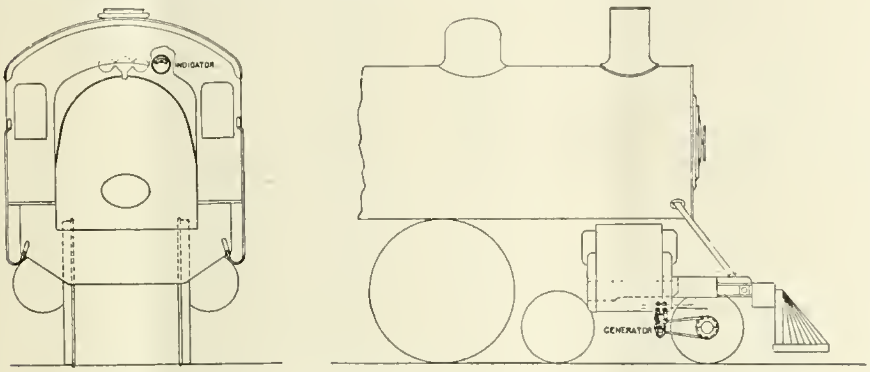
The heating apparatus is already in place, and several new features are in evidence in regard to the system of piping used in conveying steam, compressed air, electricity and water to every part of the works. The entire piping is covered in conduits over which slabs of reinforced concrete form a perfectly smooth flooring. These concrete slabs are each furnished with two eyebolts embedded in the concrete, and the slabs are readily raised when necessary. The attachments for hose or lighting and other appliances are fitted to the steel columns that support the roof. The machines are driven by a 100-horse-power electric motor made by the Westinghouse Electric Company of Pittsburgh.

The blacksmith and boiler departments are all under the same roof, and the overlapping smokejacks with which the forges are equipped, together with the suction blasts with which the smoke pipes are operated, keep the departments perfectly free from smoke.

A notable feature of the fine shop is the abundance of light. The walls, with the exception of the steel and concrete columns, are literally of glass. The roof is similarly lighted, so that the skilled mechanics, of which there are about 120, seem to be working in the open air. The machines are not all new, but the stock is being rapidly added to, and the works will shortly be among the most complete and compact of the kind in use. Mr. W. F. Nowell, the general foreman, has his office in an elevated position over the tool room, and has a commanding view of all that is going on in the shop. The shop is modern in its equipment and is of course one of the important factors in economical railway operation.

Hutchison Railway Speed Indicator.

Railway officials have for many years been on the lookout for a dependable device for indicating the speed at which locomotives, private cars, etc., are traveling. Various devices have been introduced, but the majority of them have fallen short of the ideal instrument for such purpose. The principal trouble has been in the transmission of the rotation of the truck wheels to the indicating device. At first thought this may appear an easy problem, but as a matter of fact, the practical conditions which obtain render it exceedingly difficut. So the problem remained, up to a short time ago, practically unsolved.



HUTCHINSON SPEED RECORDER APPLIED TO A LOCOMOTIVE.

About three years ago, Mr. Miller Reese Hutchison, the well-known inventor of the acousticon for the deaf, the klaxon horn, etc., and now the personal representative of Mr. Thomas A. Edison in naval affairs, took up the problem of providing an accurate and dependable tachometer for use on warships, to indicate the speed and direction of rotation of the propeller shafts. As an experiment, he equipped one of the United States warships with his tachometer in June, 1908. It still remains in the same calibration as originally, and has received no attention or adjustment since it was put in. This has been followed up by the equipment of a number of steamers, warships, etc., with the Hutchison tachometer, among them being the U. S. S. "*Florida*" on which a very comprehensive system has been installed.

From this marine tachometer there developed the Hutchison industrial tachometer for use in any plant where rotative or lineal speeds are to be indicated and recorded.

The railway field next received attention, and in November, 1910, a tachometer was applied to the new Edison-Beach storage battery car, an account of which appeared in our issue of May, 1911, page 190. This car is in commission on the Watchung branch of the Erie, and was equipped with the Hutchison railway speed indicator. It has been in daily service throughout the winter, and is today in the same accurate calibration as originally. The theory of the Hutchison speed indicator differs materially from other efforts in this line, in that the little inductore type magneto is mounted on a spring base and driven by means of a V-belt from a split V-pulley clamped to the axle near one of the boxes. The spring base keeps the belt tight, and the iron shield over the magneto prevents disturbance from external magnetic influence, etc., when the device is used on electric locomotives.

In this little generator there are no moving contacts, no commutators or brushes to corrode or need cleaning and adjustment. The armature remains stationary, as to the pole shoes, and between them rotates a peculiarly shaped iron sleeve which causes alternating current to be generated in the stationary armature, the voltage being directly proportional to the speed of rotation. Self-oiling bearings are used throughout.

From this little generator there is lead a two-wire flexible cable to the indicator, which may be placed in any location desired on the locomotive or car. In fact, several indicators can be operated from the one generator.

These indicators are dead beat and accurate. The scale is large and easily read, and, taking all in all, there is every indication that this outfit will prove extremely useful to railroads.

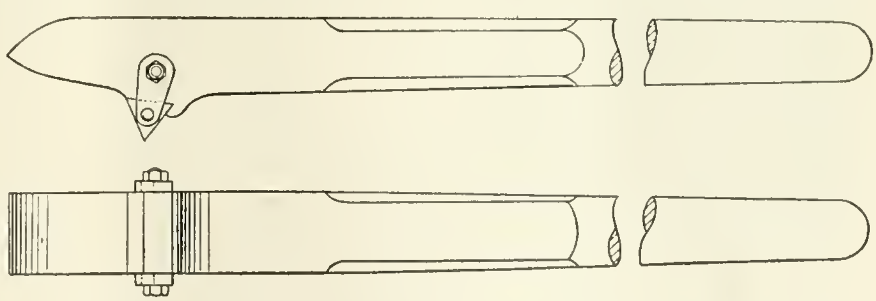
Home for Railway Men.

The report of the Board of Trustee and officers of the Home for Aged and Disabled Railroad Employees of America, is just issued in a pamphlet of 32 pages, and is a remarkable document as demonstrating the capabilities of railroad employees in establishing an institution of a kind embracing an outlay of over $100,000, and that all this has been accomplished in less than two years. The home is situated at Beach street and St. John's avenue, Chicago, and together with the adjoining grounds occupies over half a city block. The lodges and divisions of the railway brotherhoods and their ladies' societies took up the work with a degree or earnestness that was altogether admirable. Among the contributions the Brotherhood of Locomotive Engineers, at their meeting at Detroit, in May, 1910, gave $15,000. The B. R. T. made a similar appropriation. The railway men at the Canal Zone at Panama, through their four brotherhoods contributed $2,780.50. The Brotherhood of Locomotive Firemen and Engineermen, at the convention in June, 1910, contributed a further sum of $15,000. Among other contributions the lodges and divisions at Freeport, Ill., held a great popular picnic at the Freeport County Fair in September, 1910, and were enabled to donate $5,000 to the fund. The home is being maintained by an assessment of ten cents per year on the entire membership of the associated brotherhoods, and if this is not sufficient it can be readily increased. Fifty aged and disabled railway men were inmates of the home during 1910, and ample provision has already been made for the increase in numbers which is inevitable.

Good Pinch Bar.

By Charles Markel, Shop Foreman, C. & N. W. Ry., Clinton, Ia.

The attached blue print shows a pinch bar that was suggested, made and used at Clinton shops of the Chicago & North Western by the blacksmith foreman, Mr. J. Coleman. The advantage of this bar is that it has three sharp heel points to be used and when they become dull a new one can be applied and the old or dull one resharpened ready to be reapplied. You will note that the heel piece is made from good tool steel and is triangular in shape and held in place by two side plates and a ⅜-in. bolt. This makes a splendid pinch bar if placed in the hands of a careful user.



CLOEMAN'S SHARP HEEL PINCH BAR.

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Heroes of Railway Life.

In recently addressing one of the Apprentice Schools belonging to the Erie Railroad, Dr. Angus Sinclair, who is Special Instructor for the company, said: The education and practical training which you are receiving will fit you to fill satisfactorily the highest position on any railroad. This scientific education, combined with the excellent practical shop work you are receiving, makes you better prepared to achieve renown in your chosen calling than the education given to any other class of men. In my opinion you will be better trained for making your mark as high railroad officials than any of the classes of men who are getting educated to become leaders in railroad life. Technical school and college graduates were a few years ago considered the most promising persons for filling the higher official positions on railroads; and a movement was inaugurated to introduce such graduates to railroad positions, but nowadays we hear very little about that movement. A few college graduates made good in railroad life, but they were the exception. The years spent attending college is much better employed in the shop, for then a youth receives a sound foundation of engineering skill and knowledge, at the time when habits are forming and when his mind is most susceptible to acquire the art and information of so much importance in the business.

There is some reason for believing that a college training has a tendency to unfit a young man for passing through the rough work essential to acquiring manipulative skill in a mechanic trade. He receives no instruction essential to the business of an engineer which you fail to receive, and he has devoted much time to the pursuit of promiscuous knowledge which is a luxurious superfluity.

Very few of the men who have taken the lead in managing and promoting railroad enterprises had received any share of what is known as the higher education. Science did absolutely nothing to develop the locomotive engine. The man who first applied a piston to move in a cylinder thereby producing a practical steam engine was a working blacksmith. Oliver Evans, who invented the high pressure steam engine and made the locomotive a possibility was a miller. Peter Cooper, who built the first American locomotive, was a merchant. Baldwin and Phineas Davis were mechanics. Ross Winans who did so much to develop the Baltimore & Ohio motive power, E. L. Miller who designed the first engine for the South Carolina Railway and Col. John Stevens, first president of the Camden & Amboy Railroad were business men. James Millholland, who developed the anthracite-burning locomotive, was a machinist, and Zerah Colburn, who invented the wide locomotive firebox, was a working draftsman. Harrison, Norris, the Sellers, Rogers, Cooke, Hinkley, Mason and other noted locomotive builders drifted into the business through predilection or accident. John B. Jervis, who applied the truck to a locomotive, was a civil engineer; Brooks was a railroad master mechanic; Porter was a business man; Dickson who started the Dickson Locomotive Works was a capitalist. None of the men who became active in developing the American locomotive made any pretentions to being educated engineers. The most important improvements were developed by intelligent workmen.

The men who took the lead in developing and managing railroads as presidents and general managers were mostly persons having influential financial supporters or men who rose through native ability to be the heads of railroad companies. John Edgar Thomson, who organized the Pennsylvania Railroad, was its first president and the first celebrated railroad manager, was a hard working civil engineer, with fine natural business capacity. Philip E. Thomas, who originated and pushed through the Baltimore & Ohio Railroad, and who has been called the founder of the American railway system, was an ordinary business man. Commodore Cornelius Vanderbilt started work as a ferry boatman. C. P. Huntington worked on his father's farm until ambition moved him to become a clock peddler; Leland Stanford was a miner, then a merchant before developing into a great railroad builder. Taking a few other eminent railroad men of the past activities, such as Sidney Dillon, Thomas Nickerson, David H. Moffat, W. J. Palmer, T. B. Blackstone, E. H. Harriman, John M. Forbes; men who took a leading part in putting a net work of steel rails over the American continent; passed the spring vigor of their manhood devoted to practical work. Most of them were highly intelligent men possessed of much practical knowledge acquired in the precious leisure hours snatched from their toilsome days.

Among the men who carry the highest responsibilities of railroad management today, this upward progress has been made through performance of practical duties. Among those who are worthy of mention in this respect are James J. Hill, Marvin Hughitt, F. D. Underwood, W. C. Brown, James McCrea, J. Kruttschnitt, Daniel Willard, W. H. Canniff, A. L. Mohler, C. M. Hays, E. B. Thomas, A. J. Earling, W. H. Truesdale. John C. Stuart, W. G. Besler, G. W. Stevens, B. L. Winchell, and a host of others, to give whose names would invest my remarks with the appearance of an official directory.

As being much like one of ourselves, I am moved to make special mention of William Mahl, vice-president and comptroller of the Harriman Lines, who began his working life as a machinist apprentice, imbued with the ambition to learn every detail of the business.

Railroad life presents better opportunities for advancement to men having no other means of promotion beyond their ability, then any line of business that I am acquainted with, and there are very few college graduates among the lists of men who have become famous, for their great railroad achievements. Napoleon, as a note of encouragement, said that every French soldier carried the possibility of a field marshal's commission in his knapsack; I am justified in saying that every ambitious man of good character entering railway service has the possibility of becoming a president.

The Modulus of Elasticity.

It seems almost a truism to say that when it comes to the comparison of two or more things some sort of standard is necessary to which the articles under examination may be referred. When we give the length of a bar of iron as 10 ft. we mentally or actually compare it with the standard of length known as one foot, and we affirm that it is ten times as long as that standard. We may use yards or inches if we choose but the mental reference to the standard of yards or inches forms the basis of our comparison.

In the early part of the eighteenth century a spurious coin worth intrinsically half a farthing was constantly passed in Ireland as worth one half-penny. It was thus made to have a value four times what it was actually worth. This spurious coin was called a "Rap." When one of these coins was received by a shopkeeper who knew what it was, it was nailed to the counter in order that it might form the basis of comparison of all other coins of the farthing or half-penny variety which might be presented in the course of business. From this circumstance arose the expression "Nail that rap to the counter," when some extravagant talker tried to impose upon his hearers. On account of the falsity of the rap, the custom also probably gave rise to the phrase, "Nailing a lie." The low value of the coin certainly is responsible for the expression "I don't care a rap."

All this has nothing to do with the modulus of elasticity except to show the fact that for purposes of comparison some standard must at least exist actually or in the mind, and to which we refer the thing or things to be compared. The standard dictionary defines the modulus of elasticity as "A number determining the extension or change of form (strain) of a body under the influence of a stretching or distorting force (stress), and, in the case of a body whose dimensions are all unity, equal to the ratio of the strain to the stress." This definition does not, of course, give any hint of what use the ratio is when it has been found.

The modulus or co-efficient of elasticy is useful in several engineering calculations. It is the weight that would lengthen a bar of any given material of 1 inch section to double its original length, or would compress it till its length became zero, if it was possible to stretch it or compress it to that extent without breaking it. As a matter of fact the modulus of elasticity does not represent any actual results obtainable with any material, but is the figure representing this theoretical standard. Kent gives the modulus of wrought iron as 22,000,000 lbs. and steel about 30.000,000 lbs. In comparing the moduli of elasticity of these two substances it is evident that for each ton applied to the standard bar of 1 square inch section, the stretch of wrought iron would be greater for each ton of load added than that of steel, always, of course, within the elastic limits of the material. Because one gets the same stretch on fewer tons with iron.

In a calculation where it is desired to ascertain what is the load that will produce a certain stretch in inches within the elastic limit, the modulus of elasticity plays an important part. Again, if the stretch in inches which is permissible within the elastic limit is known, the modulus of elasticity is part of the formula whereby the load capable of producing that stretch is found. In all this it must be remembered that the principle of the modulus of elasticity applies only within the elastic limits of the material in question. This limit may, roughly speaking, be taken at about one-third of the breaking strain of the material. A convenient way stating the modulus or co-efficient of elasticity is this: If for steel the modulus be expressed by 30,000,000 lbs, which is the weight required to double the original length of a standard bar of 1 sq. in. in section under tensile strain, then the statement holds good, that steel will extent $\frac{1}{30,000,000}$ part of its normal length, for every 1 lb. increase of load per sectional square inch, that is put upon the bar. The safe load, on a bar or beam, the safe stretch or deflection of bar or beam, the safe height of columns may be determined by the help of this purely imaginary quantity called the co-efficient or modulus of elasticity.

It may be well to say here that a bar of iron or steel in tensile stress stretches while sutaining the safe load. When the load is removed the bar shortens to normal length and the load may be gradually increased and still the bar spring back after each release until a certain load is reached. This particular load after removal, leaves a permanent set in the bar which marks the disappearance of elastic action. This load shows the elastic limit has been reached and from that on the bar under load even less that it originally bore without distress, will constantly weaken and finally break.

Apprentice Schools.

Several railway companies have inaugurated schools for the instruction of apprentices and others in the scientific phases of their business. When intricate appliances began to be developed in connection with the operation of railway machinery it was found that some of them were beyond the grasp of the ordinary mechanic, and so railway officials began to look at graduates of technical schools as the material capable of making mechanics who would combine the knowledge and skill requisite in the repairing of electrical apparatus, lubricators, air-pumps, injectors, safety valves, pressure gauges and other articles likely to be beyond the grasp of the ordinary mechanic.

The experiment of converting technical school graduates did not work satisfactorily. Most of the graduates drifted into drawing offices, into testing departments and into chemical laboratories. Their tastes led toward the lines of occupation that did not preclude the wearing of genteel clothes, that involved no greasy hands or grimy faces. Most of them were willing to begin life at the top and work gradually downwards, but four or five years of college life pretentions raised expectations of a future career that did not involve the doing of anything that might be regarded as common labor. There is nothing heroic in taking down a greasy eccentric strap or in caulking the seams of a hot fire-box, and the absence of the heroic was apt to disgust the college graduate mildly open to entering upon the career of a mechanical engineer.

A few of the college graduates persisted in keeping to the real work of the shops, and went rapidly upwards, but they were shining exceptions. Some of the railroad officials perceived that their apprentices constituted the best material for performing the higher duties, and schools were instituted for their instruction in the science of the business. These apprentice schools have been steadily extended, and have become more than an experiment.

The Erie Railroad Company are doing highly practical work in the tecnical instruction of their apprentices. There are schools in connection with six of the repair shops, the average attendance being about 50 at each place. The instruction which is imparted by qualified men is given during the shop working hours, and is of a character directly applicable to the whole range of mechanic trades connected with the designing and repairing of railroad rolling stock. The apprentices belong to all the departments and include machinists, blacksmiths, boilermakers, pattern-makers, molders and others.

Most of the specially instructed apprentices remain loyal to the company, but occasionally a young man is allured to other employers before he gives the company that has gone to the expense of educating him, the benefit of his skill long enough to repay the outlay.

Shop Efficiency.

A short time ago Mr. W. W. Scott, general foreman of the Cincinnati, Hamilton & Dayton Railway at Indianapolis, Ind., read a paper on shop efficiency before the Indianapolis Railway Mechanical Club. Speaking on this subject, Mr. Scott said among other things:

Efficiency is the high water mark of ability in any particular line. Shop efficiency means the blending together in one mass, ability of greater or lesser degree. While temperament and environment are determining factors, to successfully get results you must pick out the weak members and assign them to the lower class of work. In other words, men who have the least ability in any particular line should be given the work which has the least responsibility in keeping up its action relative to the stronger parts. You can thus reach a high state of efficiency with the weakest members of your working staff.

That being accomplished, the organization of your stronger workmen should be easy. To bear this statement out, I can recommend the practice of concentrating classes of work. We assign certain workmen classified work. These men first being picked out on account of their particular fitness for certain jobs. The valve man, the rod man, the cross-head man, the air-brake man, the link man, are all handling what may be called classified repairs. All these make for shop efficiency. After all this has been done and your men are lined up to bring out results which will put your shop or roundhouse on a good basis, you find the material situation is so bad that it requires one-third more expense to make something you need than it ought to cost, or you hold up your work until proper material is furnished you from some outside point. This is one of the great drawbacks in shop and roundhouse work.

I find from experience in handling men that we have some strong, others weak; not physically, but in mentality. Often I find the weak man though a good workman, is influenced by the stronger personality who is, perhaps, not so good a workman. When I find a condition like this, I arrange in some manner to compliment the weak one for a good piece of work and criticize the stronger for his poor methods, and I soon find out that the weaker man is looking up to me for encouragement and not to the other man to criticize our business methods.

Personally, I like to see a well organized gang of men working in the utmost harmony with their fellow employes, and turning out the maximum amount of work expected. And I will say that I believe such conditions exist on the road where I am employed. We have our share of trouble, and I sometimes think a little more than our share, but it helps to take the sting out of engine failures, when you know the men behind you are loyal. You can never attain a high degree of efficiency unless the loyal feeling is there. Loyalty is the power which makes your position agreeable to you. Disloyalty means disorganization. I would say to you when you judge a workman in the ranks because of some dereliction of duty, ask yourself before passing judgment, "Is he loyal?" Let it sink in, and then think it over. You can never go far astray when you judge men by their loyalty.

In promoting efficiency I believe a great factor is "getting together." I mean this: Get your foremen and talk over your engine or car troubles just as if it was a bad case of ague or typhoid. Compare your experiences and I predict you will soon find a remedy for many if not all of the ills a locomotive is heir to.

Some men, handling subordinate foremen, think it best to keep up a constant contention among them. You cannot get good results from that method of handling men. I am going to give you some of the important essentials as regards shop efficiency and how best to promote it, from my point of view.

As the machine side of a railway shop controls the output of any shop, the machine foreman should know what work is needed as soon as the engine hits the back shop, and before, if possible. To arrange for this, our shop carries in the general foreman's office a card index. This index is accessible to all foremen. If inspections show a defect that will not necessitate the shopping of engine, and cannot be included in running repairs, a record is made and set opposite number of engine, and when an engine goes over the pit or into shop, this record is looked up and repairs are made. This card index system is scanned by the storekeeper who keeps his stocks up in conformity with what we need.

To have as far as practicable a standard established for running parts most liable to get out of repair; eccentrics and straps, butt-end brasses, cylinder heads and cross-heads. We are now preparing on our road a list of parts which should be standard for several classes of engines.

To best promote efficiency is to treat the men kindly; if possible, keep a spirit of contentment in their breasts, and you will find a greater output of finished product from their hands. By kindness I do not mean favoritism. Favoritism should never be shown. Win their respect and loyalty and your battle is seven-eighths won.

In conclusion I would quote from a paper by Mr. E. N. Owen, general foreman on the Southern Pacific at Bakersfield, Cal. To show how a shop was brought to a high state of efficiency by one master mechanic I will explain his methods. To begin with he held foremen's meetings, one each month, to which all foremen were invited, and they came with the understanding that each was to give a statement showing in what way he had improved facilities for handling work in his department. All improvements were discussed and suggestions for betterment gone over. If one had done nothing, he was given much good natured raillery. The writer got it sometimes, but never felt hurt; indeed he was spurred on to do better the next time.

We may make special machines and special vises as often as we like but the human hand that plays such an important part in this world must be directed carefully and intelligently to get the highest efficiency.

Electric Signals.

The first automatic signals on a steam road using alternating current for operating and lighting the signals, as well as supplying the track circuits, were installed on the Cumberland Valley Railroad between Lemoyne and Mechanicsburg, a distance of seven miles, and have just recently been put in service.

Power for operating the system is supplied from a 2200-volt, 25 cycle, single-phase, alternating current line carried on poles along the right-of-way, current being obtained from the power plant of the United Electric Company located at Lemoyne, Pa. Lightning arresters are placed at intervals of two miles and trouble from lightning has been confined practically to an occasional fuse blown out. The signals have three positions in the upper right hand quadrant. They are normally clear and are electrically lighted. The small amount of energy used by the 2 candle power electric lamps to light the signal does not justify putting them out in the daytime.

Transformers are used at each signal location with suitable taps to step the voltage down from 2200 to 55 volts for operating the signal motor and lights, and 5 volts for track circuits controlled by suitable resistances. The motors are of the induction type and have no contacts or brushes and no friction surfaces aside from the two armature bearings. The relays are of galvanometer type for track circuits with a vane type for slow release control.

The polarized system of alternating current track circuits is used; this controls the third or clear position of the signals, without the use of line wires, so that the two main wires are the only line wires used in the automatic territory. Track circuits average one mile with longest circuit 7,000 ft.

On many steam roads having trolley lines in close proximity it is frequently found that the return current of the trolley line will follow the rails of the steam road and if the steam road is using a signal system of direct current track circuits, constant care must be taken to prevent the stray trolley current from affecting the relays of the signal system and causing them to give a false indication. The use of alternating currents for track circuits effectively prevents any trouble due to stray currents as the relays will not respond to any current except the alternating current of the particular cycle and phase for which it is adjusted.

No batteries are used on any part of the Cumberland Valley automatic signal system, and the maintenance expense is principally due to the lubrication of the signal mechanism, and the care of the rail bonds and insulated joints. The operation of these signals has been so satisfactory that a contract was recently awarded for signaling forty-three additional miles of double track on the Cumberland Valley, divided into three sections. An additional feature is carrying sufficient current in the signal mains to supply electric lights at all stations as well as to operate the signals. This will be the first instance of such use of signal circuits on a steam road. The current supply for this signal and lighting system from Harrisburg to Mile Post 27 will be furnished by the United Electric Company, Lemoyne. The sections east and west of Chambersburg will be supplied from the power plant owned by the Company and located at Chambersburg, Pa.

The operation of automatic block signals of the three-position, upper quadrant type is as follows: If the line is clear ahead of a train, the signal blade stands in a vertical position indicated at night by a white light. It also has a red marker light 7 ft. below and 2 ft. to the left of it, giving it a staggered effect, thus indicating that it is an automatic signal. If a train occupies the block immediately in advance of a signal the blade assumes the horizontal or stop position, indicated by a red light at night, the following train must come to a full stop at the signal, and then proceed carefully, expecting to find a train ahead. If a train approaching the signal finds the blade in the 45 deg. position, indicated by a green light at night, it shows that the block immediately in advance is clear, but that the second block ahead is occupied. Under this arrangement, a train approaching a signal showing a white light is assured of two clear blocks, or, in other words, the track is clear for two miles ahead. At an interlocking tower three blades are shown in a horizontal position, and at night three red lights in a vertical position, indicating stop and stay to an approaching train until it receives a clear signal to proceed. If given the top blade or white light at an interlocking tower, a train may proceed at full schedule speed; if given the middle blade, or white light, the train will proceed at limited speed, and if given the lower blade, or white light, the train will proceed at low speed, prepared to stop immediately.

The object of the staggered marker light which always shows an unchanging red light at night is to give notice that the signal is automatic and if all the indicating lights went out the marker light would enforce a stop. The red marker light, however, necessitates the passing of a red light by a locomotive engineer.

Dispute About Wootten Boiler.

There has been considerable controversy concerning the inventor of the so-called Wootten boiler, the credit having been claimed for several different persons. It is beyond dispute that in 1855 Zerah Colburn, when mechanical engineer for the New Jersey Locomotive & Machine Company, designed a boiler having a fire box 6 ft. wide, illustrated in Sinclair's "Development of the Locomotive Engine," page 304. The fire box had no combustion chamber. Adding the combustion chamber was the improvement claimed in the Wootten patent. Wootten was not, however, the first inventor to apply a combustion chamber to that form of boiler. That addition was made to the Colburn boiler by John Brandt, superintendent of the New Jersey Locomotive & Machine Company.

When the Wootten boiler became popular, which was about 1880, the people controlling the patent made a great many railroad companies pay royalty for its use. When they requested the Erie Railroad management to pay royalty the charge was declined on the ground that the invention was old. That claim was disputed and the Erie people showed an old wide boiler in their Susquehanna shops which had been provided with a combustion chamber. That settled the dispute.

Periferal and Angular Velocity.

Sometimes we are asked questions that indicate that the questioner is not very clear in his mind as to the difference between periferal and angular velocity. Take the case of an engine, say, with a 56-in. driving wheel and a 10-in. axle. Now, as the engine runs along the track, the wheel makes about 360 turns to the mile. If wheels and axles remain together it is evident that the axle must have turned over about 360 times as well as the wheel.

We say the angular velocity of each is alike because, when the wheel made a quarter turn the axle did the same. It made the half, three-quarters, and every other fraction of a turn in the same time that the wheel took to do it because the angular velocity of each is alike.

When it comes to the periferal velocity of the axle it, being only 10 ins. in diameter, has a circumference of only 31.416 ins. Making 360 turns along the ground would advance it only a little over 942 ft. This shows that the axle has been carried along 4,338 ft. in the time it revolved 360 times. The angular velocity of wheel and axle are the same, but the periferal velocity of the wheel, supposing the engine traveled 60 miles an hour, would be 88 ft. a second, while the perferal velocity of the axle would be 15.7 ft. in one second.

Book Notices

THE SUPPLY DEPARTMENT. By H. C. Pearce. Published by the *Railway Age Gazette,* 112 pages, cloth. Price $2.00.

This contribution to railroad literature is the work of an experienced railroad man who has been engaged as general storekeeper on the Southern Pacific Railroad. He brings to his work as an author a thorough knowledge of the subject. The book is divided into fourteen chapters and embraces a comprehensive system of organization and the best methods of installing the same. The system of accounting is of marked value, embracing as it does the best practice which has been evolved from many experiments. We commend the book to all interested in the better management of the supply department of railways.

THE PRINCIPLES OF SCIENTIFIC MANAGEMENT, by Frederick W. Taylor, M. E. Published by Harper and Brothers, New York. 144 pages, cloth. Price $1.50.

The author of this book, who is a past president of the American Society of Mechanical Engineers, has presented numerous articles on kindred subjects to some of the leading magazines, and is a recognized authority on the subject of which the book treats. In the work before us the facts are pointed out that scientific management does not necessarily involve any great invention, nor the discovery of new and startling facts. It has, in many instances, however, more than doubled the productivity of the average man engaged in industrial work. The book is worthy of the careful perusal of all who are interested in the subject of material gain in the development of each man to his greatest efficiency and prosperity.

POWER, by Chas. E. Lucke, Ph. D. Published by the Columbia University Press, New York. 12 mo., cloth, 316 pages, with numerous illustrations. Price, $1.50.

This book embraces a series of eight lectures delivered at Columbia University and are designed primarily to point out the enormous effect that the substitution of mechanical power for hand and animal labor has had on the organization of society and the conditions of living. The style is clear and graceful, and the descriptions of the apparatus and machinery for the converting of natural energy in any of its available forms into useful work, is graphic and interesting. The illustrations are excellent and the presswork is of the best.

The subject matter of this book is interesting, as it is a subject that does not readily occur to the lay mind and while reading it one gets instruction in a pleasant form.

Locomotive Running Repairs

XVI. The Brick Arch.

The repairing of the brick arch used in the fireboxes of many of the modern locomotives may seem a simple matter of replacing the burnt out portions of fire-brick with new pieces suitably constructed, but something more than a mere superficial knowledge of the structure and uses of the brick arch should be obtained by all interested in the mechanical appliances used on the locomotive.

Since its appearance on the Boston & Providence railroad in 1857, where it was first introduced by Mr. George S. Griggs, it has undergone a variety of changes in form, and is still being experimented upon. The most popular form in which it appears at the present time is that shown in the accompanying illustration, Fig. 1. It will be observed that there are four tubes that pass longitudinally through the firebox, the tubes being connected on one end to the back sheet of the firebox, and at the other end to the inner sheet below the flues. These pipes are 3 ins. in diameter and are generally what is known as No. 7, B. W. G. in thickness. In order to secure these pipes in place it will be noted that openings are cut into both the outer sheets of the boiler, one opening being in the back sheet over the firebox door, and the other in the throat sheet under the barrel of the boiler.

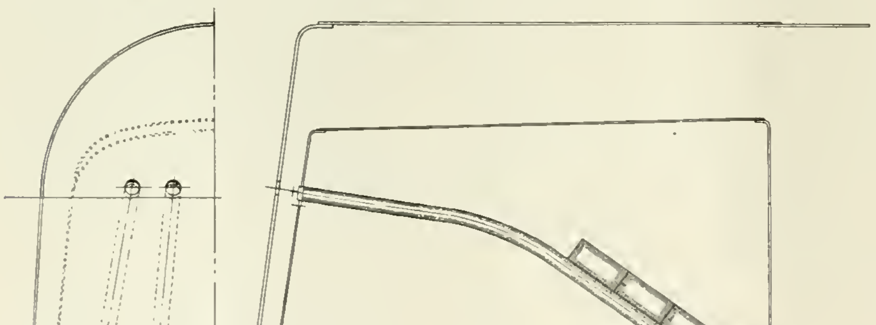


FIG. 1. BRICK ARCH IN POSITION ON SUPPORTING TUBES.

These openings admit of the pipes being placed in position. The holes are cut 1/32 in. larger than the outer diameter of the tubes, and the opening in the outer sheet readily admits of means for expanding the tube to fill the hole, and also for the purpose of half beading the end of the tube as shown in the illustration, Fig. 2. It will be readily understood that it is not necessary that the complete beading of the end of the tube should be made as is the case with the ends of flues that protrude into the firebox. The outer opening is fitted with a threaded brass plug which serves as an additional inspection plug and is readily removable and facilitates the cleaning of the boiler.

It may be stated in passing that these tubes aid considerably in the circulation of the water in the boiler, and it is claimed by those who are employed on locomotives so equipped that their steaming qualities are improved by the use of these tubes. Apart from the water circulation theory, however, the principal use of the tubes is to sustain, or partially sustain, the bricks which are placed crosswise on the tubes with their outer edges resting against the inner sheets of the firebox. The bricks are so constructed that in addition to resting on the flues they are arched in form and meeting in the center of the firebox they form an arch which under ordinary conditions would be self-supporting, but which under the great heat to which they are exposed have a tendency to crumble and wear away in the center on account of the stronger current of flame and heated gases having a tendency to converge towards the center of the arch.

In supporting the bricks, which, it will be noted extend nearly four feet back from the flue sheet, a series of bearings are attached to the side sheets of the firebox. These firebrick arch lugs, as they are termed, are generally placed so that each brick will rest on two of them. They are of wrought iron, and consist of a body of 1¼ ins. square, the body being 2 ins. in length. A threaded end, 1 in. long, and ⅞ in. in diameter, tapering, and threaded with twelve threads to an inch, is adapted to screw securely into the boiler. In order that the wiping effect of the fire, which has been already alluded to, may not speedily destroy these lugs, the bricks are furnished with recesses that overlap the lugs, and not only protect them in some measure from being burned off, but also form a secure means of holding the bricks in place. These notches in the bricks are usually made during the construction of the bricks, but it is rare that they exactly fit the location of the lugs, and hence some chipping has usually to be done in the notches so that the bricks rest securely in their respective positions.

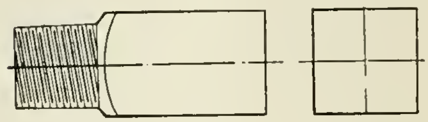


FIG. 3. FIRE BRICK ARCH LUG.

The size, and even the form of the lugs have been the result of careful experiment, especially among the accomplished mechanical engineers of the Boston & Maine railroad. Their work has also been supplemented and thoroughly tested by the engineers of the American Arch Company. As shown in the illustration, Fig. 3, the angle of inclination from the threaded end of the lug to the body of the lug is cut at 30 degrees. This has been found to be more durable than a square corner, which will break more readily than the sloping angle referred to. In removing the studs for any cause it is usual to clear out the thread in the boiler with the tap, so that these studs will range from ⅞ in. in diameter, to 1 3/16 in. in diameter, each replacing of a new stud being slightly larger in the threaded portion than its predecessor. It has been found that if the bricks are carefully fitted and overlap the stud, it may not be necessary to replace the lugs for a period of as much as two years in active service, but they should be carefully examined on each occasion when the bricks are removed, and replaced, if necessary by new ones.

The bricks nearest to the flue sheet are furnished with narrow projections extending to 4 ins., which forms three or more open spaces between the bottom of the flue sheet and the front end of the bricks. These openings are of advantage not only in superinducing an extra draught which has the effect of retaining a constant degree of heat in that portion of the fire, but aids in consuming or preventing an excess of smoke, which is the chief advantage in the use of the fire-brick arch. Much ingenuity has been shown in the formation of these openings. As shown in Fig. 4, the openings are of a semi-circular form. Of this class of brick arch which has recently come into use on a large number of the Pacific type of locomotive, there are only two fire-brick tubes used, the brick being so constructed that they rest on the pipes in curved grooves formed in the brick, the outer bricks nearest the sides of the firebox resting on the side sheets and sloping slightly downwards on their inner edges towards the tube on which the other side rests. The central bricks are slightly raised in the center forming an arch, the edge of one brick being furnished with a groove and the other with a projection adapted to fit into the groove, the whole forming a very substantial structure with the advantage that the central pieces may be removed in the event of their destruction being more rapid than that of the pieces of brick nearest to the sides of the firebox.

In the earlier forms of the brick arch, the closeness with which the bricks were fitted to the front of the firebox had the effect of forming a receptacle which speedily filled with ashes, having a tendency to choke some of the lower flues. In all forms of the brick arch now in

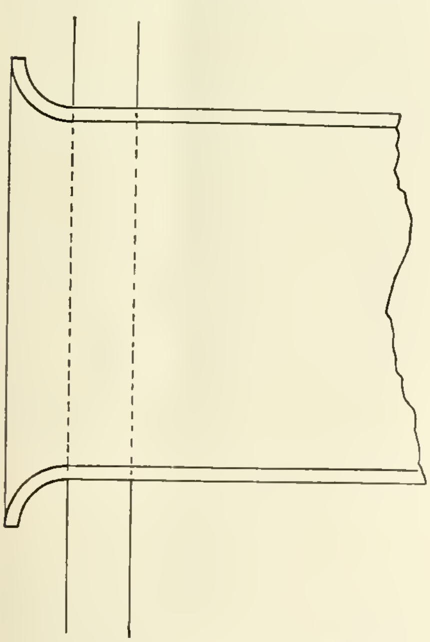


FIG. 2. END OF ARCH TUBE IN SHEET.

use, spaces are left between the flue sheet and brick arch, which precludes the possibility of any ashes or other material collecting. It will also be observed that the bricks as now constructed are hollowed out so that they are not only lighter, but may be said to have a larger heating surface on their under sides, so that their capacity or area of contact with the smoke and other unburnt gases is greatly increased, and their degree of efficiency enlarged. Other organic changes have occurred in the construction of the bricks, notably a bevelling of the edges so that the tendency to rupture or disintegrate is lessened.

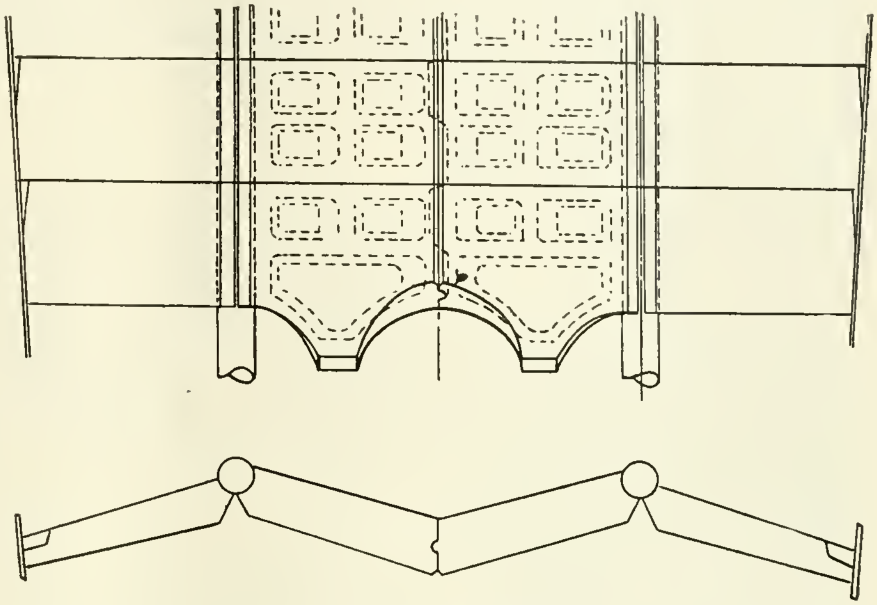


FIG. 4. ARCHED BRICK ARCH MADE IN FOUR SECTIONS ACROSS BOX.

Regarding the element of durability, the brick arch in regular service needs renewal once in thirty days, the average distance run by the locomotives being between 5,000 and 6,000 miles. The cost is said to be about five or six dollars each renewal. As a preventive of smoke it is of considerable utility, and the experienced fireman can readily manage with the aid of the brick arch to reduce the amount of smoke to a minimum when it is of consequence, as in crowded districts. As to the steaming qualities of a locomotive equipped with the brick arch as compared with the same class of locomotive, the testimony of many experienced engineers all tend to favor the use of the brick arch. This is not surprising, because it can be readily understood that the presence of a considerable mass of fire brick at a high degree of temperature cannot have other than the effect of aiding combustion, while the presence of water tubes of the dimensions referred to, in the firebox, is an aid to the water circulation and facilitates the generation of steam.

It may be mentioned, however, that many successful experiments with fire brick arches have been made where the presence of water tubes in the firebox has been dispensed with. Some of these take the form of a low arch consisting of two massive bricks resting on the sides of the firebox and meeting in the center, each piece being constructed with a semicircular groove, and the two grooves coming together form a round opening into which a round iron rod 1½ in. in thickness may be readily inserted and so prevent the bricks from making any vertical movement from their proper position. Others are so constructed that there is a space centrally adapted to receive a keystone-shaped portion of fire brick which holds the arch in place. These variations are all of more or less merit, and in the various classes of locomotives with their varieties in form and size of fireboxes, the same form of firebrick arch is not equally adaptable to all.

We may add that the latest comparative tests of locomotives furnished with fire brick arches and others not so equipped show that the amount of coal consumed varied in favor of the brick arched locomotives by 12 per cent., the two locomotives being in every respect the same, with the exception of the brick arch equipment. The loads were identical, being 18 car loads of coal in each trial. The same engineer and fireman were engaged in running both locomotives which were of the consolidation type, and in the tests, occupying over six hours, the miles run to one ton of coal by the locomotive equipped with the brick arch amounted to 16.5, while in the other locomotive the miles run per ton of coal were 14.7, the total amount of coal consumed in the former case being 12,150 lbs., and in the latter 13,650 lbs. It has also been repeatedly demonstrated that the average life of flues has been extended from 20 to 30 per cent. by the use of the brick arch, and thus the saving in fuel and material largely overcomes in every instance the cost of construction and maintenance.

Questions Answered

SUPERHEATED STEAM.

39. F. H. R., Rutland, Vt., writes: Would you kindly explain the theory of the superheater? How the increased pressure is obtained, also what formula would be used to give the tractive power of a locomotive equipped with a superheater? A.—The tractive effort formula of a locomotive is not affected by the presence or absence of a superheater on the engine. If you will turn to another column of this issue you will find the question of the theory of superheating dealt with a little more fully than can be done here. Also read first letter in our General Correspondence.

UNDESIRED QUICK ACTION.

40. A. B. Youngstown, writes: What could cause a triple valve, that is apparently in good condition and properly lubricated, to work in the emergency during a 12 or 15-lb. service reduction and not to work in emergency during a full service application if the reductions are made in 3 and 4 lbs. at a time?—A. No doubt a partly-closed service port is responsible for this unusual action. With the heavy reduction, brake pipe pressure falls faster than the auxiliary volume can escape into the brake cylinder through the partly closed service port, while the full service application made in steps 3 and 4 lbs. permits the lapse of sufficient time for the auxiliary reservoir pressure to reduce as fast as brake pipe pressure is falling, regardless of the restriction in the service port.

WALSCHAERTS VALVE GEAR.

41. C. A. H., Enid, Okla., writes: Please answer through your paper why do some eccentrics lead the pin and some follow the pin with the Walschaerts valve gear? I know of two inside admission piston valve engines where on one engine the eccentric leads the pin while on the other engine it follows the pin. Both engines have radius rods connected above valve rod. A.—Both locomotives are equipped with valves of the inside admission type, and in running forward the eccentric follows the crank pin. Read Valve Motion article page 222, May issue.

CONTROL OF GOVERNOR.

42. B. L. W., Newfoundland, writes: Why is the pump governor not operated with main reservoir pressure when the D-8 brake valve is in use?—A. Owing to the fact that main reservoir pressure must be forced through the excess pressure valve against the tension of a spring before it can enter the brake pipe, it is necessary to connect the governor so that a fall in brake pipe pressure will promptly start the pump to supply it. Main reservoir pressure can be used to control the pump when the handle is in lap, service or emergency positions, by adding a siamese fitting and an additional regulating portion which can be connected to the main reservoir pressure and adjusted for 100 or 110 lbs. pressure, which will not interfere with the operation of the other top.

HORSE POWER OF AN ENGINE.

43. Newfoundlander writes: Suppose an engine with train weighing, say, 100 tons, making 200 r. p. m., with a certain mean effective pressure in the cylinders, arrived at the top of a hill in one hour after leaving station. Now, if another engine left at the same time on another track with same percentage of grade ahead of it, but with train weighing 200 tons and making 100 r. p. m., with same m. e. p. arrived at the top in two hours, would the last train develop as many h. p. as the first one? A.—You have arbitrarily assumed the loads in this case and they may or may not be true, but with same m. e. p. in cylinders, same size of drivers, stroke, etc., the engine making twice the number of revolutions per minute would give just exactly double the horse power the other one gave. The formula for horse power is:

$$\text{H. P.} = \frac{\text{PLAN}}{33{,}000}$$

and in both the cases you mention, everything remains the same with the exception of N and in one case it is double the other, consequently the answer will be double where N is doubled.

AIR PUMP TEST.

44. W. H. S., Springfield, Ill., writes: I wish to fit up an apparatus for testing air pumps in the roundhouse. What size orifice would you suggest for use in testing the 9½ and 11-in. air pumps, and should the valve handle be placed in release or running position during the test?—A.: A 9½-in. air pump in first-class condition, and under what is assumed an average condition as to piping should, with 125 lbs. steam pressure, attain a speed of 135 strokes per minute and maintain air pressure at 77 lbs. against an 11/64-in. opening or 87 lbs, against a 5/32-in. opening, and should make 124 strokes per minute. With 175 lbs. steam pressure the pump should maintain 127 lbs. pressure against a ⅛-in. opening and run at a speed of 136 strokes per minute. The 11-in. pump in first-class condition should run 109 strokes per minute with 125 lbs. of steam and maintain air pressure at 94 lbs. against an 11/64-in. opening. With 175 lbs. steam pressure the pump should attain a speed of 107 strokes per minute and maintain 150 lbs. air pressure against a ⅛-in. opening. This you will note is an efficiency test for the steam cylinder and valve mechanism, as well as the air cylinder, and refers to the pump in first-class condition, and when the pump reaches the stage at which it should be condemned depends upon the class of service the locomotive is working in. Owing to the many details that must be considered in conducting a reliable test, this matter will be referred to in the air brake department in future issues. For instance, the length of an orifice must be considered with the diameter, that is, the orifice discharges at its proper capacity when the length is 2.6 times the diameter, and will not maintain the constant flow unless the edge of the drilled opening remains sharp. If the orifice is used in the brake pipe the brake valve handle should be placed in release position and an allowance made for the warning port opening, but we prefer the opening at the main reservoir drain cock and the valve handle on lap position to preclude the possibility of brake pipe leakage affecting the result.

BOILER TESTING.

45. T. E. Walcott, Ia., writes: Q. How high a testing pressure of cold water should a stationary boiler be subjected to that is 20 years old, and carries a working pressure of 80 lbs. The boiler is of the fire-tube kind. A.—Boilers that have seen 20 years' service should be reduced in the matter of the amount of pressure at which their safety valves should be set. A boiler that began its industrial career at 80 lbs. pressure should not be set a higher than 60 lbs. after the period of service alluded to. The testing should at least be 25 per cent. higher than the running pressure. In testing a boiler, the liability to fracture is lessened when the water is heated. A boiler as old as this one should be most carefully examined by some outside impartial and competent expert, who could have no personal interest in keeping the boiler in service.

BROKEN AIR PIPE.

46. W. H. S., Baltimore, Md., writes: Can you use the brake on an engine equipped with the No. 6 E. T. brake if the distributing valve supply pipe is broken off? A.—Yes, if the distributing valve has a quick action cylinder cap. You would then plug one end of the broken pipe and close the stop cock in the other end, if handling a train an engine brake

would be had during emergency applications or after a service reduction has passed the point of equalization, but if handling the engine alone you can carry the automatic brake valve handle in service position and the independent valve handle in slow application position and when the brake is to be applied move the automatic brake valve handle to holding or running position so that brake pipe pressure will enter the brake cylinders through the quick-action cap and when ready to release return the automatic brake valve handle to service position and release with the independent valve in release position returning handle to slow application position as soon as the brake has released. By closing the stop cock in the supply pipe on a test rack or on a locomotive, and moving the valve handles as described will show you how the brake applies and releases under the conditions mentioned.

MAXIMUM DENSITY OF WATER.

47. Newfoundlander writes: It is said by some writers that the point of maximum density of water is 39.1 degs. F. Others say 39.2. Please advise which is to be taken as true? A.—The maximum density of water on the Centigrade thermometer is 4 degs. When changed into degs. Fahr. you will find that 39.2 is probably the closer figure of the two.

PUMP REVERSING.

48. B. L. W., Newfoundland, writes: Why will a leaky reversing slide valve cause a pump to "dance"? A.—Ordinarily the steam pressure acting on the reversing valve holds the valve and rod in position while the main piston is making the downward stroke, therefore the leaky reversing valve, which permits steam pressure to get between the valve and its seat in the bushing allows the steam pressure to equalize all around the reversing valve with the result that the valve and rod fall to their lower positions by their own weight as the main piston starts downward. As soon as this occurs the steam pressure is exhausted from the outside of the large piston of the differential valve, thus the reversal of the pump is instantly accomplished, and the result is the shorts strokes or "dancing."

SIGNAL WHISTLE BLOWS.

49. W. L. B., Newfoundland, writes: With the S. F. 4 governor, what causes the air whistle to sound when the brake valve is moved to lap position? The whistle does not sound when releasing the brake, which would indicate that the reducing valve is all right. A.—Failure of the signal whistle to blow when the brake is released cannot be taken to indicate that the reducing valve is in good condition and it is not likely that the S. F. governor contributes to the disorder. We might name several conditions of defective and improperly adjusted governor tops under which leaky pipes and main reservoir pressure in the signal system would cause the whistle to blow, but you will have no trouble with the whistle if the signal pipes and signal apparatus is free from leakage and if the reducing valve is properly adjusted, does not overcharge the signal pipe and opens promptly to supply a loss of signal line pressure. If the E. T. brake is used, the signal line check valve should also be known to be free from leakage.

WATER-GLASS AND WATER LEVEL.

50. Subscriber, Newfoundland, writes: If a boiler is filled half full of water, and the steam connection with the top of the water-glass is disconnected, will water flow over top of gauge-glass with only atmospheric pressure in the boiler? A.—No; there is nothing to make the water rise higher in the glass by the simple breaking of the connection above the water level when no steam is on.

FEED VALVE BUZZING.

51. W. L. B., Newfoundland writes: What causes the buzzing sound so often heard in a slide valve feed valve? A.—If the supply valve piston is a proper fit in the bushing there should be a dull buzzing sound caused by the rapidly moving supply piston when the feed valve is in operation. You may have reference to the high-pitched or squeaky sound of the B 6 valve when operating with considerable differential in pressure, which is due to the vibration of the diaphragm spindle. Adding a diaphragm sometimes effects a cure, but the proper remedy is to pry the ends of the regulating spring away from the coils, but the spring must again be ground to a perfect bearing against the regulating nut and spindle after this is done.

FACTOR OF ADHESION.

52. Subscriber, Newfoundland, writes: What is meant by the term "factor of adhesion" and how can it be calculated? —A. If you will turn to page 107 of our March, 1910, issue of RAILWAY AND LOCOMOTIVE ENGINEERING you will find a full description of the meaning and application of this term. On page 184 of the May, 1910, issue we had an article on the smooth wheel on the smooth rail, which would interest you to read in connection with the other article.

WEIGHT AND SIZE OF CYLINDERS.

53. Subscriber, Newfoundland, asks: Is there any rule by which one can figure the weight of a locomotive by its cylinders.—A. There is no rule by which such a calculation could be made.

Hints on Using Taps.

In general construction work three taps and a drill go together, the drill being the standard tapping size. The drill is generally well attended to. The taps get very little attention and in time with wear, and rough usage they become almost unfit for use. When the bottom threads become worn, the worn portion should be ground off, keeping the end of the tap square. The end threads of the tap should be tapered as originally shaped, care being taken to grind more off the back than the cutting edge, otherwise the tap will not cut. The amount of bevel should not exceed 1/32 in. If the threads are too much beveled the tap has a tendency to wobble when starting. This applies to the intermediate tap, the tapered tap being but little used where the hole is not clear through the metal. The plug tap should also be ground off at the end when the bottom threads are worn or broken and the bottom edge beveled to an angle of 45 degs. This lessens the risk of breaking the threads and while the plug tap ground to this angle will not penetrate to the very bottom of the hole, the stud should also be beveled at the point so that a thread at the bottom of the hole is not a necessity.

It should be noted that it is easier starting a tap in a hole if the edge of the hole is left sharp and not countersunk as is sometimes done. Oil should not be used until the tap has a good hold of the metal; the dry tap adheres more readily to the metal. When tapping rough material, the tap should be given a half-turn backward every three or four times. This breaks the chips, which if allowed to curl up will jamb the tap. These observations do not apply to the tapping of nuts on a machine, as the cut taken by machine taps is light, the tap being tapered its entire length. When a nut is too tight for a stud, a taper shaped piece of tin run through the nut with the tap will enlarge the nut. Time should be taken to try a square on the tap before proceeding too far with the operation.

Lacteal Lubrication.

In cutting threads in copper, or otherwise cutting copper in machine tools, there is frequently considerable difficulty in producing a smooth surface. Lubricating oil will sometimes bring about the desired result, but the use of milk as a lubricant never fails to produce the finest finish on copper.

Poor Policy.

In the days before the introduction of State railroad commissioners and others who reduced the freedom of railroad management, a common expression heard in railroad circles was, "how much will the traffic bear?" More weight than it could comfortably bear was frequently put upon the traffic, a policy which caused the appointment of railroad commissioners.

Air Brake Department

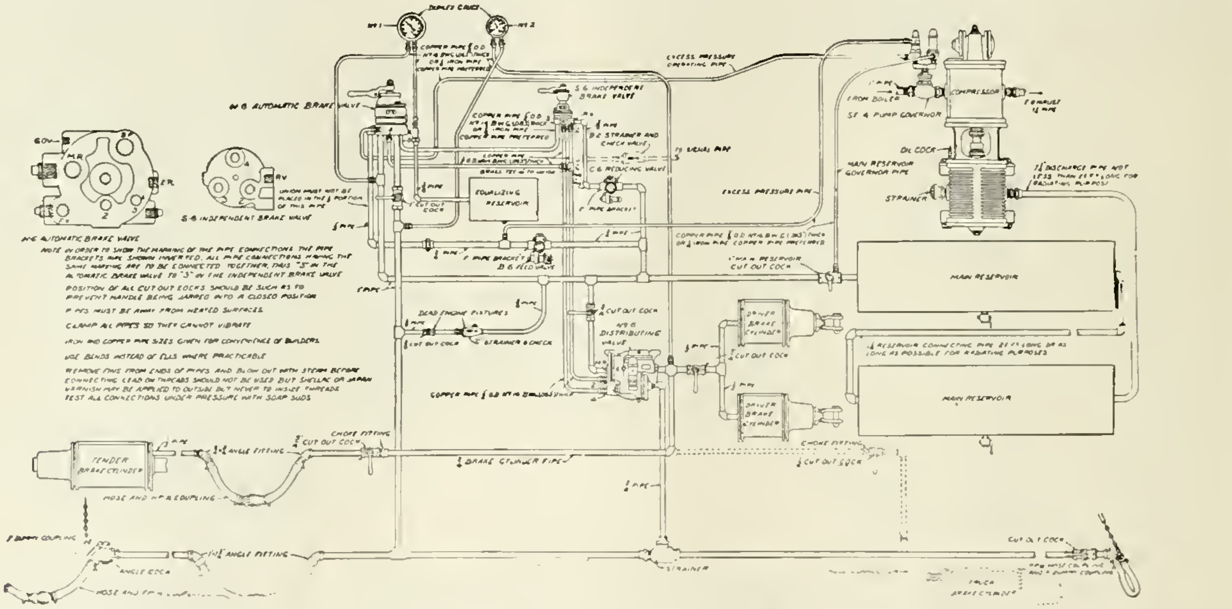
Conducted by G. W. Kiehm

Handling Defective Equipment.

While the man who is in charge of a locomotive should know the first thing to be done in every case of emergency, especially in the event of accidents or breakage of any part of the locomotive, the man who expects to assume charge of one must know, before he can successfully pass an examination for promotion.

This examination will disclose the man's knowledge of temporary repairs to the locomotive running gear and boiler appliances in case of an accident while out on the road, and the brake equipment is dealt with in the same manner and on some railroads more attention is paid to the fireman's knowledge of the air brake than to his knowledge of the running gear of a locomotive.

The air brake has become such an important factor in the operation of a railroad that it is no longer ignored by any railroad management, but, on the contrary, enormous sums of money have been and are being invested with a view of educating employes, and in return for the money expended in air brake instruction cars and in instruction rooms, the management expects every man who is in the line of promotion to have a knowledge of the operation of the air brake. The man who has no knowledge of the brake and only interests himself enough to pass an examination and thereafter pays no more attention to it will eventually have trouble.



PIPING DIAGRAM OF THE NO. 6 ET EQUIPMENT.

It is true that the brake equipment on a locomotive should be known to be in a condition that precludes the possibility of an air brake failure before the engine leaves the terminal, but roundhouse inspection and facilities are as yet far from perfection, and accidents are liable to occurr at any time.

Therefore on account of the liability of air pipes breaking, due to improper piping, lack of attention, poor workmanship or defective pipe, it is desired to state just what can and should be done if an air pipe of the H 6 brake equipment breaks while out on the road.

Explaining each individual move in turn is at this time unnecessary, as a little thought on the subject will make the reasons clear, and it is assumed that no repairs to the broken pipe can be made, but that it is necessary to plug the pipe and use the brake by the next best method.

If the air pump discharge pipe, the radiating or connecting pipe, was to break and no connection could be made by means of two-air hose, it would, of course, mean an engine failure. Attempting connections by means of gauge pipes is poor policy, as the capacity of those pipes is too little, and attempting connections with pieces of hose and hose clamps is very uncertain.

If the reservoir pipe was broken off near the reservoir it would also mean an engine failure, but if broken off between the branch to the reducing valve and feed valve and the brake valve, both ends of the broken pipe can be plugged and running position used to release the brakes.

If the feed valve pipe was broken, the end toward the brake valve can be plugged and the spring box unscrewed from the feed valve and a blind gasket placed in the governor operating pipe. The brake valve handle would then be carried in release position and the maximum pressure head adjusted to maintain the brake pipe pressure desired.

It will be remembered that with the brake valve handle in release position the exhaust port of the application cylinder is closed, and leakage into the cylinder would apply the brakes, but running position can be used for a sufficient length of time to release them. Should the engine brake stick, the release pipe branch between the brake valves can be disconnected and both valves used in applying and releasing the brakes.

If the brake pipe was broken off under the brake valve, the handle should be placed on lap position and the brake pipe leak plugged, and by connecting the brake pipe hose on the front of the tender with the brake cylinder hose at the rear of the engine, and closing the stop cocks leading to the engine brake cylinders, air could be admitted to and withdrawn from the brake pipe with the distributing valve, which would be operated with the independent brake valve. The adjustment of the reducing valve would be changed to the pressure to be used in the brake pipe, and if this was more than 68 lbs. the safety valve of the distributing valve should be screwed down.

If the brake pipe was broken between

the brake valve branch and the hose connection on the rear of the engine, the broken pipe may be plugged toward the brake valve and the brake pipe charged by coupling the brake and signal hose on the pilot and at the rear of the engine or tender.

If the reducing valve pipe is broken, the adjusting nut of the reducing valve can be unscrewed and the break toward the independent valve plugged. When applying the brake both handles would have to be moved, and when the locomotive brake came to be released, the independent valve handle would then be returned to running position.

Breaking the release pipe between the brake valves would cause no inconvenience, but would necessitate the use of the independent valve if the holding feature of the brake is desired. If the governor excess pressure pipe was to break, it could be plugged and a blind gasket inserted in the operating pipe union connection.

If the operating pipe was to break, the same effect would be encountered and it would only be necessary to plug the broken pipe in order to stop the leak.

If the pipe connecting the maximum head was to break, the leak could be plugged, and if the brake was to remain applied for a considerable length of time, the pump would be throttled by hand to prevent boiler pressure accumulating in the main reservoir. If any gauge pipes break they can be plugged or closed at the ends, but the pressure maintained in that particular piece of pipe could not be observed thereafter. If the equalizing reservoir pipe were to break it would be handled in the same manner as with the G 6 brake valve, by plugging the broken pipe and the brake pipe exhaust port. If this was attempted while the engine is in motion the H 6 brake valve could not be placed in emergency position while the stop cock in the brake pipe is closed, as a flow of air to the distributing valve would apply the engine brake.

If the brake pipe was broken off from the distributing valve, the brake pipe leak would be plugged, and the automatic brake valve should be used to operate the train brakes and the independent valve to operate the engine brake.

If the brake cylinder pipe was broken off at the distributing valve, the stop cock in the supply pipe would be closed at the first opportunity if it could not be reached immediately from the engine cab. If a stop is to be made with the cock in the supply pipe open, the application cylinder should be kept open by means of the independent valve, so that main reservoir pressure would not fall below brake pipe pressure by escaping through the broken pipe.

If the supply pipe was broken off, the stop cock would be closed, and if broken above the cock, the pipe should be plugged. There could be no engine brake with the broken brake cylinder pipe, or with the broken supply pipe, but if a quick-action distributing valve cylinder cap was in use at the time the supply pipe was broken, and if time permitted, a plug could be driven into the broken pipe toward the distributing valve, and the engine brake could be used in an emergency application.

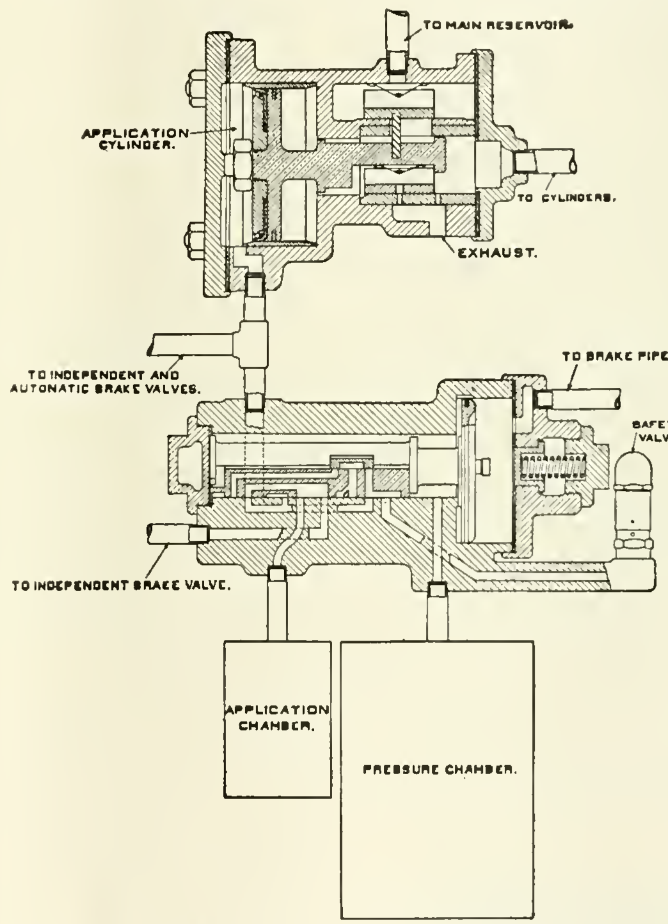
If the application cylinder pipe was broken off, the break toward the distributing valve could be plugged. Some attention must be given to the amount of reduction and brake cylinder pressure developed after an application cylinder pipe is plugged, as it is evident that if the driving wheels were to pick up and slide during a stop, the independent valve could not be used to release them. To be on the side of safety the adjusting nut of the safety valve should be unscrewed a few turns while the pipe is being plugged.

If the release pipe was broken off, no repairs need be attempted; the pipe should not be plugged, but in switching service the use of the independent brake can be gained by plugging the break toward the distributing valve. If the pipe of the dead engine fixture was broken, one end of the pipe could be plugged; the closed stop cock would prevent any escape of air from the other end of the pipe.

It is obvious that the foregoing has no reference to a time that the engine may be a second one in double heading, and if the man up for promotion has the object of making these temporary repairs clear in his mind, and understands the reason for proceeding in the manner outlined, it is not likely that he will abandon a train on the road on account of some broken air pipe on the engine, and afterward have the Road Foreman of Engines, or the Air Brake Instructor, explain to him how he should have proceeded in order to bring the train to the terminal.

Handling Improved Equipment.

Attention has been directed to the importance of the time element in the operation of air brakes, and the following remarks will apply to some difficulties encountered in train handling not due to defective apparatus, and will have particular reference to the Westinghouse E. T. brake. These remarks are intended for the benefit of students of the air brake, the fireman who will soon be up for promotion, in particular as the engineer does not always care to stop and explain to the fireman his reasons for varying from standard methods of train handling at times when conditions necessitate it, and often the fireman's opportunities to visit the instruction car come at long intervals. Before referring to any defects that are likely to be encountered during brake manipulation it is absolutely necessary that the flow of air through the system be understood, and that the person handling



THE ELEMENTS OF NO. 6 DISTRIBUTING VALVE.

the brake has a good, general knowledge of it, and is at least able to put "two and two together" when it comes to the effects of brake valve manipulation. The statement that the man who knows the most about the brake in the instruction car is usually the man who handles the train on the road in the roughest manner, while the man who is the most skillful in handling the brakes as regards to shocks to the train, knows the least about the subject, is entirely incorrect, regardless of any instances that may be cited to prove the statement.

The very fact that a man is able to handle the brakes on a train of cars with such a degree of skill that it is commented upon, proves conclusively that he does know something about it, even if he does not stop every one he meets and tell them how it should be done. On the other hand, the man who is handling trains roughly enough to cause comment and to damage equipment and lading, makes it plainly evident that he does not know all he should concerning the subject, regardless of what he says he knows, or else he has formed some very careless habits.

To say that a man can handle trains of 70, 80 and 100 air brake cars successfully under modern operating conditions and knows nothing about air brakes, is absurd, and the fact that a man can handle long trains of loads and empties mixed, and on various grades and curves, in a satisfactory manner, proves beyond question that he does understand the air brake and is keeping in touch with developments in the art of train braking, and unless he has an understanding of the effects derived from brake applications on the various equipments when mixed, he cannot successfully handle the brake on modern trains.

At any stage of train handling there is one pre-requisite that cannot be ignored, and it is the knowledge of an ability to get compressed air back into the train for charging or re-charging the brakes, and it is the prime factor in the operation of any air brake, if it is impossible to get sufficient air into the train to operate the brakes while the handle of the brake valve is in running position, it must be attempted in release position, and if it cannot be done in either case, the cause must be discovered and remedied, whether the compressors are not furnishing enough air, or whether excessive leakage makes it impossible to retain the compressed air that is furnished.

In this connection it may be well to observe that one important fact is often apparently forgotten, and that is, brake pipe pressure is used to operate the triple valves throughout the train, and if done by brake pipe leakage, the engineer cannot be accused of making the stop; however, if he is given a chance, better results can be expected.

In charging a train when the locomotive is equipped with the H 6 brake, the matter of getting air into the brake pipe holds good; if for any reason brake pipe pressure falls faster than it can pass through the feed valve, the pumps will be stopped by the governor until such time as main reservoir pressure falls to within 20 lbs. of the brake pipe pressure, or until brake pipe pressure again rises to within 20 lbs. of the main reservoir pressure, assuming that the tension on the adjusting spring of the excess pressure head is 20 lbs.

The automatic brake valve is intended to be used in stopping a train of cars; the lone engine is generally supposed to be handled with the independent brake, and a misconception of the use of the independent brake is often the cause of hasty remarks made by the train crew.

After the brakes have been applied with the automatic brake valve, the independent valve can be used to release or re-apply the engine brake, but it will be remembered that if the engine brake reapplies of its own accord after being released independently of the train brakes, some part of the engine brake is not necessarily at fault, as the equalizing valve of the distributing valve is not disturbed by any such proceeding, and a further reduction of brake pipe pressure, due to leakage, will result in a movement of the equalizing valve and a re-application of the brake on the engine, but the application cylinder can be emptied at any time with the independent brake. A misunderstanding of this simple action of the distributing valve is often responsible for work reports such as "examine independent brake; it leaks on," or "examine graduating valve in distributing valve brake leaks on."

After an overcharge and a re-application of the brakes on the head end of a train and engine no engineer would attempt to release the engine brake by means of the old style of straight air brake valves, and although this independent release can be accomplished by the use of the independent valve, it is just as ridiculous to release the engine brake, leaving the car brakes on the head end applied, as it would be to attempt to force a triple valve to release position by means of a straight air brake valve.

When the engine brake applies with the handles in running position it is evident that the equalizing valve has moved to application or lap position, and the only way it can be returned to release position is by increasing the brake pipe pressure a trifle higher than pressure chamber pressure, and it is accomplished by a quick movement to release and back to running position, and though the brake on the engine can be released with the independent valve, the equalizing valve cannot be moved, nor can the head brakes on the train be released until an equilibrium of brake pipe pressure is restored.

Release position of the automatic brake valve is intended for releasing train brakes. Were it not so, there would be no release position on the H 6 brake valve; however, the length of time the handle remains in release position is of the utmost importance, as with modern equipment there can be a serious misuse of the release position.

The abuse of the release position has in some quarters been prevalent to such an extent that it has become necessary to forbid the use of release position when the L. N. passenger equipment is in use because of the fact that the engineer would forget it and let the valve stay in release position long enough to overcharge the supplementary reservoirs.

An overcharged supplementary reservoir in combination with a little brake pipe leakage generally means carrying the brake value handle in release position, or a stop to bleed the reservoirs.

The modern triple valve test rack makes possible the release of brakes on 8, 10 or 12-car trains in running position, but in such cases the brake pipe reduction should never be less than 10 lbs. to insure an opening of the feed valve. In freight service especially is the movement from running to service position advocated for applying brakes and lap position for holding brakes applied, and similarly the movement from lap to release position is intended for releasing brakes on the train; holding position can be used later on if desired, but the movement from lap to holding position is merely an awkward method of releasing brakes by means of the feed valve.

If the use of lap position only for holding the brakes applied is adhered to, lap position will not be used while "preparing" to make a stop, or while selecting the point at which the stop is to be made.

In handling the E. T. brake under modern operating conditions the intended use of the different positions of the brake valve must be understood if trains are to be handled successfully, as it is not a difficult thing to imagine there is something wrong, but a far more difficult matter to handle the brake and get over the road when there is really something wrong with it.

Microbe Theory Applied to Stones.

The decay of building stones, according to Dr. Tempest Anderson of England, is not due to wind action or other surface influences, but to internal disintegration, resembling wood rot, and he ascribes it to some low organism, like the molds and fungi which cause the decay of vegetable substances. Doctor Anderson thinks he has found a cure for the stone disease, or at least a form of treatment which diminishes its ravages. He treats the stone with germicides, the best of which appears to be a mixture of sulphate of copper solution with bichlorid of mercury and creosote.—*Youth's Companion.*

Electrical Department

Development of the Electric Motor.

By A. J. Manson.

Electricity is now playing a very important part in the transportation of passengers and freight, and will be used as a motive power more and more as time goes on. We have the street car, the multiple-unit trains consisting of several cars coupled together and controlled by one man at the head of the train, and the electric locomotive. It is interesting to review the progress of electric traction and to consider how the present design of electric apparatus was reached.

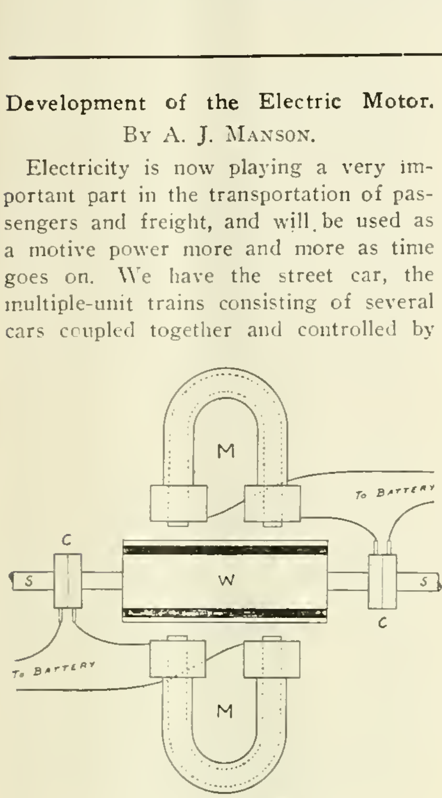


FIG. 1. DAVIDSON'S MOTOR, 1842.

The electric motor dates back to 1821 when Faraday showed a simple experiment. The end of a bar magnet was projected through the bottom of a cup partially filled with mercury in which was dipped the end of a wire which was suspended so that same could move freely. One terminal of a battery was connected to the wire, the other terminal making connection with the mercury. This allowed current to pass through the wire and rotation of the wire took place around the pole of the magnet and continued until the circuit was opened.

Further experiments were made and in 1831 Prof. Henry of the Smithsonian Institution built a very small engine making use of this discovery of Faraday's. This electro-magnetic engine was, as he expressed it, "nothing more than a philosophical toy." Several small electro-magnetic engines were built, and in 1834 Prof. Jacobi of St. Petersburg invented one which he later in 1838 applied to a boat which had paddles 28 ft. long, 7½ ft. wide and which projected in the water to a depth of 2½ ft. This boat could accommodate twelve persons and was capable of making a speed of three miles an hour. This electro-magnetic engine was worked by a battery of 64 large Groves' cells and was of about one horse power capacity. The Grove cell consists of a jar of glazed ware in which is placed an amalgamated zinc plate in dilute sulphuric acid. A small porous cell, of earthen ware, containing the strongest nitric acid in which dips a piece of platinum foil, is placed in the jar of sulphuric acid. The platinum is the negative pole of the battery and the zinc is the positive.

Many different types of electro-magnetic engines were constructed, and by 1841 there was a kind of mania for them in New York City for application to printing presses, etc. Among the best was that invented and built by Davenport of Salisbury, Vermont. In 1838 he ascertained that a bar of iron could be drawn with great force into a coil of wire when current was passing through this wire and in 1840 he built a two-cylinder walking beam engine, each cylinder much like a steam cylinder. He had metal pistons moving in hollow coils of wire, each coil forming a whole hollow cylinder. By regulating the time of the flow of current through these coils, each piston at the proper time was drawn into its coil and power was transmitted to the walking beam and to the movable parts.

The first application of an electro-magnetic engine for motive power was made by Robert Davidson of Aberdeen, Scotland, who built a locomotive of five tons and experimented with it on the Edinburgh and Glasgow Railway in 1842. This locomotive had two axles, it was 16 ft. long and 6 ft. wide, and on this machine four of his motors were mounted. The motor which he used is shown in Fig. 1. The shaft S-S is the axle of the locomotive. Over this was placed the wooden cylinder W on which was fastened three pieces of iron bars running the whole length of the cylinder, two of which are shown. The electro-magnets, M, were fastened to the body of the car and held stationary. The car was propelled by the magnets drawing round the iron bars fastened to the cylinders by connecting and disconnecting the electric current to the windings or coils of the magnet at the proper time. This was accomplished by means of the contactors C, each consisting of two rings connected together. The inside ring in each case was metal; the outside ring was part metal and part ivory, the location of the metal parts being such that the two brushes would be connected electrically at the proper time so that the magnet would be energized and would exert the pull on the iron bars, but would no longer be energized when the bar was just passing by the face of the magnet when any pull would tend to prevent the rotation already set up. By this means each bar in succession was attracted by the magnets and the car was put in motion and reached a speed of four miles per hour.

In all the engines up to this time the magnet was used to apply its force in only one direction and that was attraction. Prof. Page, of the Patent Office, Washington, D. C., had been working on an electro-magnetic engine and early in 1849 patents were taken out. He found that it took an appreciable time after the current had commenced to flow in coils of wire wound around the iron bar (as in Davidson's motor) before a magnet was formed and a pull exerted, and that this magnetic force remained an appreciable time after the flow of current was broken and so to have the magnetism in step so to speak with the current he made use of hollow coils as had Davenport in his walking beam engine. Page, however, went further and used several coils connected to make up his cylinder rather than one long coil as Davenport had done. After building and experimenting with three small engines Congress appropriated $20,000 and with this money Page built two electro-magnetic engines. The first was for a printing press or similar work and was tested, developing nearly seven horse power. At a lecture before the Smithsonian Institution, Washington, D. C., in 1850, Page exhibited his engine which was operated by batteries. This engine was of the reciprocating type, two foot stroke and the whole weighed approximately one ton. During the lecture boards of 1¼ ins. thickness were cut with a saw of 10 ins. diameter. With this engine a force of 600 lbs. was obtained when moving slowly.

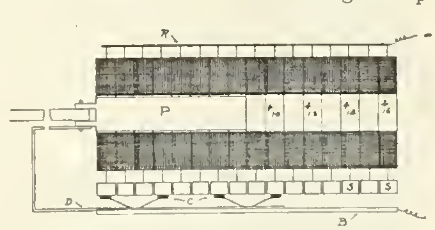


FIG. 2. PAGE'S MOTOR, 1851.

The second engine built was a locomotive for railroads, and on April 29, 1851 this electro-magnetic locomotive which weighed eleven tons, including batteries and passengers, of which there were seven, ran from Washington, D. C., over the Washington branch of the Baltimore

& Ohio Railroad to Bladensburg and return, a distance of nearly twelve miles. The running time from Washington to Bladensburg was 39 minutes. This was not entirely due to the slow speed of the locomotive, but to trouble which Prof. Page had with his batteries, for the locomotive was capable of making fifteen miles per hour on the level and the fastest rate during the trip was nineteen m. p. h. The batteries used were those having a porous cell containing acid placed in the other acid, similar to that used by Jacobi, and the vibrations of the locomotive caused several of these to break which accounted for the time consumed. Seven stops were made during the round trip on account of this battery trouble. On the return trip Page reversed his locomotive while running and found that this was a convenient and satisfactory way of braking. Page's locomotive was estimated at 12 horse power, there being two of his motors mounted on the locomotive, driving cranks on the axles.

The construction of his motor is shown by Fig. 2. The coil as mentioned above is not one winding, but is made up of sixteen coils, each one containing 1,500 yards of square copper wire. One end of each coil is connected to a copper segment, S. There are four sliding contacts, C, which are connected by a rod D to the piston P, so that movement is same as that of the piston. This piston is a cylindrical mass of iron weighing 800 lbs. These contacts C are connected electrically to the bar B which is energized from the positive terminal of the battery. The current from the battery flows through bar B to contacts C, through segments to magnet coils, to rod R and back to battery. Only two of the contacts C are connected electrically to the bar B at one time. When P is in position shown ready to move to the right the two right hand contacts carry the current energizing coils No. 7 and No. 10 which draws the piston toward the center. The contacts move with this piston and new coils are energized ahead and those behind cut off from the circuit. A mechanical means is provided which is adjustable so that when proper position of piston P is reached for end of stroke, the current is shifted to the other two contacts and the piston is drawn back. By means of this adjustment any length of stroke may be had. In this way Page obtained the double acting piston which had not been accomplished before. This engine of Page's was the most perfect electro-magnetic engine ever built. After completing this engine the appropriation by Congress had all been used up and Page lacked the means to carry on the work further.

While the development of the electro-magnetic engine was in progress experiments were being carried on along another line, namely, the generation of electric current. Faraday, in 1831, showed that if a metal disc was rotated near a pole of a magnet and the two ends of a wire were placed in contact with this disc, one at the center, and the other near the rim, that an electric current would flow through the wire. This was the beginning of the dynamo electric machine. Many machines were built using magnets and discs or bars, but the most important step in its development was due to Siemens, of the firm of Siemens & Halske, of Germany, who, in 1850, built what was called the Siemens Armature. They argued that better results could be obtained by using wires and having these wires rotate rapidly in front of the magnets, cutting the magnetic fields, than could be obtained by previous methods. Their armature was constructed with this end in view, and consisted of a grooved wooden rod about 2 ft. long wound longitudinally with many turns of insulated wire. With this armature they could use a horseshoe magnet with long and flat pole faces. They also found that very much better results could be obtained by replacing the permanent magnets, which were large and heavy, with electro-magnets, i. e., iron bars with turns of insulated wire on them through which current was flowing. These electro-magnets were able to give a much stronger field and, moreover, were much lighter. The next step forward was the machine built by Wilde and exhibited in Paris in 1867. In this dynamo electric machine the armature consisted of several of the wooden rods with insulated wire placed equally around the diameter of the armature which gave a more uniform current of electricity as there were more coils used. The poles or magnets in this machine were electro-magnets and the current for energizing them was obtained from a small Siemens armature rotating between the poles of a small permanent horseshoe magnet which was fastened on top of the large machine and which was belted to the shaft of the large armature.

Siemens and Wheatstone, the later a noted Englishman, at the same time, but independently, in 1867, found that the small machine could be omitted and the dynamo could be self-excited, i. e., that some of the current generated could be passed through the magnet coils due to the residual magnetism of the iron core of the magnets. Residual magnetism, it may be stated, is the very small amount of magnetism which is left in the iron core which has been energized by current flowing through the coils after this current has been cut off. This residual magnetism is sufficient to generate a small amount of current which flows through the field or magnet coils and brings them up to full strength rapidly, as increase of field means increase of current. This, then, was the beginning of the dynamo electric machine, as the same principles were made use of as in the modern machine of today.

We have spent some time reviewing the progress of the dynamo electric machine, because the modern railway motor was developed from the dynamo. In May, 1879, Siemens, at the Institute of Civil Engineers in London, England, showed that if a dynamo electric machine is connected to an electric current supply, from an outside source that rotation of this machine will take place and will be capable of delivering power. He exhibited a small machine which was run from two wires entering the room and which developed about ½ h. p. Here was the real beginning of the electric motor, for in this same year Siemens exhibited at the Berlin Exhibition two dynamo electric machines built by his company, the Siemens & Halske Company, of Germany, one of which was connected to a steam engine, supplying current to a small circular track, and the other mounted on a truck receiving power from a third rail and which pulled cars and carried passengers during this exhibition.

(*To be continued.*)

Horse-Power and Man-Power.

In connection with steamship propulsion the average man is apt to speak very glibly of so many hundred, or thousand, horse-power. But it is extremely doubtful if one person in a hundred really has a due appreciation of what the phrase actually means. On this point some very interesting remarks were made at the last annual dinner of the Scottish staff of Lloyd's Register by Mr. John Heck, the Glasgow engineer surveyor to the society. Proposing the toast of "shipbuilding and engineering," he said that, calculating the strength of twelve men to be equal to one horse-power, it would require 840,000 men to produce as much energy as the 70,000 horse-power developed by the turbine machinery of the express Cunarder *Lusitania.* Then, if the men were to work on the eight-hour day system those figures would give a total of 2,520,000, that being the number of men whose strength—if by any possible flight of the imagination it could be coupled to the liner's propeller shafts—would be necessary to drive the vessel across the Atlantic ocean. So it would take all the men in Scotland to supply the energy produced all the day round by the wonderful turbine machinery of this great ship. —*Ry. & Travel Monthly.*

General Foremen's Department

Members Please Read and Act.

To the Members of the International Railway General Foremen's Association.

Do you realize that we have only two more months until we are to meet at Chicago to attend our seventh annual convention? It is high time we were making arrangements to attend this convention, and any of you who have not already made arrangements, I would suggest that you do it at once, so when the times comes to go, nothing can hold you back.

Up to this time conditions appear to be in favor of a large attendance, and there is no doubt that we shall have the largest attendance ever had in the history of our organization. The Supply Men's Association have made elaborate arrangements to entertain us. The topics have all been mastered by the various committees, and they will be on hand with the latest information in railroad work. Invitations were sent to all the heads of the different railroads, and these were accepted without hesitation. We are expecting representatives from every railroad in the United States, among them will be good speakers and men who can tell us most anything we want to know, as they have been in the railroad field nearly all their lives.

Remember the date of the convention; July 25th to 27th inclusive, at the Sherman Hotel, Chicago, Ill. If you have not engaged your room, I would suggest that you do so at once, as you may not be able to secure the desired location at convention time.

We want every man to bring his wife or sweetheart to this convention. You will have a better time, and they'll help you to have it. Elaborate arrangements have been made to entertain the ladies, and we feel sure they all want to come with you. Now don't forget to bring them along.

Any further information desired will be cheerfully furnished by our secretary, Mr. L. H. Bryan, of Two Harbors, Minn., or myself.

Don't forget. We want every member of this organization to attend this convention in July, as there will be important business transacted which will concern each of you individually." "If you have not made up your mind to attend, do it now.

Respectfully and fraternally,

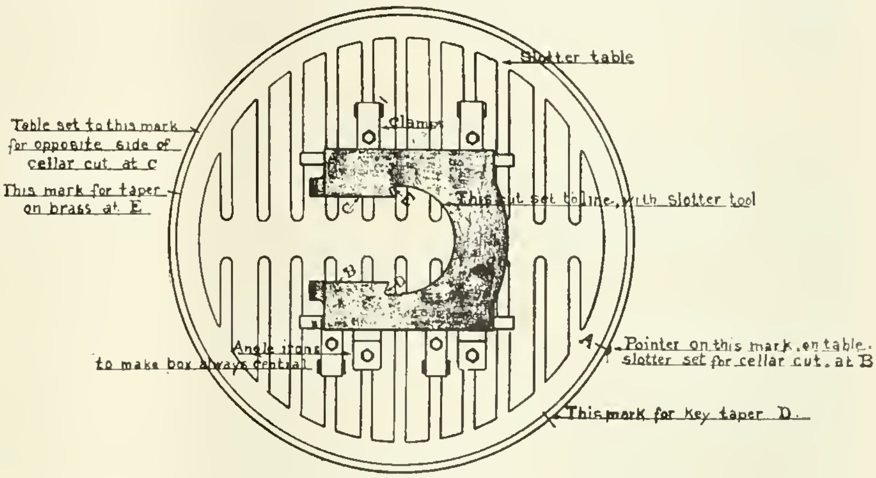
C. H. Voges,

President International Ry. General Foremen's Ass'n, Bellefontaine, Ohio.

Slotting Driving Boxes C. & N. W. Ry.

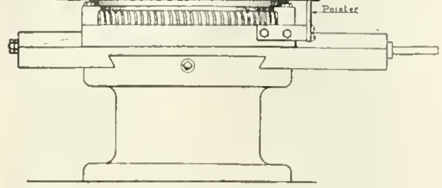
By Charles Markel,
Shop Foreman C. & N. W. Ry., Clinton, Ia.

Our illustration shows the C. & N. W. Ry. method of slotting driving boxes on a slotter having the table indexed and a pointer permanently placed on the base of



PLAN OF SLOTTER TABLE WITH BOX IN PLACE.

the machine. This method insures all boxes being made alike, and very little skill is required on the part of the workman. All boxes are laid out to an iron template, and the first box slotted is set to circle by the pointer held in the tool post. When the box is set to this circle the



FRONT VIEW OF BOX ON SLOTTER.

two angle irons are placed against flange of box as shown, and mark on the table is brought to the pointer, which sets the box correctly for cellar fits and bevels without any measuring or calipering on the part of the workman. All other boxes are then placed against the angle irons mentioned, which does away with resetting all other boxes to be slotted.

Drilling Hardened Steel.

Holes may be drilled in tempered steel, such as circular saws, springs, hardened wire, and other articles by hardening an ordinary twist drill in sulphuric acid. The pure acid should be placed in a saucer or other flat-bottomed vessel to a depth of about ⅛ in. The point of the drill should be heated to a cherry red heat and dipped in the acid vertically with the point of the drill in the acid. This will make the point extremely hard, while the remainder of the drill will remain comparatively soft. If the point should break off easily, sharpen and harden as before with a little less acid in the vessel. In this manner the point of the drill may be hardened sufficiently to drill tempered steel, while the softer parts of the drill prevent the drill from breaking while passing through the hole which it is very apt to do if an extended portion of the drill is hardened by the use of the acid.

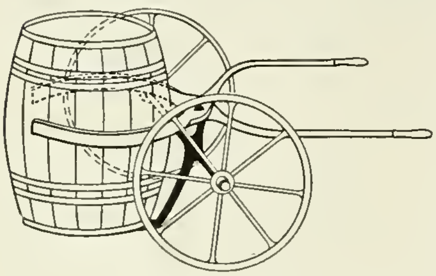
Hardening Punches.

Hardening of punches that may be of irregular shape and apt to crack when hardened, may be safeguarded by careful heating, so that the thinner portion of the punch may not be heated more than the thicker part. This can be readily accomplished by turning the article around in the fire. Even heating is the safe groundwork of all tempering. When the proper heat has been attained, immerse in cool water, and note that the portion of the shank of the punch which it is not necessary to temper should not continue at exactly the same height, while the lower part is held in the water. A slight vertical movement should be given to the article so that the hardened point should not have an abrupt beginning. While the article is cooling in the water the fingers of one hand should be made to approach cautiously towards the cooling article, and when sufficiently cooled to allow the fingers to touch it, it should be withdrawn. If allowed to remain in the water until perfectly cool the tendency to crack is very great. If a degree of heat is left in the hardened tool to equalize the variable strains incident to the inequalities already referred to, the tool will be found to have all the durability that may be expected, and of sufficient hardness for the work intended.

Handy Coke Truck.

An enterprising foundry foreman, who like some of the heroes of the past, is a man of infinite resource and sagacity has recently devised a very useful truck for handling coke barrels in charging the cupola.

The truck consists of a big pair of



BARREL CARRIER.

tongs mounted upon wheels, as shown in the illustration. In operation at this particular shop the apparatus is rapidly propelled by Italian power, the barrel is clutched in the tongs, the bottom hanger, or foot is kicked under the barrel, and the handles are compressed as the barrel is moved.

The barrel can be set down quickly without fear of upset, and even shaky barrels are easily handled, in this way.

Machine Tools.

Quite an interesting discussion has been started by one of our contemporaries on the advisability of retaining the expression "machine tool" when an article, such as a lathe or a wheel press or other similar appliance is referred to. The term is shown to be incorrect when so used. The primary meaning of "tool" is something that is used in the hand like a hammer, a chisel, a saw or a screwdriver. The word "machine," says the American Machinist, is given in Webster's as a contrivance which serves to produce or change motion.

A milling cutter is a machine tool, if you like, because it is something intended to effect mechanical operations and it is put in a machine instead of being worked by hand. The instrument which holds the work and operates the cutter is not a machine tool, it is the machine, and the cutter is the machine tool or the tool of the machine. The whole thing ought not to have the name of only a small part, because tool is here used as a noun and machine as the adjective, telling you what kind of a tool your cutter is. It is not a hand tool, it is a machine tool. A similar mistake would be made if one should speak of a hammer as a hammer-handle. Handle is the noun and the adjective hammer tells you that it is not the handle for a spade, but the whole instrument is not a hammer handle.

Industrial Safety.

Some very interesting and instructive reading may be found in the pages of a small publication called the Journal of Industrial Safety which is issued by the Industrial Safety Association. The good work of safeguarding the life and limbs of workers in shops and factories is making some progress, though much yet remains to be done. The generally accepted railroad crossing sign contained the startling words, "Stop, Look, Listen!" It is one of the best ever invented.

Chemists have agreed that the emblem of the skull and crossbones on a bottle shall convey the idea of a poison or that death lurks in the solution. This emblem is too gruesome or too emphatic for a danger less than death

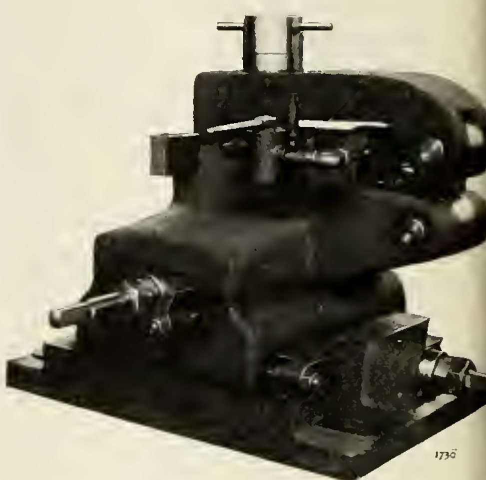
DANGER SIGN FOR LIVE WIRES, ETC.

which may lurk around the factory or shop. An emblem which is used in one shop is shown in our illustration. It implies the danger of death from electric energy.

This is a comprehensible emblem for its special purpose. What is needed is an emblem equally serviceable which may be adopted or accepted at danger points as a warning sign. It is not easy to create such an emblem. One industrial concern has used a red star on a white ground, for the warning where death is not likely to follow an accident. We would like to hear from our readers on the subject. The star is good, but it does not tell its story at a glance. See what you can do.

Exhibit of Car Wheel Lathe.

The Niles-Bement-Pond Company, of New York, will exhibit a power-manipulated Pond car wheel lathe at the Master Mechanics' and the Master Car Builders' conventions at Atlantic City, N. J., this June. The M. M. convention takes place on the 14th, 15th, and 16th of June, and the M. C. B. comes off on the



POND PATENTED POWER TOOL REST.

19th, 20th, and 21st of June. The exhibit space of this company is situated diagonally opposite the convention pier and the wheel lathe shows in a striking manner the improvements which the makers say have made possible an average output of three pairs of wheels an hour for an entire day's run. On this lathe will be shown the new, patented power tool rest, which is adjusted by one screw and is operated by air. It relieves the operator from all exertion as it clamps tools rigidly and instantaneously by the simple opening of an air valve. We would advise our friends to take a look at this tool and the air clamping device at Atlantic City, N. J.

Brass Castings

Where clean, yellow brass castings are desired, a mixture of 7 lbs. of copper, 3 lbs. of spelter, 4 oz. of tin, and 3 oz. of lead makes a good casting alloy and one which will cut clean and free, and is also strong. An increase in the amount of tin augments the strength of the alloy and also increases the degree of hardness.

Dispatcher Can Control Signals.

In our January issue we presented an article descriptive of the art of train dispatching by telephone. This article attracted a gratifying amount of attention; we have since presented the news of extending installations of telephone train dispatching. This, by the way, is assuming so great importance that in the latest report of the Block Signal and Train Control Board of the Interstate Commerce Commission having statistics up to January 1, 1911, fuller statistics of telephone train dispatching are given than in any preceding report. This shows a total of 41,717 miles of road on which telephone train dispatching is effective. The extent to which the new system has commended itself to some of the larger railways is indicated by a few extracts showing representative telephone dispatching mileage. Thus the Santa Fe has 3,884 miles; the Burlington 2,383; the allied New York Central Lines 2,727; the Great Northern 3,881; the Illinois Central 2,550; the Pennsylvania 1,734; the Rock Island 2,248; the Norfolk & Western; 1,066; the Northern Pacific 1,190; and the St. Paul 1,044. The Canadian lines are not included in this report, but inasmuch as the Canadian Pacific alone will have, by the end of the present season, over 4,000 miles under selective telephone dispatching, it will be seen that the extension of the system is by no means confined to United States territory.

The possibilities of the selector in train control service were by no means exhausted in accomplishing individual and exclusive calling of the operator, agent or towerman desired and the manufacturers have been pushing forward to more extended service in the signaling field. What has already been accomplished indicates that it is within reason to state that a railroad may, if it so desires, procure an equipment which will enable a dispatcher to absolutely control train-order signals at dangerous points, whether given by semaphore, order board or lights, setting and restoring signals from his distant position at headquarters or the division point, without calling upon the local operators or station force. Railway and Locomotive Engineering has kept in touch with this development and is now able to present a comprehensive account of selective block signaling.

Selective train order signaling is based on the simplest principles of block signaling: that no train may pass a certain point forming the entrance to a block until the last preceding train on the same track has passed beyond a certain point farther on, forming the end of that block or until that block section is free of trains or cars, from whatever direction. It is not a substitute for the automatic block or track circuit system and does not compete or conflict with it in any way. It is a combination of two pieces of equipment, each absolutely reliable, as proved by years of experience apart and has been developed as an auxiliary device. Where roads cannot put in the automatic block system, selective train order signaling enables them to put in a safety device which will be of constant use, no matter what changes may be made later. There is nothing experimental about the system and while it may be regarded as a progressive installation, there is nothing about it to be discarded at such time as a road decides to change any part of its signaling system to the automatic block. By merely adding the necessary motor and track relay, all of the present apparatus will be continuously available.

This system has been developed by the United States Electric Company of New York and Chicago, and the two pieces of apparatus in general use are the Gill selector and the electric slot semaphore. In 1864 there were practically no block signals in use on the railroads of the United States. The January 1 showing covered 17,711 miles of track protected by automatic signals and 53,557 miles by non-automatic signals or practically three miles equipped with non-automatic to every mile equipped with the automatic or track circuit type. It is by no means belittling the services which the manual block system has rendered to railroads to point out that after all is said and done by the dispatcher, the human equation comes into play and may render, and oftentimes has rendered ineffective the most carefully prepared plans and most definite orders. Changing of operators, their forgetfulness, blundering with signals or confusion of orders, however amply guarded against by printed rules, are still sources of accidents and may continue to be until the dispatcher is clothed with absolute and supreme power over signals at important points governing train movements.

This automatic power and control is given by the selective train order system. The system may be applied to any or all existing signals. An application may be made at important junctions without affecting other signals on the circuit worked in the ordinary manner. The ordinary control calls for the resetting of the signal by manual power, but only after obtaining the electrical consent of the dispatcher. For full control, including resetting of the signal by the dispatcher, two selectors at a signal are necessary. With dispatcher-controlled equipments the signals may be made to control the movement of inferior trains when a superior train with which they may have a meeting point is delayed and when such inferior trains are either approaching or in a siding, or at a station where no operator is on duty. Offices where no night operators are provided may still be used as train-order points with this equipment, the dispatcher setting the signal and giving orders to the train crew direct over the telephone circuit.

The selective system of signaling comprises at the dispatcher's office a set of the United States Electric Company's standard automatic calling keys and at each signal station the company's semaphore signal, such as is standard on steam roads. The cut shows the mechanism in the special semaphore box, with the door opened. As the parts are shown, the semaphore magnet is energized, the mechanical lock is released and while the blade is at the "danger" position the slot latch is engaged and the parts are as they

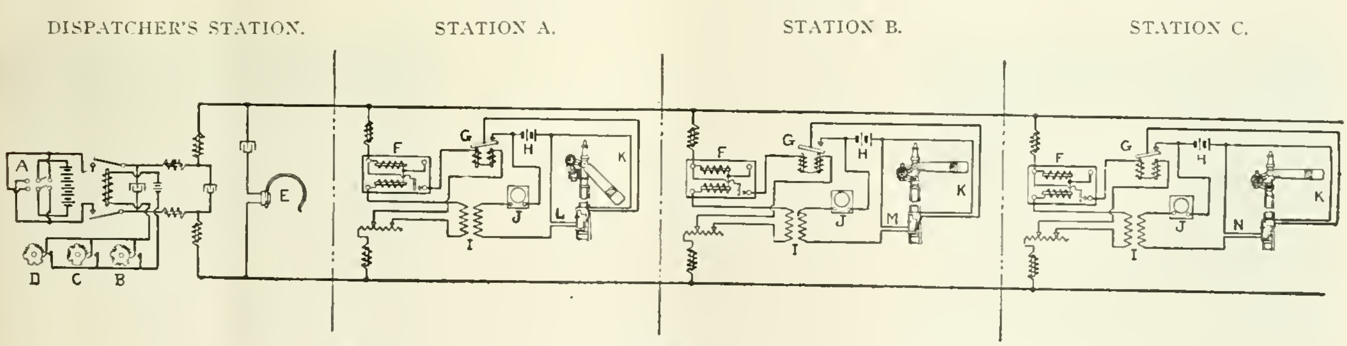
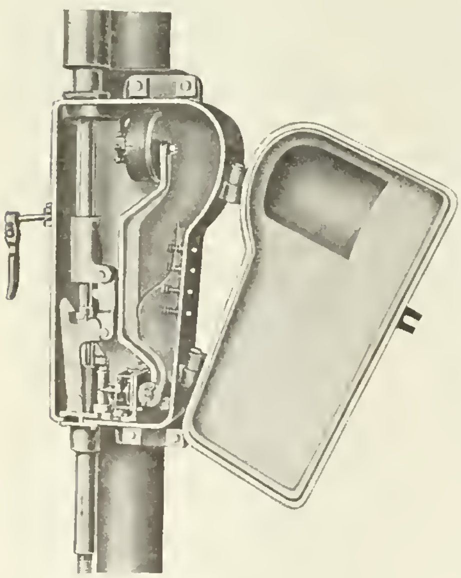


FIG. 2. UNITED STATES ELECTRIC COMPANY'S SELECTIVE SEMAPHORE CIRCUIT.

will be when the dispatcher has given permission for the restoration of the signal. In the cut, with the parts indicated by reference letters, the semaphore magnet is de-energized, the signal blade is at the "danger" or "stop" position, and the signal rod is mechanically locked, preventing the restoration of the signal. The relation of the several parts will be better understood by the following explanation of the reference letters in Fig. 1.

A is the magnet for operating the signal. It is normally closed, but is opened by the selector to set the signal. B is the amature, operating through the armature lever, the slot latch engaging the signal rod. C is the armature lever. Its left face is machined and forms a track for the roller on the slot latch. D is a rubber gasket on the cover of the box to prevent the entrance of moisture or dust. E is the armature lever spring to bring the armature lever into contact with the magnet. F is the United States Electric Company's answer-back mechanism. On the completion of the setting of the signal this mechanism repeats the signal combination number to the dispatcher over the telephone wire, assuring him that the semaphore is set at "danger." G is the answer-back lever. This is operated by a bracket on the sleeve of the signal rod depressing a plunger and operates only when the signal is set in the "danger" position. H is the mechanical locking lever, pivoted at the foot and unlocked by a stud carried by the descending slot



SEMAPHORE BOX, U. S. ELEC. CO.

latch. I is a locking pin carried by a sleeve working on the slotted signal rod. J is the roller traveling on the face of the armature lever and actuating the slot latch. K is the slot latch engaging the signal rod. It cannot be engaged unless the magnet is energized.

A 6- or 10-volt battery of the closed circuit type is required with each signal. The signal blade is held in the "safety" or "clear" position by means of the magnet in the electric slot being continuously energized by the local battery as is common in railway practice. When the dispatcher desires to throw any particular signal to the "stop" position, he turns the automatic calling key for that station as is done in a train dispatching circuit. When the contact of the selector closes it completes the circuit of the semaphore relay, which then operates the slot, causing the semaphore to go to the "stop" position. Immediately on the conclusion of this movement the dispatcher gets, by induction, over the telephone wire, a definite, audible answer back, comprising a repetition of the distinctive signal number and showing that the signal operated has gone to the desired position. When the semaphore has gone to the "stop" position the blade is mechanically locked, the lock H engaging the stud I, so that it is impossible either for the blade to be pulled down to "safety" or for it to be moved back to the "safety" position by the restoring lever.

After orders have been given to the train crew by telephone and properly verified, the dispatcher gives permission for the restoration of the signal by reversing the calling battery by means of a switch and sending again the station call by his individual key. This will again close the selector contact and open that of the semaphore relay, permitting the signal to be restored to the "clear" position.

In the circuit diagrams, Fig. 2, the reference letters have this significance: A, reversing switch, B, C, D, calling keys 223, 241 and 421 respectively; E, telephone receiver; F, Gill selector; G, semaphore relay; H, local battery; I, induction coil; J, buzzer; K, wires to semaphore magnet; L, M, N, wires to answer-backs, 223, 241, 421.

The system is operated in a closed circuit and is so arranged that any failure of the current supply curtailing a signal will set that signal at the "stop" position, when the crew of an approaching train will be required to get into communication with the dispatcher to obtain authority to proceed. For single track lines double lenses are provided to show the light signal in both directions. The selective signaling system may be connected direct to the ordinary train dispatcher's telegraph or telephone wire without interfering with the service at other stations where semaphore signals are not installed. They will work as far as a telegraphic impulse can be made effective.

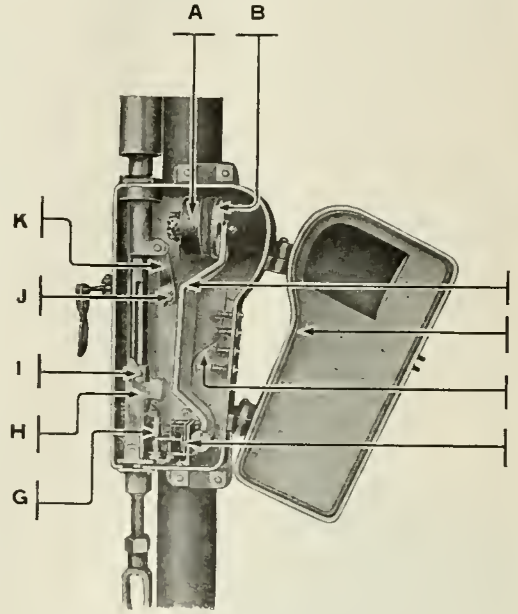


FIG. 1. SEMAPHORE BOX WITH PARTS IDENTIFIED.

Extending Telephone Intercourse.

One of the latest wonders connected with electricity was a demonstration on the New York and Denver telephone line, when messages were sent 2,000 miles. It will only require the work of the development that has been progressing steadily since the telephone was invented to enable people in America to talk with their friends in Europe.

When the writer first used the telephone the thought came "how gratifying it would be to have a chat with my old mother in Scotland." It is likely that such a luxury will come soon, and friends at long distances apart will enjoy the familiar intercourse that only the sound of the voice can convey.

P. R. R. Relief Fund.

During the month of March, nearly one-quarter of a million dollars have been paid in benefits to employes of the P. R. R. or their families. Since these departments for both the lines east and west of Pittsburgh were established the amount paid out in benefits has reached a total of $30,437,057.

On the lines east of Pittsburgh during the month of March payments to the amount of $158,640.34 were made by the Relief Fund. In benefits to the families of members who died $58,057.09 were paid, while to members incapacitated for work the benefits amounted to $100,583.25.

In March the relief fund of the Pennsylvania lines west of Pittsburgh paid out a total of $64,725.25, of which $12,800 were for the families of members who died, and $51,925.25 for members unable to work.

Items of Personal Interest

Mr. W. H. Snyder, general foreman of the mechanical department of the Tonopah & Goldfield, has been appointed master mechanic of that road, with office at Goldfield, Nev.

Mr. J. B. Elliott, master mechanic of the Baltimore & Ohio, at New Castle Junction, Pa., has been appointed master mechanic at the Glenwood shops, Pittsburgh, Pa., vice Mr. J. F. Prendergast, resigned.

Mr. A. M. Darlow, roundhouse foreman of the Chicago & Eastern Illinois, at Danville, Ill., has been appointed mechanical engineer of the Buffalo & Susquehanna Railroad, with office at Galeton, Pa.

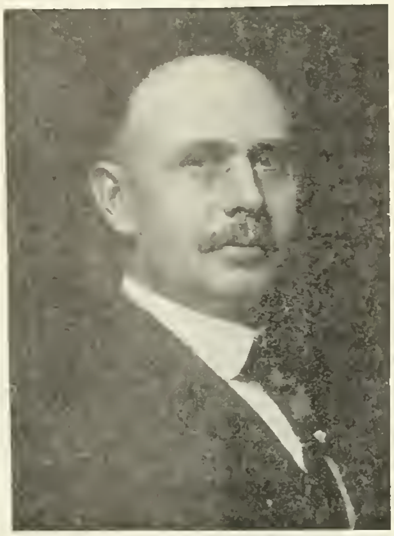
Mr. Silas Zwight has been appointed master mechanic of the Northern Pacific, with office at St. Paul, Minn., vice Mr. H. M. Curry, promoted. He began railway work in 1887 with the Chicago, Burlington & Northern, now part of the Chicago, Burlington & Quincy.

Mr. E. E. Mullins, mechanical engineer of the Northern Railway Company (Costa Rica), has been appointed superintendent of motive power of the same road, with office at Limon, Costa Rica, vice Mr. W. H. Sample, resigned.

D. F. CRAWFORD,
Vice-President, M. M. and M. C. B. Ass'n.

Mr. J. N. Mowery has been appointed master mechanic of the Western division of the New York, New Haven & Hartford, with office at Waterbury, Conn.

Mr. E. G. Stradling has been appointed signal engineer of the Chicago, Indianapolis & Louisville, with office at Lafayette, Ind.



C. E. FULLER,
President, M. M. Ass'n, and Vice-President of the M. C. B. Ass'n.

Mr. H. M. Curry, general master mechanic of the Northern Pacific lines east of Mandan at St. Paul, Minn., has been appointed mechanical superintendent of that road, with office at St. Paul, vice Mr. William Moir, retired.

Mr. I. D. Thomas, master mechanic of the Altoona (Pa.) machine shops of the Pennsylvania Railroad, has been promoted to be superintendent of motive power of the Erie division of the Pennsylvania Railroad and the Northern Central Railway, with office at Williamsport, Pa., vice Mr. J. T. Wallis, promoted. Mr. J. C. Mengel, master mechanic at West Philadelphia, Pa., succeeds Mr. Thomas. Mr. J. M. James, master mechanic at Olean, N. Y., succeeds Mr. Mengel. Mr. J. M. Henry, master mechanic at Sunbury, Pa., succeeds Mr James. Mr. Eliot Sumner, master mechanic at Baltimore, Md., succeeds Mr. Henry. Mr. H. P. Meredith, assistant engineer of motive power, in the office of the general superintendent of motive power, at Altoona, Pa., has been appointed master mechanic, with office at Baltimore, Md., succeeding Mr. Sumner. Mr. C. L. McIlvaine, assistant engineer of motive power of the Erie division and the Northern Central Railway, at Williamsport, Pa., succeeds Mr. Meredith. Mr. C. D. Barrett, assistant master mechanic, at Wilmington, Del., succeeds Mr. McIlvaine, and Mr. B. B. Milner, on special duty in the office of the assistant to the general manager, has been appointed assistant master mechanic, with office at Wilmington, Del., succeeding Mr. Barrett.

H. T. BENTLEY,
Vice-President, M. M. Ass'n.

Mr. A. L. McNeill has been appointed assistant purchasing agent of the Chicago & Alton, and the Toledo. St. Louis & Western, with office at Chicago, Ill.

Mr. J. Lowell White has been appointed assistant purchasing agent of the New Orleans, Texas & Mexico, the Beaumont, Sour Lake & Western, the Orange & Northwestern and the St. Louis, Brownsville & Mexico, with office at Houston, Tex.

T. RUMNEY,
Vice-President, M. M. Ass'n.

Mr. George E. Cessford has been appointed district master mechanic of the Chicago, Milwaukee & Puget Sound, with office at Miles City, Mont.

At a recent meeting of the directors of the Missouri Pacific Railway, Mr. B. F. Bush was elected president.

Mr. J. W. Daly has been appointed passenger traffic manager of the New York Central Lines, with office at La Salle Street Station, Chicago, vice Mr.

T. H. CURTIS,
President, M. C. B. Ass'n.

Warren J. Lynch, resigned to engage in other business.

Mr. N. G. Campbell, agent for the Central Railroad of New Jersey, at Wilkes Barre, Pa., has been appointed to the position of train master for the same company, with office at Mauch Chunk, Pa.

Dr. Charles P. Steinmetz, of the General Electric Company, recently delivered a series of the two lectures on "Electrical

ANGUS SINCLAIR,
Treasurer, M. M. Ass'n.

Energy" before the students of the College of Engineering of the University of Illinois.

Mr. C. H. Cartlidge, bridge engineer of the Chicago, Burlington & Quincy, recently gave a lecture to the College of Engineering, University of Illinois, on "Concrete Pile Trestles."

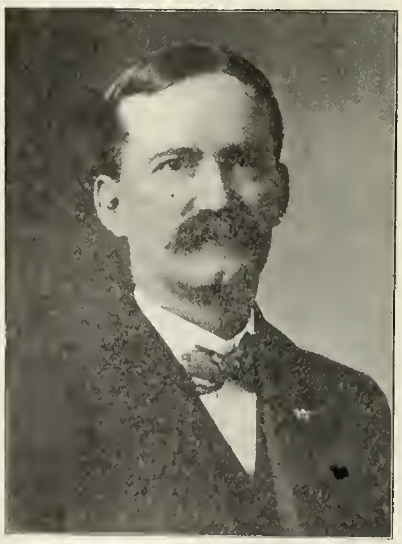
Professor R. L. Sachett, of Purdue University, recently gave an exchange lecture to the students of the College of Engineering of the University of Illinois, on "English Sewage Purification."

Mr. J. M. Carroll, who was one of the pioneers of the Eastern Minnesota (now belonging to the Great Northern system), and also a member of division 290 of the B. of L. E., has been appointed master mechanic on the Great Northern, with office at Havre, Mont.

Mr. L. W. Pulliam, member of division 782 of the B. of L. E., has been appointed traveling engineer of the Louisville & Nashville, his territory extending from Cincinnati, O., to Atlanta, Ga.

Mr. J. W. Shepherd, member of division 762 of the B. of L. E., has been appointed traveling engineer, with jurisdiction over the Fulton district of the Illinois Central Railroad, with office at Fulton, Ky.

Mr. Reuben C. Hallett, well known throughout the railroad field, has been appointed to the sales staff of the recently organized Transportation Utilities Company, direct representatives of the Acme and General Railway Supply Companies of



JOSEPH W. TAYLOR,
Joint Secretary, M. M. and M. C. B. Assn's.

Chicago, with headquarters at 30 Church street, New York City.

Mr. William C. Wilson, formerly connected with Bingham & Taylor, Buffalo, N. Y., has been appointed to the sales staff of the recently organized Transportation Utilities Company, direct representatives of the Acme and General and Railway Supply Companies of Chicago, with headquarters at 30 Church street, New York City.

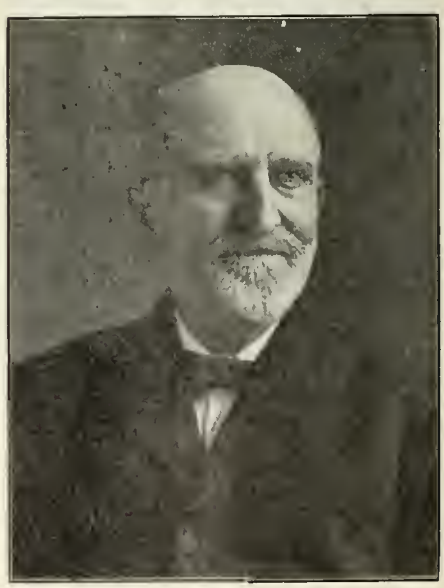
Mr. Charles F. Palmer has been appointed sales manager of the J. Faessler Mfg. Co., Moberly, Mo., makers of Boss and Universal flue expanders, flue cutters and other boiler tools. Mr. Palmer's office is at 810 Olive street, St. Louis. He is well qualified for this position by reason of his previous experience in selling Faessler tools and as representative of the Frank E. Palmer Supply Co. of St. Louis.

A. STEWART,
Vice-President, M. C. B. Ass'n.

Mr. H. O. Fettinger has resigned as representative of the Safety Car Heating & Lighting Co. of New York, to accept a position with the Clement Restein Company, Philadelphia, as manager of the railroad department.

Obituary.

Charles H. Dressel, vice-president of The Dressel Railway Lamp Works, died



J. S. LENTZ,
Treasurer, M. C. B. Ass'n.

at his residence, 54 Hamilton Terrace, New York City, on April 25th, 1911, in the 49th year of his age. Dr. Dressel had been an invalid for many years, during a great part of the time being confined to his house, but in spite of this his death was sudden and unexpected. He had been associated with the lamp company named after his father, the late George C. Dressel, for about 20 years, being at the time of his death vice-president and director. His circle of acquaintances amongst railroad officials was a wide one. His disposition was such as to win for him many close friends. He had been a member of the Railway Signal Association since 1897. He is survived by his widow and one son, also one brother, Mr. F W. Dressel, president of The Dressel Railway Lamp Works. The fact that his death followed only three weeks after the death of his mother makes the affliction doubly severe for those who survived him.

Manufacture of Steel Tubes.

The April meeting of the Pittsburgh Railway Club was made notable by a visit to the Elwood City plant of the National Tube Company, the members and a large number of friends having been guests of that company. The visit was greatly enjoyed by the visitors, so much interest was manifested in the various operations connected with the manufacture of seamless steel tubes. This is the kind of object lesson that helps to broaden the minds of railroad men concerning articles largely used in their business. If more of such visits could be made there would be greater harmony between the makers and users of railroad equipment.

At the evening meeting of the club Mr. F. N. Speller, metallurgical engineer of the National Tube Company, read a highly interesting paper on locomotive boiler tubes, which was listened to with close attention and discussed at considerable length.

An impression prevails among many railroad men that charcoal iron is the material principally used in making tubes for locomotives, but Mr. Speller admitted that the charcoal iron tube is a thing of the past and that the modern tube is made of steel. Bessemer steel had been employed in tube making, but it was found to be too brittle under severe kinds of service and open hearth steel is now the favorite material. Seamless and lap welded steel tubes are now made from the same grade of soft basic open hearth steel.

Tubes ought to be as uniform in composition and density as possible to resist corrosion. Corrosion is caused by impurities in the feed-water, more particularly the presence of dissolved oxygen and carbonic acid. Steel tubes should be made as stiff as possible consistent with the best welding qualities and ability to go successfully through the stress of expanding and bending.

The necessity for a good welding quality steel is of first consideration in making locomotive tubes so that they may be easily safe ended, and this point has received a great deal of study, especially in the manufacture of lap welded tubes where it is, of course, one of the first essentials to manufacture. Charcoal iron carries considerably more impurities than soft open hearth steel, and these impurities form a self-fluxing mixture which facilitates welding. Railroad specifications have been so tightly drawn on composition in some cases as to work against the production of a good quality of steel for locomotive boiler tubes by calling for unnecessarily low phosphorus and sulphur. There is now very good reason to think that a mistake has been made in this direction and that the general welding quality of the steel would be much improved, and the steel at the same time would lose nothing in other respects, if the maximum phosphorus and sulphur limits were both raised to .05 per cent.

RAILWAY CLUB OF PITTSBURGH ON A VISIT TO THE ELWOOD CITY PLANT OF THE NATIONAL TUBE COMPANY

Looks Like Prosperity.

We understand that the Grand Trunk Railway of Canada was recently in the market for one hundred engines and got prices from the Baldwin Locomotive Works and also from the Canadian Locomotive Works at Kingston, Ontario.

Coffee made of burnt turnips, milk colored with coal tar, and pepper which is ground olive stones are three of the exhibits at a faked food exhibition in London.

Air Locomotive for the U. S. Navy.

The Navy Department of the United States has during the past eleven years purchased several compressed air locomotives for use in naval magazines at various points on the Atlantic and Pacific coasts. The advantages of this type of locomotive for service at magazines containing large quantities of explosives are too manifest to require explanation, as there is nothing about it warmer than the surrounding atmosphere, and it exhausts nothing but pure air.

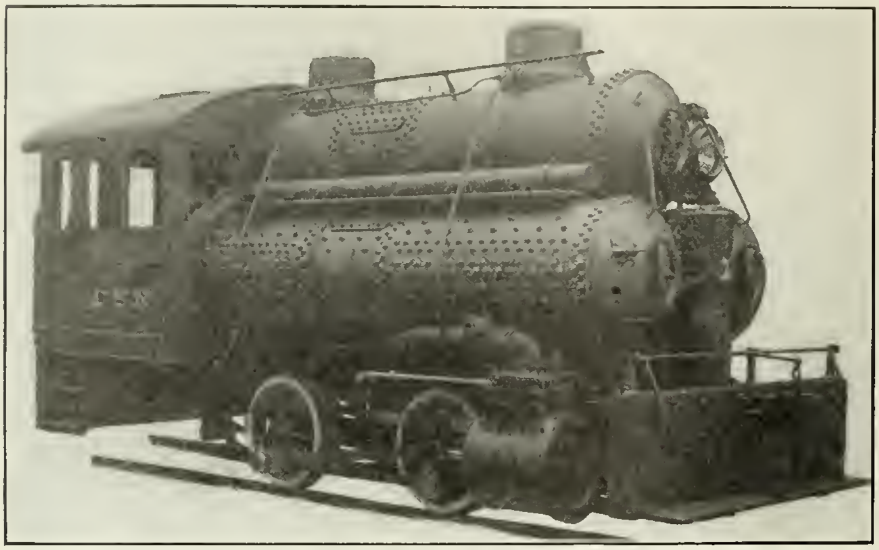
The locomotives employed for this service have been of various sizes, from six tons up to thirty tons. The last and largest was delivered to the United States Naval Magazine, at Hingham, Mass., last November. The complete haulage plant at this point consists of the locomotive, two electrically-driven air compressors delivering air at 1,100 lbs. pressure, a battery of eight storage tanks, each tank being 32¾ ins. diameter and 20 ft. long, and 600 ft. of 6-in. pipe, which connects the storage tanks and the compressor with two charging stations, one in the locomotive house and the other out on the main line of the railroad running through the reservation.

In operation the locomotive is charged at either charging station in about two and one-half minutes, and with its maximum pressure of 800 lbs. it will travel a distance of about 4 miles over the reservation railroad, hauling four or five standard freight cars. The reservation railroad consists of 9,600 feet of main line with numerous short branches to shell houses, magazines and the power house. One terminal connects with the New York, New Haven & Hartford Railroad at West Hingham, and the other is on the wharf in a tidal river.

The locomotive is used for hauling ammunition from the N. Y., N. H. & H. R. R. side track to the magazines and shell houses, and from them to the wharf for delivery to the ships of the navy.

Each of the two compressors has a piston displacement capacity of 220 cu. ft. per minute and an actual capacity of about 190 cu. ft. per minute. When compressing this quantity of air to 1,100 lbs. pressure the electric motor driving either compressor requires about 60 K. W.

An ordinary charge for the locomotive is 15,000 cu. ft. of free air, so that either compressor will supply about six charges per day of eight hours sufficient to move the locomotive with its ordinary service loads a distance of from twenty to twenty-five miles. With both compressors in operation the locomotive could travel from forty to fifty miles under the same conditions.



FIRELESS LOCOMOTIVE USED IN A POWDER AND SHELL MAGAZINE.

The battery of tanks and the 600 ft. of 6-in. pipe provides a sufficient stationery storage for the prompt charging of the locomotive. The tanks and pipe line are normally filled with air at 1,100 lbs. pressure, so that by the simple process of equalizing the pressure through the charging station connection, the locomotive is charged without waiting for the compressor. It is this provision which makes it possible to charge the locomotive in less than two and one-half minutes from the time the locomotive comes to rest until it is in motion again. The stationary storage is in this case unusually large; in fact, it is sufficient to operate the locomotive for half a day or more under ordinary reservation requirements without starting the compressor.

The appearance of the Hingham locomotive is well shown by our illustration. Its general specifications are: Cylinders, two-stage with atmospheric interheater. High-pressure cylinder, 11 ins. in diameter by 18 ins. stroke. Low-pressure cylinder, 22 ins. in diameter by 18 ins. stroke. Tractive force, 10,000 lbs. Wheelbase, driving and total, 5 ft. 9 ins. Weight in working order, all on drivers, 60,000 lbs. Capacity of main reservoir, 375 cu. ft. for a charging pressure of 800 lbs. The main reservoir consists of three cylindrical steel tanks, 40 ins. outside diameter. The regulating valve is set to maintain a uniform pressure of 250 lbs. at the throttle valve to the high-pressure cylinder. Valves, special H. K. Porter company ball-bearing balanced slide valve for high-pressure cylinder. Plain slide valve for low-pressure cylinder. Driving wheels, 36 ins. in diameter. The noteworthy features of this locomotive are the atmospheric interheater and the unusual cylinder ratio of four to one in volume. These two features are interdependent. Without the interheater the cylinder ratio would be unsatisfactory, and with the interheater the usual cylinder ratio would be wrong.

The interheater consists of a cylindrical reservoir filled with small tubes, forming a part of the conduit from the exhaust of the high-pressure cylinder to the valve chest of the low-pressure cylinder. The air in its passage from the high to the low-pressure cylinder travels longitudinally through the interheater in a zig-zag line back and forth across the tubes with which the interheater is filled. The exhaust from the low-pressure cylinder is utilized to create a draft through the interheater tubes, thus bringing large quantities of atmospheric air into close contact with the refrigerated air from the exhaust of the high-pressure cylinder. In this apparatus practically all of the heat lost due to the work done in the high-pressure cylinder is restored and the air is delivered to the valve chest of the low-pressure cylinder at practically atmospheric temperature, giving substantially isothermal instead of adiabatic conditions for calculating the relative volume of the cylinders.

The atmospheric interheater, in addition to changing the ordinary cylinder ratio for locomotive practice, also greatly increases the efficiency and removes a serious obstacle to the efficient use of compressed air, unless pre-heating is resorted to, namely: The great degree of refrigeration which occurs if a high ratio of expansion is attempted. The builders inform us that on numerous tests locomotives of this type have shown an efficiency fully 50 per cent. better than the simple compressed air locomotive.

The reason why the two-stage expansion with the compressed air locomotive is vastly more advantageous than with the steam locomotive is readily explained by the fact that a higher initial pressure does not call for additional fuel to generate it, as the air must in any case be raised to a very high pressure in order to obtain adequate storage within a reasonable bulk, and by the equally important fact that interheating between the two cylinders costs practically nothing. With the steam locomotive interheating or reheating between the two cylinders requires heat derived from coal or other fuel burned in the

American Railway Association.

The spring meeting of the American Railway Association was held at the Engineering Societies' building, New York, on May 17, 1911. There were present 162 members. In the report of the committee on transportation, several questions and answers concerning practice under the standard code of train rules were submitted; these were approved by the association. The committee recommended a revised form of the detour agreement, which was adopted. The request of the committees on signaling of the Railway Signal Association and the American Railway Engineering Association, that reports be submitted by those committees was presented to the committee on transportation for consideration, accompanied with the request that the essentials of signaling be outlined or defined for the future guidance of the committees in question.

The committee also called attention to the fact that a special edition of the standard code of train rules, which includes the various forms of the several rules which have been in use since they were originally adopted and the interpretations rendered by that committee, had been completed and was issued on March 1, 1911.

The Committee on Maintenance in their report embodied a summary of replies received to their circular referring to the subject of a standard height for car door fastenings. They also reported that they had considered the undesirability of the use of untrussed wooden brake beams. They also referred to the progress which had been made by the sub-committee on the standard dimensions of box cars and standard clearances, and stated that they hoped to be able to report upon these subjects at the fall meeting of the association.

The committee on the safe transportation of explosives and other dangerous articles reported that a hearing had been given by the Interstate Commerce Commission on the subject of the promulgation of regulations for the transportation of dangerous articles other than explosives, at Washington. They further stated that they had under consideration a number of minor amendments to the regulations for the transportation of explosives, which are to be submitted to the commission before they become effective, after which they will be presented to the association with such detailed rules affecting the duties of employees as may be found necessary. The report of the chief inspector of the bureau for the safe transportation of explosives and other dangerous articles for the fiscal year ending December 31, 1910, giving in detail the operation of the bureau, was made a part of this report.

The committee on electrical working reported that they had created three sub-committees from among their members on the following subjects: Third-rail clearances, electrical connections and overhead crossings for electric light and power lines, and that all of these sub-committees have done considerable work on the subjects allotted to them.

The committee on relations between railways presented several amendments to the car service and switching reclaim rules which were adopted by the association. The committee reported that the Interstate Commerce Commission on April 11, 1911, gave the same approval to the association's explanations to the demurrage rules which it had already given to the rules themselves.

Shay Geared Locomotives.

The Lima Locomotive and Machine Company of Lima, Ohio, have issued a pamphlet dealing with their product which is the Shay geared and rod locomotives. The pamphlet is called catalogue No. 15 and it gives the general specification to which these locomotives are built. It gives the physical tests of the materials used and various other pieces of information which a prospective buyer ought to know.

The Shay locomotive has a very wide and varied range of successful service, being used on logging, mining, plantation, industrial and standard trunk line railroads. On standard trunk lines the Shay is not suitable for through freight service on account of its relatively limited speed, but in the mountainous section of such roads, on branch lines, or as a helper engine, it is performing excellent service on several of our standard railroads today. It is adapted for logging roads, for as a rule they combine heavy grades, sharp curves, and temporary track. The fact that all the weight is on the drivers, and its great power, fits it for heavy-grade work; the freely curving trucks enable it to pass sharp curves not only with the least possible friction, but also without straining or displacing the track, which is a point of importance in soft ground. While it is thus used for the spur tracks in the woods, it is also able to make from fifteen to twenty miles per hour of a regular steam railroad on the main line, according to the size of the engine. The company will be very happy to send a copy of catalogue No. 15 to anyone who applies direct to them.

New Molding Catalogue.

The Mumford Molding Machine Company, of Plainfield, N. J., have just issued a loose leaf sheet catalogue illustrating their line of molding machines for foundry work and including jolt ramming machines, split pattern machines, power squeezes and pneumatic vibrators. Write for the catalogue if you are interested It is sent free on direct application.

Acetylene Welding.

The recent meeting of the New York Railroad Club was the occasion for the consideration of a paper on the subject of "Acetylene Welding," prepared by Mr. J. M. Morehead. The speaker said among other things:

"The flame temperature of any fuel can be calculated to a very close degree of accuracy by dividing the number of heat units generated by the combustion of the fuel, by the amount of heat absorbed by the products of combustion. A fuel with a high calorific value burning to products having a low specific heat will have a high flame temperature. Suppose we should burn sufficient hydrogen to give 1,000 heat units and sufficient carbon to give 1,000 heat units, the products of combustion of the hydrogen would be water vapor, while those of the carbon would be CO_2. Now water vapor absorbs four times the heat that CO_2 does, and as the products of combustion absorb heat and determine the flame temperature, it is obvious that it will take four times the amount of heat to raise water vapor that it would to raise carbon dioxide, and consequently the flame temperature of the hydrogen fire would be very much lower than would the flame temperature of the carbon fire.

"We have in acetylene a fuel possessing the highest calorific value of any gas, which at the same time produces products of combustion having the lowest specific heat, and hence the combustion of acetylene with oxygen—the nitrogen eliminated—gives the very acme of flame temperature the highest temperature which it is physically or chemically possible to obtain by the combustion of fuel. To obtain the best results in acetylene welding it is essential that the acetylene and the oxygen be in a state of practical purity. Acetylene may contain a number of chemical impurities besides an admixture of air. Acetylene may contain ammonia and sulphuretted hydrogen, but with modern types of acetylene generators in which a limited amount of carbide is added to a large excess of water impurities are automatically eliminated by the scrubbing which the gas receives in bubbling through the lime and water in the generator.

"If only the welding of iron and of steel are considered the purity of the oxygen, if it is above 90 per cent., while desirable is not of vital importance. A proportionately larger amount of oxygen must be used to make up for the impurities, and still fairly satisfactory results can be obtained. In the welding of copper, brass and aluminum, however, high purity is quite essential, as at the excessive temperature of an acetylene blowpipe copper and aluminum will absorb nitrogen if this impurity exists in oxygen, and this renders the work brittle and unreliable. For cutting with oxygen purity is of prime importance."

Coming to what may be called the practical part of the subject as far as railroad repair shops are concerned, Mr. Morehead said, "By acetylene welding, iron, steel, cast iron, aluminum, brass, copper platinum and other metals can be so perfectly united that when smoothed the joint cannot be discerned. Some of the applications are reclaiming light and heavy castings coming from the sand with blow holes, sand holes, cold shots, luggs off, etc.; reclaiming light or heavy cracked or broken castings, whether of cast iron, cast steel, brass bronze or aluminum; adding metal to parts subjected to friction, making such part as serviceable as originally; repairing large or small boilers in place, welding in new parts or filling in cracks edge to edge; split piping of all kinds can be quickly welded when in place, usually without breaking connections; welding flanges on pipes; pipe manifolds or connections of intricate form can be made; rivet heads quickly cut off and shanks driven out; holes in metal parts (even when connected) can frequently be enlarged by heating with the torch and using punch and hammer; tool steel can be added to common steel; dies can be cut out, also repaired; cast iron heads can be united to valve stems; castings impossible or difficult to mould can be made in parts and united; many joints which never need be broken can be welded instead of bolted and compactness, lightness and greater strength secured; imperfect steel castings of all kinds can be reclaimed. The percentage of imperfections in these is much greater than in any other class of castings; shafting, etc. cut too short can be extended; bridges, boilers, arches, steamships, can be wrecked by the cutting process; wearing qualities may require steel in certain places while wrought or cast iron will afford the requisite strength for the bulk of the supporting body; bolt and other holes worn beyond use can be restored to former size, etc.; holes drilled in error can be filled in, dressed down and rendered undiscernable; small metal parts broken off or missing can be added; the shape of patterns can sometimes be modified, also metal added; main frames can frequently be welded in place without stripping; steel rails can be bonded with copper, also welded end to end; teeth broken from gear wheels can be renewed; steel or wrought iron to the thickness of five or six inches can be cut, the kerf about one-eighth to one-quarter inch in width; all kinds of metal, fluid and liquid containers, can be made without joints and less liable to leak when bruised or dented, also defective parts can be cut out and repaired with a perfect sheet, the same shape and welded into position edge to edge; joining of steel parts for reinforcing concrete."

Automatic Stops.

The latest bulletin compiled by the block signal and train control board, under direction of the Interstate Commerce Commission, contains the statement that automatic train stops are used in connection with block signals on the Erie, the Hudson & Manhattan, the New York City Terminal of the Pennsylvania, and the suburban lines of the Washington Water Power Co. On the Erie the Harrington automatic stop is used on 11.8 miles of one track of double-track road. On the Hudson & Manhattan automatic stops are used in connection with all signals. In the Pennsylvania Terminal in New York automatic stops are used in connection with signals throughout the tunnels, covering 4.4 miles of road, or 13.7 miles of track. The Washington Water Power Co. uses automatic stops in connection with automatic signals on 29 miles of track.

Illinois Central Coal Test.

The railway engineering department of the University of Illinois has just completed an interesting series of locomotive tests for the Illinois Central. The tests were made to determine the relative evaporative efficiency of different kinds of coal. The fuel was burned in the firebox of a locomotive in the Champaign yards of the railroad, and the steam generated was exhausted through a pipe which took the place of one of the safety valves. The tender was removed and in its place a platform was placed on which were scales and tanks for the measurement of the amount of coal used and water evaporated. Draft was kept up by allowing some of the steam generated to blow through the steam nozzle, the valves having been removed from the steam chests.

Broken Setscrews and Taps.

Removing broken setscrews and taps are among the annoyances of machine shop work. A broken tap may in some kinds of work be driven through with a blacksmith's punch and sledge, and the hole enlarged and then tapped with a larger size of tap. Setscrews cannot be so treated and the best method of extracting them when broken is to heat the broken part by the use of a blow-pipe or otherwise. When the temper is drawn out of the broken screw it may then be readily drilled; care being taken to avoid cutting into the thread. A square punch or drift may then be used and the broken fragment removed by unscrewing. Small cape chisels may sometimes be effectively used in cases where the drilled hole may be too small to admit of a square drift sufficiently strong to turn the broken fragment.

Good Ideas Paid For.

"Ideas are worth money. Develop them and we'll pay you for them," is the sum and substance of the latest official notice to the men of the Pennsylvania Railroad. The Buffalo and Allegheny Valley division plans to recompense employees for suggestions which after investigation may prove to be of sufficient value to warrant adoption. The object of this offer of payment is to develop in employees the habit of thoughtfulness, originality and initiative and thereby to secure greater efficiency from the men. Employees have always been free to make suggestions, but the company now intends to pay for valuable ideas coming from men in the rank and file. Under the new plan those employees who are not in charge of men, are now requested to submit suggestions for which they may be paid. Everything has been done to facilitate the smooth working of the scheme and great latitude is allowed to the men in that suggestions need not necessarily be confined to the immediate duties or department of the employee to whom a valuable idea occurs. General Notice No. 2 says: "An employee of one department may make suggestions for improvement in another department, branch or division of the service."

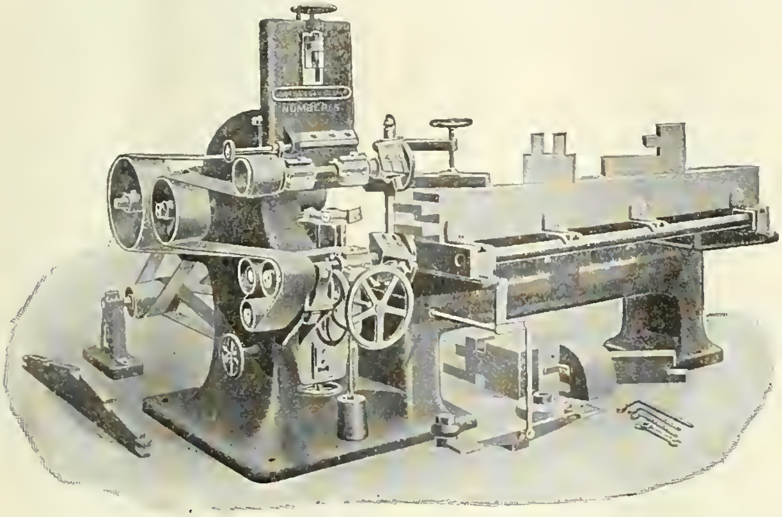
In outlining what the management is seeking it is stated that suggestions must contain ideas which will increase efficiency of operation; improve methods of operation; be beneficial from an economical standpoint; increase the safety and convenience of passengers and patrons of the company; increase patronage; promote safety of employees. In any way promote the interests of the company, whether pertaining to improved mechanism, better office practice or other features. May involve the use of new methods or the modification of old ones; may include the comfort or betterment of employees, and must not include personal complaints or antipathies.

Telephones to Reach Switchers.

The Lehigh Valley Railroad is installing a thorough telephone equipment to regulate the movement of trains on its New York terminal division. Each of the towers and offices scattered over this division, from Newark to the Hudson River waterfront, will have its telephone connection with the despatcher's office in the Jersey City yard. Thus the superintendent, whose office is near the despatcher's, can keep track of the motive power and control its distribution with the minimum loss of time. He will be able to get an order to any switching engine on the division almost instantly. Trains are now despatched by telephone over the greater part of the Lehigh Valley. The installation now in progress is an extension of the system; employed in despatching regular trains.

A General Purpose Car Tool.

Many car shops, especially those doing repair work, have a good deal of cutting off, gaining and tenoning to do, but not enough of each kind of work to justify the installation of separate machines. To meet the demand for a general purpose machine which will do all this work, J. A. Fay & Egan Co., the railway car shop tool builders, at their big plant in Cincinnati, brought out what is known as their No. 5 Large Car Tenoner and Gainer, which is shown in our illustration.



LARGE CAR TENONER AND GAINER.

As a gainer this machine will cut gains in any part of heavy timbers. It will work timbers up to 23 ins. wide by 15 ins. thick and the C-shaped construction of the frame makes it possible to work timbers of any length.

As a tenoner, this machine will cut single or double tenons and if so ordered is also arranged to cut triple tenons. As a cut-off saw it will do all kinds of heavy cut-off work, a 20-in. blade cutting off up to 6 ins. thick. The carriage is moved by a rack and pinion feed, the return movement being about three times faster than the forward or cutting movement.

There is no over-estimating the value of a machine of this kind in a car shop. the most critical of efficiency engineers could find no fault with it. Because of the variety of work that can be done upon it, this machine will be kept busy all day long every working day in the year and the extra heavy construction gives it the necessary strength to stand up to this work. As every man connected with either the mechanical or purchasing departments in railway service has a Fay & Egan catalogue, it is suggested that this machine be looked up or any information desired will be sent upon application to J. A. Fay & Egan Co., Cincinnati, Ohio.

Full Open Valve.

A good many people think that in order to open a globe valve or other valve having a circular port covered with a disc that it is necessary to carry the disc away from the valve seat a considerable distance. In fact, some people, if they had their way, would take the disc entirely away from the circular aperture as one might take a stopper out of a bottle, so that the opening might become what they call an unobstructed passage. This is not necessary, for the simple reason that the aperture has a certain definite area, and this being circular it is very easy to calculate it. Now, in order to get the same area in the form of an imaginary cylinder from the raised valve to the valve seat, it is only necessary to raise the valve a certain distance off the seat and then you have all the opening of which the valve is capable. Thus it is found that if you raise the disc or valve off its seat ¼ of the diameter of the valve, you will have the maximum opening. In fact, in uncorking a bottle where the internal diameter at the neck was 1 in. the cork need only be raised one-quarter of an inch from the bottle to get full opening.

A Turbine Locomotive.

Experiments continue to be carried on looking toward the application of turbines to locomotives. Quite a number of these mechanical curiosities appear from time to time in Germany. At a college in Charlottenberg there is a locomotive of the type referred to where a turbine is placed on each of the driving axles, the steam from the boiler passing through the several stages in succession. The turbines are on the outside of each driving wheel. The steam is conveyed by a pipe from the boiler to the first turbine on one side and passing through three turbines on one side, it is conducted to the three other turbines on the other side. We are not in possession of the facts relating to the initial or final pressures, but we presume the initial pressure would need to be of considerable magnitude to retain any great degree of pressure for the last of the six turbines. College professors have not added much to the locomotive since its introduction, but it will be remembered that James Watt brought forth his steam engine from the laboratory of Glasgow University.

"B 4 Any."

A new high speed steel under the appellation of "B 4 Any," specially adapted for use on cast iron has appeared on the market. It is no longer novel to record the birth of a new high speed steel, but "B 4 Any" has so far done such good work that it promises to occupy a prominent and very important position in machine shops in the near future; therefore it is worth while to accord a little closer attention to it.

A test was recently made at the establishment of Messrs. Watts, Campbell & Co., Newark, N. J., where a piece of 1-in. square "B 4 Any" steel was made into a tool. This tool was put on a large lathe and set to work on a fly wheel, of hard, close grained cast iron, 28 ft. in diameter and with a 48-in. face. With a speed of 70 ft. per minute, ¼ in. feed and ⅞ in. cut, the tool turned and faced one wheel, hub, rim and end, without grinding, in which condition it was set to work on the second wheel; nor did it require grinding till the second wheel was nearly completed. This is undoubtedly a good record.

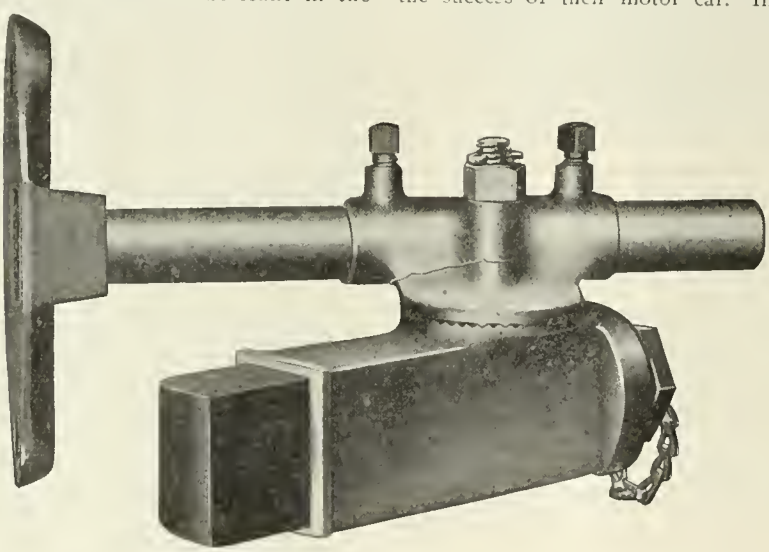
At the workshops of one of America's great railway systems, another test was conducted with a result which was at once a proof of the efficiency of the tool as well as being spectacular. A tool ⅞ in. square was used on a double armed lathe for turning cast iron cylinders for making iron packing rings for locomotive cylinders. The "B 4 Any" tool was put into the outside arm and a tool of another well known brand of high speed steel into the inside arm of the lathe. Then the machine was started off at a speed of 115 ft. a minute. The "B 4 Any" tool went 3 ins. and burned down. The other burned down almost immediately after the start. At 104 ft. speed a minute, "B 4 Any" tool turned the whole of the outside, while the other brand on the inner side went about 6 or 7 ins. and then burned down. The "B 4 Any" after finishing the outside was placed on the inner post and finished the inside. It made a second cut before grinding.

The "B 4 Any" high speed steel is brought out by Wm. Jessop & Sons, Inc., 91 John street, New York City. In English workshops "B 4 Any" has proved so great a success on cast iron that it promises to be at once placed in the front rank in our American machine shops.

Lubricating Driving Wheel Flanges.

The Collins Metallic Packing Co., of Philadelphia, have brought out an improved wheel flange lubricator which is shown in our illustration. The device is unique and is well deserving of special attention.

It is well known that the wear on wheel flanges is a serious matter with all railroads and especially so with those having more or less curvature to contend with. There is also with the lubricated flange less wear on the rail head with consequent prolongation of the life of the track. The manufacturers claim that the lubricator will last as long as the locomotive to which it is applied, lasts, and a careful examination of the construction of the flange lubricator would seem to confirm this statement. Under various tests the lubricating stick has given service from 3,000 to 6,000 miles, depending upon the curvature of the road and the class of power to which it was applied. An indicator on the back of the lubricator shows at a glance the amount of lubricant in the holder, and this can be seen at a distance of ten feet.



COLLINS DRIVING WHEEL FLANGE LUBRICATOR.

The device is already in use on a number of the leading roads in the United States, Canada, Porto Rico, Australia and Mexico.

This concern has heretofore marketed a device for accomplishing the same result, and with marked success. The improved form is automatic and therefore obviates the necessity of adjusting the lubricant. The Collins company will be happy to forward a neat little folder giving fuller information than our space here permits, to anyone who is interested enough to apply for one.

Persistence of Vision.

Have you ever noticed the end of a match after the flame has been blown out? The little point of charred wood glows for a moment before it is extinguished. If this little glowing spark be waved back and forward or moved round and round before the eyes it will appear as a band of light or as a little circle or elipse as the case may be. The little spark seems to give a continuous performance. This is owing to what is called the persistence of vision. Huxley stated this persistence as about the one-tenth of a second. This means that when the eye sees an object the image does not fade out for that length of time, even though the object itself be removed in less time. This is the principle upon which the moving picture machines are worked, and, indeed, it is probable that without the law of persistence of vision we would never see a flash of lightning, as we do now, in the form of a continuous luminous line.

McKeen Cars Are Rolling Along.

The McKeen Motor Car Company, of Omaha, Neb., are feeling justly proud of the success of their motor car. In witness thereof, they have informed us that a seventy-foot McKeen motor car has just been completed for the Ann Arbor Railroad, and has been shipped by the Chicago & North Western for its destination at Manitowoc, Wis. Four more cars of the seventy-foot design are on order by the Ann Arbor Company, and will be delivered during the month of June. All of these cars will be used in passenger service in the State of Michigan. There are at the present moment, 107 of these cars in service and 15 railroads have placed "repeat" orders for the motor cars, and 42 railroads are either operating or have ordered motor cars. The Oregon-Washington Railroad & Navigation Company have recently placed an order for a second seventy-foot car which is a duplicate order. These cars will be used on the lines of that company in the vicinity of North Yakima and Kennewick, Wash.

Good for Evil.

Tommy returned sobbing from school with a very bad black eye. "But I'll pay Billy Bloobs off for this in the morning," he said. "No, no," replied his mother, "you must return good for evil. I'll make you a nice jam tart, and you must take it to Billy Bloobs and say, 'I told mother how you'd punished me, and she says I must return good for evil, so here's a nice tart for you'."

The following morning, with tart in one hand and his books in the other, poor Tommy hastened joyfully to school, only to return in a sadder plight than the day before, saying between his sobs: "Mother, I gave your message and tart to Billy Bloobs, and he's blacked my other eye and says he wants you to send him a pudding!"—*Ideas.*

Nickel-Chrome Car Wheels.

The Nickel Chrome Chilled Car Wheel Company of New York have recently issued a pamphlet setting forth the virtues of this alloy iron for car wheels. In fact they say the nickel-chrome chilled car wheel is the first improvement made in chilled car wheel mixture for fifty years. The pamphlet is not a catalogue in the usual sense of the word. It is a very readable description of what this new alloy of iron is, what it does and why it does it. The results of tests with the style of wheel, made on the Pennsylvania Railroad are given. One very important point is the tests of the strength and rigidity, of the flange and it appears from the tables given in the pamphlet that a very substantial improvement in the reliability of the flange is secured by the use of nickel-chrome iron. In the severe service tests under locomotive tenders the wheels, we are told, gave every satisfaction. This interesting pamphlet is intended for general circulation, but those having the first call will be those who are interested enough to drop a postcard to the company at 30 Church street, New York, and ask for a copy.

Relation of Circles.

If a pipe of a given diameter delivers a given quantity of water in a minute and you want double the amount of the water in the same time, it will not do to double the diameter of the pipe. This may be made clear by an example. If a 4-in. pipe gives you what you want per minute, an 8-in. pipe will give you not twice, but four times the amount. This depends upon the law of methematics, which states that circles are to one another as the squares of their diameters. This is evident when we compare areas. The way to find the area of a circle is to square the diamter and multiply the product by .7854. This decimal fraction is a constant because you use it for all diameters, and as it is the same for all the real relationship of one circle to another, turns on the square of the diameter. The size of pipe required to give twice the amount of water that a 4-in. pipe can supply in a stated time is very close to 5 11/16 ins. You will find the area of this pipe about double the area of the 4-in. one.

Dixon's New Folder.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has just published a very neat folder entitled "Maintenance Painting for Electric Railways." It gives excellent photographs of street railway viaducts, power plant stacks, and car trucks painted with Dixon's silica-graphite paint. The folder explains in a very interesting way, the special adaptability of this paint for street railway uses, and the paint department will be glad to send copies to anyone interested in economic railway maintenance, and what holds good on street railways is largely true of steam roads.

Absolute Zero.

It has been ascertained by careful experimenters in the realm of physics that a perfect gas will expand 1-273rd of its volume for each increase of 1 deg. centegrade. This means that a gas at 273 degs. C. has twice the volume it had at zero on the centegrade thermometer. Conversely a gas shrinks the same amount at the loss of each degree. If, therefore, a gas has a certain volume at zero and it be cooled down far below that amount it will be considerably reduced in volume. At minus 273 degs C. or at 273 degs. below the freezing point the gas would theoretically have no volume at all. As a matter of fact, some physical change in the gas takes place before that extreme degree of cold is reached, so that it practically ceases to be a gas, but the theoretical limit of — 273 degs. C. is the absolute zero of temperatures. It is believed to be this almost unthinkable deep degree of refrigeration which exists in the depths of interstellar space.

Might Have Known More.

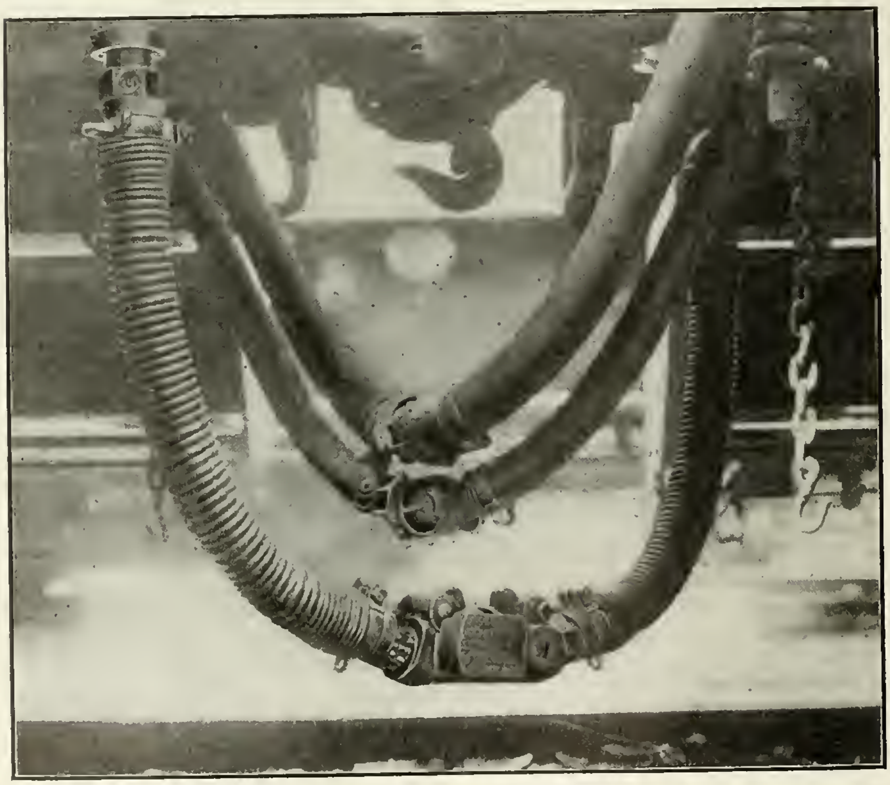
Mr. Geo. F. Baer tells a good story on himself which illustrates the viewpoint of some as to the cares, duties and responsibilities of railroad presidents. The story is substantially that Mr. Baer was enjoying a post-prandial cigar one evening under his own vine and fig-tree, when he was approached by a tall man with a carpet bag in his hand. The stranger surveyed Mr. Baer for a moment and then enquired, "Be you the president of the Reading road?" Mr. Baer felt a flush of pardonable pride as he answered in the affirmative. The man came still nearer the august presence and said, "What is the price of a ticket from Reading to Niagara Falls and back?" Mr. Baer replied, "My dear friend, I do not know, you will have to go to the ticket office." The man picked up his carpet bag and prepared to leave, and as he did so he said slowly, "So you are the president of the Reading Railroad and you don't know the price of a ticket to Niagara Falls and back!" Then with withering scorn he added as he moved away, "You're a h—l of a railroad president!"

Catenary.

Here is a word that looks interesting, and it applies to curves. A catenary curve is one formed by a chain supported at its ends and hanging freely in a graceful sweep down from the points of support. The word comes from the Latin *catena*, a chain, and this curve is assumed when the chain is of the same weight and thickness per unit of length. In other words, when the chain is the same size from end to end. The suspension cables of the Brooklyn bridge are examples of what a very flat catenary curve looks like.

Coming nearer home and in the railroad field, there is another excellent example of a catenary curve, and that is formed by the way the Gold Car Heating & Lighting Company, of New York, suspend their new protected steam heat hose of which we gave a description in our March issue, page 129. The good results which they get are easily accomplished. The ordinary way of suspending all kind of hose between cars is to attach them to 45-deg. pipe fittings. The Gold people simply use a right angle bend and their steamhose hangs straight down from the horizontal pipe in the most easy and natural way. There are two marked advantages which are obtained in this way. There is no kinking of the hose, for it hangs as nature would hang it, that is, according to the catenary curve, and this method brings the couplings easily and tightly together, and facilitates the operation of uncoupling, as the car inspector has not to break the joint over his knee or otherwise force it apart. The new way brings the couplings in contact so that they are able to make the tightest, because the most natural, joint, and they are easily uncoupled by the act of lifting them up. The new mode of suspension is easy on the hose, good for the coupling and most satisfactory for the car inspector, and that is a good working combination and spells economy.

Before leaving the subject of the catenary curve, which is so excellently shown in our illustration by the hose, we may refer to the locomotive headlight which, as most of our readers know, is a parabola with the light in the focus of that remarkable curve. It is interesting to know that the catenary curve could be derived from the parabola even if there were no chains and no protected steam hose to give it to us. If we sawed the headlight in two along the axis and then cut out a thin board the exact shape of the mid section of the parabola and put a lead pencil in the focus, where the light usually is, we could trace out a catenary curve by rolling this wooden parabola along the



GOLD'S METHOD OF ATTACHING STEAM HEAT HOSE.

floor and letting the pencil trace a curve on the wall. A curve so traced is called a roulette, so that this curve is one of the roulettes of the conic sections, or, to be quite exact, the catenary is the roulette of the parabola. The relationship which exists between these two families of curves is very remarkable, and it may serve to remind you when you look at a headlight, of a good way to hang the steam heating hose between the cars.

Fire at the Crandall Shop.

On Tuesday, May 9th, a considerable portion of the factory of the Crandall Packing Company at Palmyra, N. Y., was destroyed by fire. Arrangements have been made by this enterprising concern to build a new, modern factory of considerably greater capacity than the building which was burned. In the meantime, so we are informed, temporary headquarters have been secured so that the company's business is being carried on. The packings made by this company are used for water, air, gas and ammonia. Their New York office is at 136 Liberty street, and that in Chicago is at 71 Washington street.

Sad Finishing Touches.

During a discussion at the New York Railroad Club of facilities for putting the finishing touches upon newly repaired locomotives, Mr. James Kennedy said:

"The saddest hours of my working life as a machinist have been spent in remedying little defects on locomotives after they came out of the repair shop. Sometimes the wild wind, let loose from some glacial cave in the cruel north, sung a mournful monotone through our petrified whiskers and our teeth would be rattling like dice on a pay night. Sometimes we would have to lie full length in the snow and loosen pieces of ice ponderous as blacksmith's anvils, our feeble fingers sticking to the frozen pinch bars. Sometimes the elemental fury took the form and force of Noah's deluge without the ark of refuge looming on the horizon."

The Copper Age.

Recent discoveries of ancient tools and weapons lead to the supposition that between the Stone age and what is known as the Bronze period, there may have been a Copper age, shorter than the other periods, but of consequence as leading up to the improved Bronze period. This is the more readily believed as it has been demonstrated that the exact ratio of the tin-bronze in the proportion of one to nine is not by any means as general in these old implements as it was supposed to be. The discovery of bronze by the ancients was no doubt accidental, impure copper ores giving rise to various kinds of bronze, and experience proved which of these was best fitted for certain purposes. Coarse mixtures of tin, lead and antimony with copper often lead to peculiarly hard compounds as we see in the case of so-called soft hammers.

New Company.

A new company, of which Mr. W. L. Conwell is president and treasurer, has recently been organized under the name of the Transportation Utilities Company. They were organized to represent directly the Acme and General Railway Supply Companies, of Chicago, and to market special devices and supplies calculated to suit the requirements of railways and of the building trades. Their territory includes all steam railroads operating east of Chicago and St. Louis and electric properties and building trades throughout the United States, Canada and Mexico. The New York office of the company is No. 30 Church street.

Moving Pictures and Lip Language.

"That's a good lip reading stunt," said one man to another at a moving picture show as he pointed to a boy who was completely absorbed in the rapidly moving figures. "I happen to know that he's stone deaf, but he's so accustomed to lip reading, which is really hearing with his eyes instead of his ears, that he is now unconsciously reading the lips of the figures shown in these moving pictures. A teacher of the deaf was talking to me about this very thing recently and she said that moving pictures are especially popular with deaf people on this account, as they get double enjoyment from such an entertainment. As a rule the photographed speakers face the audience, and if a person is proficient in lip reading hardly a word will be lost. It seems positively uncanny to think that what's a pantomine to us means so much more to one who understands lip reading."—*N. Y. Sun.*

Detroit Steel Castings Co.

The annual meeting of the Detroit Steel Casting Company was held on May 11, reports showing that the year which had just closed has been an unusually prosperous one, and that while business was quiet and the booking of orders was slow, the prospects for the coming year are considered good. The following officers were elected: Mr. J. S. Newberry, president; Mr. S. W. Utley, vice-president and general manager; Mr. W. S. Allen, secretary; Mr. F. P. Smith, treasurer, and Mr. J. P. Warren, assistant treasurer

Accident Bulletin No. 38.

Accident Bulletin No. 38, recently got out by the Interstate Commerce Commission for the months of October, November and December, 1910, shows that there were 248 persons killed and 3,729 injured in train accidents. Other kinds of accidents cause the total number of casualties to reach 22,586, or 2,659 killed and 19,927 injured. Of this number there were 935 employees killed and 13,882 injured, being a decrease of 13 in number killed and an increase of 1,422 in the number injured.

When making a comparison of these figures with those in the preceding bulletin, there is a decrease of 73 in the number of persons killed and 163 in the number injured in train accidents. In coupling and uncoupling cars and engines, there were 60 killed and 877 injured, being an increase of 4 killed and 155 injured.

A Bad Miss.

When Tom Keegan first arrived in Marion he went to work in the roustabout gang with the vision of a foreman's job in the distance. Although under twenty, he was a six-footer, with promise of more growth. Jim Lawler, the blacksmith foreman, was generally looking for husky helpers, and one day Tom Keegan attracted his attention. The result was Tom was installed in the blacksmith shop. One day while the foreman was out some of the men tried to have fun with the new, big helper. They fastened a piece of iron to an anvil and induced Tom to try his skill in hitting it with a fore-hammer. He swung the hammer valiantly, and struck the iron two or three times. Then, trying to make a supreme effort, the hammer slipped from his hands and went through a window. Tom looked at the wreck in consternation, and exclaimed: "I felt shure I could hit the anvil, but, be jabbers, I see I missed the smiddy."

New Q. M. S. Catalogue.

The Q. M. S. Company, of Plainfield, N. J., have just issued attractive loose leaf catalogues illustrating their line of metal sawing machines, hand power traveling cranes, jib cranes, I-beam trolleys, pneumatic hoists, power hack saws, car wheel grinding machines, Stanwood car steps and pneumatic pit jacks. This catalogue which is well worth having, may be obtained on direct application to the Q. M. S. Company.

Gravitation.

Newton's great discovery, the law of gravitation, is known to everyone as the cause of a stone dropping to the ground if pushed off the edge of a table, but the universality of the law is perhaps not so well known. The law when stated formally is this: Every partical of matter in the universe attracts every other particle with a force acting along the straight line passing through their centres, and with a force directly proportional to their masses and inversely, as the square of the distance apart. This not only means that the sun, moon and stars each attract all the others, but that the articles in the room you are in have a like attraction for each other and also for the outside heavenly bodies. We are accustomed to think of the earth attracting all the smaller bodies on its surface, but the universal application of the law compells us to recognize the fact that not only does the earth exert a downward or "toward-the-centre" pull upon the chair you're sitting on, but the chair actually exerts a proportional uppull on the whole earth at the same time. If the chair is held above the earth it moves down when the support is withdrawn, and we see it fall, but theoretically the earth has moved up a proportional distance to meet the falling chair.

Scale Removal.

The William B. Price Co., of Buffalo, have issued a neat little pocket-size pamphlet entitled, "Scale Removal Made Easy." The pamphlet is dedicated to the man who bought the boiler and who must run it. The little pamphlet is not a catalogue of appliances. It is a readable dissertation on scale; how formed; why; and all about it. The little book is handy to have if you are interested in the question of scale formation or have anything to do with a boiler. Write and ask for a copy if you want one, as the company gives away the booklet free.

Intercolonial Extension.

A recent press dispatch from Ottawa, Ontario, says the expansion of the Canadian government railway system by connecting with the Intercolonial thirteen branch lines with a total of 650 miles in length, is indicated by a resolution of which the minister of railways has given notice in the House of Commons. This addition, coupled with the two Nova Scotia branches which the government is making arrangements to build, will make the International one of the great trunk line systems of Canada. The leases are for 99 years. The Intercolonial earned a substanstial surplus for the government last year.

Norwegian Power Plant.

An enormous electric power station, at Vemark, in the province of Telemarken, was recently started, the "Rjukanfos," or Foaming Fall, supplying the power for the machinery. This fall, which is one of the magnificent sights of Norway, has been changed so that now there is a straight drop of about 400 ft., where previously the drop was 800 ft. By this means a horsepower of 145,000 has been obtained.

On Midnight Owl.

"Say, c'nduct'r, 'll you (hic) turn this seat over?"

"What do you want the seat turned for?"

"Got carried by my station. Want t' git back."—*Erie Railroad Magazine.*

Railway and Locomotive Engineering

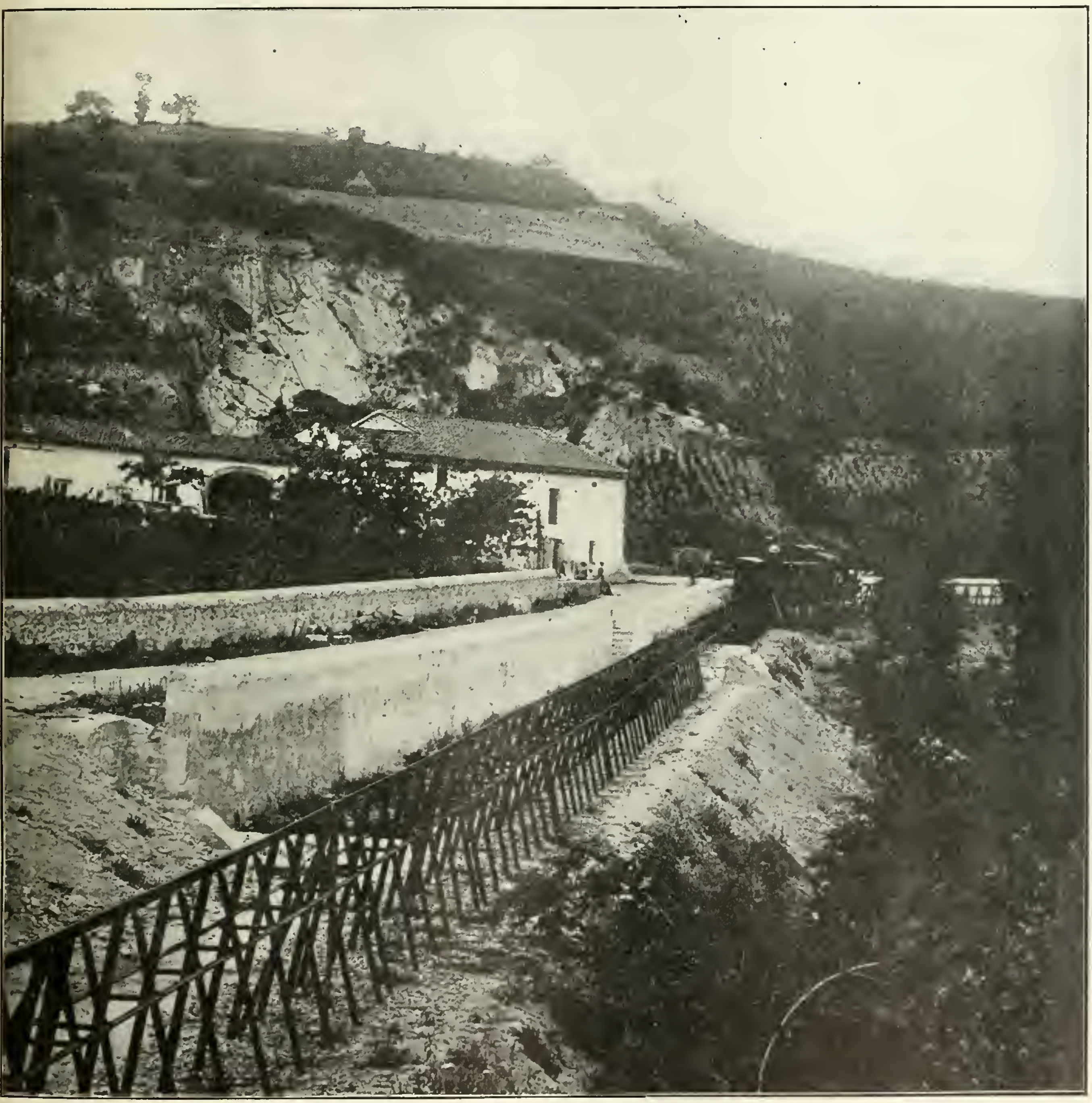
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, July, 1911. No. 7

Mono-Rail Systems of Traction.

It would perhaps be somewhat difficult to say by whom and when the first "mono" or single-rail system of traction, using the term in its broadest sense, was laid down. The point, however, is merely one of historical interest, inasmuch as the conditions of modern-day transit so widely differ from those of thirty or forty years ago that little remains of the old order of things except principles.

Perhaps the most primitive form of mono-railway which has survived to the present day is that known as the Caillet system of portable single rails laid on



THE MONO-RAIL, LARTIGUE SYSTEM, IN ALGIERS.

the ground-level, which is largely in use in northern and western Africa, Mexico, Brazil, Chili, Persia, Java and Japan.

This system is not intended for locomotive power. The rails have a flat base and weigh from 9 to 24 lbs. a yard. They are carried on short metallic sleepers, the total weight being from 60 to 165 lbs. per length of 16 ft. according to circumstances. No ballast is necessary and the rails can be laid wherever a man can pass with a load. Special bent rails are used for curves of short radius, but in ordinary cases the rails can be bent by hand. The rolling stock is for the most part supported on four double-flanged wheels from 10 to 20 ins. in diameter, placed in the same plane. Rods project sideways by which the vehicles are at once propelled and kept in equilibrium, whether by manual or horsepower. The load is distributed as evenly as possible on both sides of the centre line. Hinged supports can be let down which render the vehicle stable during loading.

The pioneer of the modern mono-rail idea was Monsieur Charles Lartigue, who in 1882 applied his system to a sand-swept desert line in Algeria. The Lartigue railway consists of a single rail, supported by A-form iron frames above the level of the ground, provided with freight panniers constructed with angle-iron. The rail is a flat bar about 3⅛ ins. high and about half an inch thick, having two fillets, one on each side, halfway up, giving the rail the form of a cross of which the horizontal member is transversely a width of 5 ft. over all. A view of this road is shown in our frontispiece this month.

Horse power is generally used to draw the load, but in cases where the line has to be constructed on a higher level to clear traffic at public crossings some other form of power has to be utilized. At the Ria mines, Department of Pyrénées Orientales, France, there is a very curious Lartigue railway, over which iron ore is carried for a distance of 6¾ miles. The line is worked by electricity on a system designed by Messrs. Siemens and Halske, in which the motor on the descending train is utilized as a dynamo which generates sufficient current to work the motor on the ascending train, the difference between the weights of the two trains being enough to compensate for the loss of

INTERIOR OF MONO-RAIL CAR.

speed of about six miles an hour. The driver is seated on the other side of the pannier and has commutators, brakes, etc., within reach. The cost of laying a simple Lartigue mono-rail, 32 ins. high, with stock of panniers, is between £300 and £400 a mile, and the cost of horse-power and drivers to draw a ton one mile may be taken at 0.17d. The system is still largely used in Algiers for the collection of alfa grass.

A good example of a Lartigue mono-railway is that which connects Ballybunion, County Kerry, Ireland, with Listowel on the Great Southern and Western Railway. This is the only example of a single-rail system working as a public concern in the United Kingdom and is probably the only power-worked Lartigue railway now in existence as a passenger-carrying line. It owes its inception to the enterprise of Mr. F. B. Behr. Early in 1886, Mr. Behr built a trial line on the side of the old Westminster prison, using a somewhat modified form of Lartigue's method. This was undoubtedly the first instance of steam engines and passenger coaches running on a single-rail railway. The line was worked by a little locomotive constructed by the Société Tubize, Belgium. It consisted of two vertical boilers, one on each side of the rail, supplying steam to a little double-cylinder engine stowed away between the boilers. To the engine was coupled a second piece of mechanism

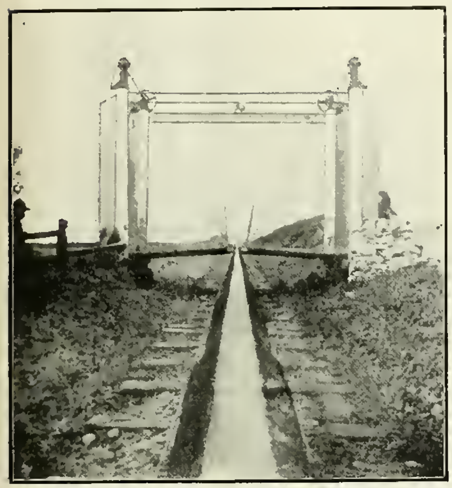
LISTOWEL AND BALLYBUNION MONO-RAILROAD, SHOWING CROSSING PLACE.

extremely short; the weight is about 10 lbs. a yard. The rails are bolted between the upper ends of the A-frames, each of which weighs about 11 lbs. when fixed; the rail stands about 3 ft. above the ground-level. The panniers hang about one foot clear of the ground; they are about three feet long and occupy

electrical efficiency. In this case a dynamo-electric machine of the horizontal type, making 1,200 revolutions a minute, is fixed on one side of the leading pannier. By means of speed pulleys, driven by ropes, the speed of the driving pulley on the rail is at the rate of 150 revolutions a minute, resulting in a forward

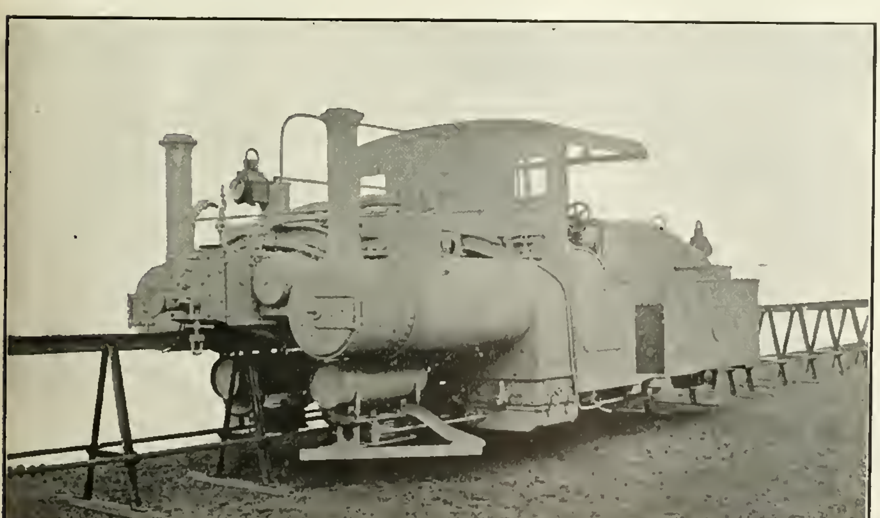
consisting of a vehicle carrying a Westinghouse compressing engine and a reservoir, the passenger and other vehicles being fitted throughout with the Westinghouse brake. This little carriage was also fitted with a pair of cylinders, constituting an auxiliary engine supplied with steam from the boilers through flexible pipes, to assist in ascending inclines. This auxiliary arrangement was afterwards repeated on the Listowel and Ballybunion Railway, Ireland. The engine had two grooved wheels, 15 ins. in diameter, and the cylinders were 4½ ins. diameter, with a 7-in. stroke. The boilers gave a total heating surface of 70 sq. ft. The engine worked at a steam pressure of 100 lbs. to the square inch, and could easily negotiate 30-ft. curves and could haul 70 tons on the level and 6 tons on an incline of 1 in 33 at six miles an hour.

In April, 1886, Mr. Behr obtained Parliamentary powers for the construction of about 10½ miles of railway be-



ROAD CROSSING OVER MONO-RAIL.

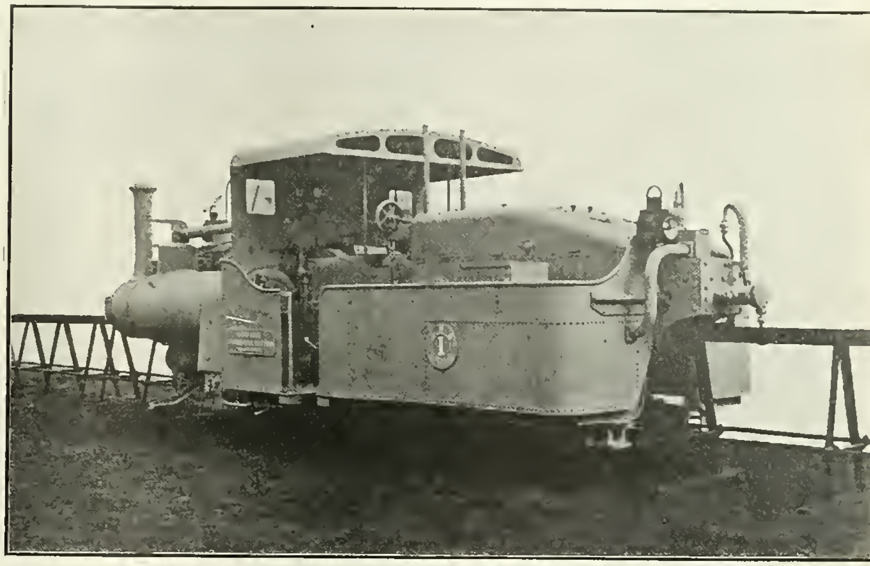
tween Listowel and Ballybunion, for the completion of which a period of five years was fixed. The capital was to be £22,000 in £10 shares, with power to borrow up to £11,000 in addition, the possession of 20 shares qualifying for a seat in the board of directors. The line



FRONT VIEW OF MONO-RAIL ENGINE, LISTOWEL AND BALLYBUNION LINE.

was opened for general traffic on March 1, 1888.

As constructed, the railway, which is single line throughout, is 9¼ miles long. There is only one intermediate station, Liselton, but there are no less than 42 occupation and public road crossings, some of the former necessitating the use of a somewhat curious form of "drawbridge" which is lowered onto the level



REAR VIEW OF MONO-RAIL ENGINE, LARTIGUE SYSTEM.

of the top rail; the signaling system to these occupation crossings is very complete. The public road crossings are all constructed by making a portion of the line move on a pivot, and each of these crossings is in charge of a gatekeeper.

The rails are double headed and the supporting trestles are provided with a light guiding rail running along on each side, one foot above the transverse wooden sleepers on which the trestles rest. These guide rails take the side thrust by means of horizontal rollers attached to the rolling stock and counteract any tendency to derailment when rounding curves. The locomotive and rolling stock forming the trains sit the running rail like a saddle, the weights being as nearly as possible equally divided on each side and the centre of gravity being kept as much as possible below the rail. Our smaller illustrations are of this road.

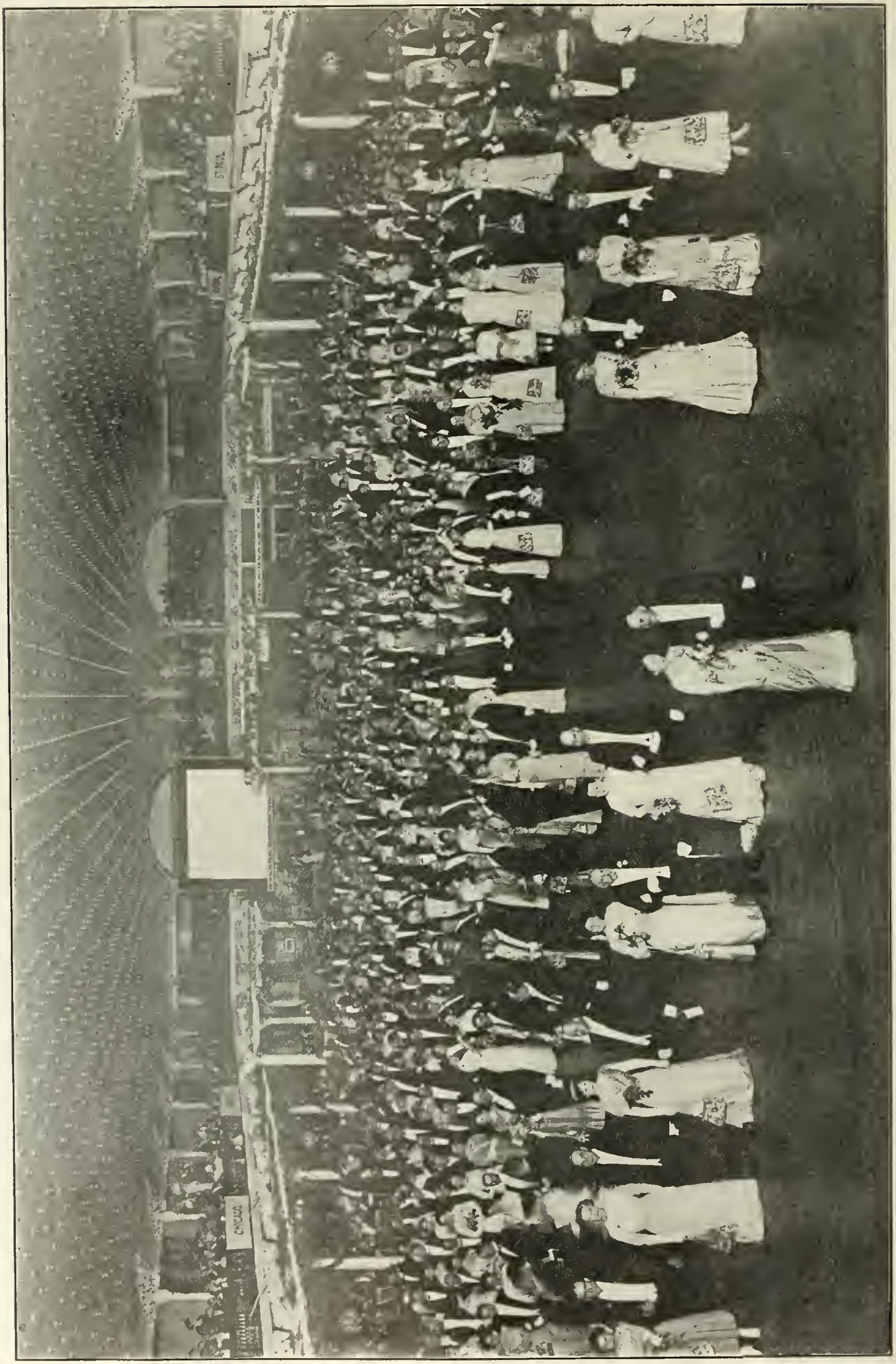
One peculiar feature of the line is the ingenious arrangement substituted for ordinary points for changing lines at the termini. This consists of a "turntable" section of the line, the rail on which is curved so as to be tangential to two roads which are not in the same straight line. This section is supported on a pivot which is not central but is situated towards one side. To connect any line with a second at one side of that to which the "bridge" is actually leading at the moment, it is turned through rather more than half a turn, which brings it into position connecting the original running line with the desired one.

The Expansion of Cast Iron.

Cast iron, if repeatedly heated and cooled and kept free from the air, increases in size without any change in weight. In experiments with a bar 12 ins. by 1 in. by 1 in. the heating and cooling being continued thirty-five times in succession, the bar grew to 12¾ ins. in length, the other measurements remaining unchanged. The chemical change increasing the length of the bar was owing to the conversion of the carbon to the graphitic form. Wrought iron, soft steel and tool steel, similarly treated, showed a very slight contraction.

Casehardening.

As it is not always convenient to secure quantities of horns, hoofs, leather and other materials commonly used in casehardening a large number of articles. Recent experiments have shown that articles made of wrought and low-carbon steel may be hardened sufficiently for ordinary purposes by packing them in a mixture of one part of saltpetre to five parts by weight of granulated charcoal.



GRAND MARCH AT THE BALL OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION AT ATLANTIC CITY, JUNE 15, 1911.

General Correspondence

Anti-Collision Device.

On page 200 of the May issue of Railway and Locomotive Engineering there appeared an article headed, "Comments on the Willesden Accident." Col. H. A. Yorke, who conducted the official investigation for the British government, in his report made some reference to the Hedley anti-climbing device. This device we very fully and very clearly illustrated and described. We subjoin Col. Yorke's letter to the Angus Sinclair Company:

Board of Trade,
8 Richmond Terrace,
Whitehall, S. W.,
May 29, 1911.

Dear Sirs:—I have to thank you for your letter of the 15th instant, and for the copy of Railway and Locomotive Engineering for May, 1911, in which there is a reference to my report of the Willesden accident, and a description of the Hedley anti-climbing device. So far as I can judge from the drawing, this invention should prove very effective.

The trouble in this country is to find a device suitable for our standard rolling stock, with long side buffers and flexible coupling. However, the matter is being considered by our railway companies.

Believe me,
Yours faithfully.
(Signed) H. A. Yorke.

Superheater Engines Pull More Cars.

Editor:

Replying to your letter of May 31, with reference to tractive effort of our superheater engines, I have never heard the claim made before that engines using superheater steam would develop a higher tractive force than one using saturated steam, assuming all conditions such as weight on drivers, size of cylinders and boiler pressure are equal, and I consider that there is no question that it does anything of the kind. The fact that the superheater steam locomotive will haul a greater number of cars at a given speed or a given number of cars at a greater speed than an equivalent locomotive using saturated steam, is due to the increased capacity obtained from the boiler of the superheater steam engine. In other words, there is no doubt that the engine using superheated steam will maintain, at any time, which taxes the capacity of the boiler, a higher tractive power than the saturated steam engine, but its maximum tractive power is actually less due to the loss in pressure between the boiler and steam chest caused by the pressure necessary to force the steam through the superheater pipes. H. H. Vaughan,

Assistant to the Vice-Pres., C. P. R.

Montreal, Canada.

Saturate and Superheat Steam.

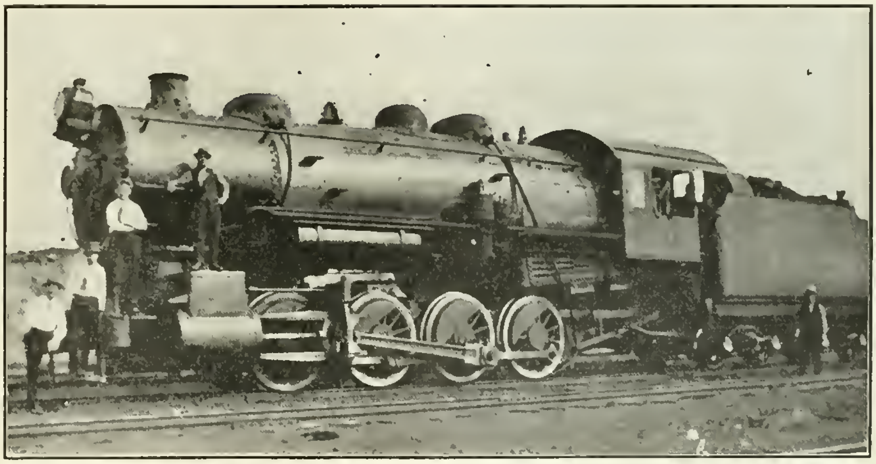
Editor:

In June issue, H. G. S., in an article or superheated vs. saturated or properly *saturate* steam, asks some questions and while I have not had any experience with the superheater and so am unable to give the exact information which he desires, I believe I can show the logic of the problem. Take a pressure of say 160 lbs. for an example; we usually consider only the question of pounds per square inch in our thoughts concerning the transformation of this generated force or power into work performed, but is that correct? Not if natural philosophy and applied mechanics are correct.

According to philosophy heat is the only force or power and our results depend on our capacity to extract from those cubic inches of steam a given amount of their heat and apply same as energy to the reciprocating parts of the engine. Steam at 160 lbs. pressure contains heat to something like 370 degs. F., if I remember rightly, but if the actual is 15 or 20 degs. F., higher or lower it will not change, except in degree, the condition.

As soon as the volume of 370 degs. F., which we call steam, starts from boiler via throttle opening, dry pipe, steam pipes, steam chests and cylinders, to atmosphere, it encounters a horde of holdups to rob it of its power. The first one of these is expansion; he jumps astraddle of its neck as soon as throttle opening is passed, digs in his spurs and tenaciously holds his seat throughout the journey.

When the niggerhead in front end is reached another little joker climbs aboard. He is called friction, and like the first stays the balance of the journey, and is aided as soon as steam chests are reached by joker radiation, who aids the others and they, by their combined efforts, produce the king joker of all, condensation, and between them a very considerable part of the 370 degs. has been appropriated by them, leaving only the residue to be converted into results or work performed, which is measured by draw-bar pull.



EIGHT WHEEL SWITCHER ON THE LACKAWANNA.

How about superheated steam; let's see. When the throttle is opened steam starts into dry pipe same as saturate steam. Expansion gets aboard when front end is reached and on its hurrying course it goes through the zigzag pipes, getting hotter and hotter all the time. Friction don't seem to be able to locate it in its course and radiation seems to have been killed so that when it enters steam chest it is at a temperature of 600 degs. F.; so blamed hot and so dry that condensation can't be found with a search warrant, and while a test of the temperature of the exhaust steam would undoubtedly prove to be much higher than that from saturate steam of same initial pressure, the factor of real importance in the mechanical world—how many degrees of heat were converted into work—must undoubtedly be much greater with the superheated steam because of the elimination of those losses, and that is why superheated steam saves water, saves coal and hauls more tonnage than saturate steam.

A. J. Schmidt.

Shreveport, La.

[This is a good letter, well written and the writer's ideas are clear and correct, but he does not give convincingly the reason why a superheater engine will pull more cars than a saturated steam engine will. That is what we want to know. If you think you know write in and tell us. Whatever is the reason, it is well worth knowing.—Editor.]

Light Air Hammer.

Editor:

Enclosed please find a photo and a blue print of a light air hammer which we have gotten up at the McComb shops of the Illinois Central. We have two of them in use, one in the boiler shop for swedging flues and one in the blacksmith shop for light welding, such as brake rods, etc. There were no patterns made for

HOME-MADE SHOP HAMMER, ILLINOIS CENTRAL.

them, the material was picked up right around the shop. I might mention that the base is made of an exhaust pipe and the cylinder from a rocker-box bushing casting. The materials were not costly but the hammers are most useful.

E. L. Bowen.

McComb City, Ia.

Traveling Firemen.

Editor:

Referring to page 242 of the June issue in reference to traveling firemen, I will say that a demonstration of proper firing is the best and should be the only way, as the engineman who is running the engine can tell the man better who is trying to fire it than any traveling fireman or road foreman can.

I could always get better results on a bad steaming engine to tell the fireman myself how to do the firing; but an engineman can not leave his post to show or demonstrate how it should be done. I have often wanted to say something on this subject, as I have often had the road foreman and traveling fireman ride with me on a bad steaming engine and could not get as good results.

It should be the duties of the road foreman and traveling fireman to demonstrate how to fire. Then, if they could not keep up steam you would know there was something wrong with the engine. Bad coal or poor firing is often the cause of an engine not steaming properly. The road foreman or traveling fireman will often have a lot of extra work done on an engine to find out what is the matter when it is only bad firing or bad coal.

Having had thirty-eight years experience on a locomotive and having used almost all kinds of coal on bad steaming engines, I will say it is only throwing money away to send a road fireman out on the road, unless he can and does demonstrate how the firing should be done.

D. B. Hines,
Loco. Engr., Union Pacific Railway.

Iowa City, Ia.

Walschaerts Valve Gear.

Editor:

Please tell C. A. H., Enid, Okla., page 256, Question 41, of your June issue to look at the two Walschaerts gear engines a little closer and I think he will find one of them has the lifter arm in front of the tumbling shaft and the other is behind it. Sometimes it is necessary to do this to place tumbling shaft so that it will project over the frame between driving wheels.

W. C. Hill,
Locomotive Engineer.

Buffalo, N. Y.

Pike's Peak Railway.

Editor:

You have, no doubt, in your past experience have had some thrilling rides, but to test your nerves I think you should take a slide down Pike's Peak on a toboggan. The attached picture is of George Royal the third, who is a conductor on the Manitou & Pike's Peak Railway. He is coming down a 25 per cent grade.

This road, as you know, is about nine miles long and to come down this piece of track in about twenty minutes and making four stops, lifting the toboggan and carrying it over switches and frogs, necessitating these stops, I think Angus Sinclair would think he was going some.

Of course, you may be familiar with the arrangement of the toboggan used there. They are in the form of two steel runners, which ride the rack rails. A bar of iron extends out through side,

GEO. ROYAL, JR., COMING DOWN PIKE'S PEAK.

covering the T or carrying rails, which prevents the toboggan from tipping over. A lever operated by a manipulator, grips the rack rails thus performing the functions of a brake.

Geo. Royal, Jr.

Pike's Peak, Colo.

[For the benefit of our readers we subjoin a few facts taken from the folder issued by the Manitou & Pike's Peak Railway. "This road, familiarly known as the Cog Wheel Route was completed in the autumn of 1890. As an engineering achievement it is remarkable, and in many respects it is the most wonderful railway in the world. In general terms it is an Abt system cog road, though that conveys little idea of what it really is. There are similar roads in foreign countries, but they are all pigmies compared to the one whose head lies on the loftiest

VIEW OF PIKE'S PEAK ROAD.

pinnacle of Pike's Peak and whose foot rests on the plain. The greatest of these stops short of 7,000 ft. of altitude. The Manitou & Pike's Peak Railway climbs 14,147 ft. above the sea, a far greater attainment of elevation, even considering the difference in the altitudes of lower terminals, than any of the others."—Editor.]

Answer to Some Queries.

Editor:

Referring to an article in the May issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 191, under the caption of "Some Queries," by Three Times Seven. The questions raised are good, live ones and should be therefore of more than passing interest to locomotive engineers. I lookd for some lively discussion of these questions in the June issue but found only one, by Mr. F. E. Patton, of Columbus, Miss., and it contained some very interesting information, all right. Having read the RAILWAY AND LOCOMOTIVE ENGINEERING for about eighteen years, constantly, I desire to rise to a point of order.

1. With right forward motion eccentric blade or strap broken. If the back motion strap, or blade can be utilized, substitute them for those of the broken parts of the forward motion, putting them as securely as possible and with the reverse lever in about full forward stroke the train can be brought forward. In making a temporary job of repairs of this kind it would be well to, in some way, chain around the bottom of the link, loosely, to allow for the throw of the eccentric, so as the link could not be thrown too far at bottom, thus causing damage. If the connections cannot be made, as indicated, then it would be well to remove both the forward and back blades and straps, cover the ports on disabled side and come ahead with what the engine can handle on one side.

In cases of this kind it is not always the best policy to remove, or take down the main rod. On some modern locomotives these parts are entirely too heavy to be handled with the number of men on the average freight train, and if the main rod is not bent or otherwise damaged, it should be left in position. This saves work at the shops, to again put it up, etc. With a set of ports covered, the natural query comes, how is the piston to be lubricated? Easy enough. Back off the cylinder head stud nuts, about one quarter of an inch, drive betwen the end of cylinder and head a few hard-wood wedges, to prevent further movement of head, and oil through this opening. Engine oil will meet the requirements, due to the fact that there is no heat, except that of friction, between the piston rings and walls of cylinder. The oiling can be done with the ordinary quart oiler. The rear cylinder cock should be removed, to aid as far as possible, in permitting air to get in to relieve the partial vacuum behind the piston and allow, more or less, the escape of compression.

2. With right back motion eccentric blade or strap broken. Remove the broken parts, secure the bottom of link, as in answer to question No. 1, place reverse lever in about full forward stroke, and proceed with full tonnage. This method will prevent setting off train and coming to terminal light.

3. This question must be looked at in a business way. If the forward motion eccentric blade or strap is broken, irrespective of whether or not the link hanger is disconnected, should be treated as the failure discussed in question No. 1. However, if the link hanger is disconnected or broken and the top, or forward motion eccentric blade or strap is disabled, the natural tendency is for the link to drop down on the link block and remain there. As to whether or not the valve will be moved by the throw of the eccentric, is of no value. The valve rod could be clamped, which would prevent the movement of the valve, and the engine could be run in this manner, if so desired, but in the forward direction. Now as to the travel of the valve. If steam were present in steam chest, getting there by the ordinary handling of the throttle, it is fair to assume that the pressure would hold the valve on its seat and thus prevent any movement. The back motion eccentric being connected to bottom of link and top of link down on the link block, the block will simply turn slightly backward and forward, and back motion eccentric will not impart any motion to valve. In a case of this kind the engine would be only working on one side. In the way I see it, there would be no tendency for over-travel of valve.

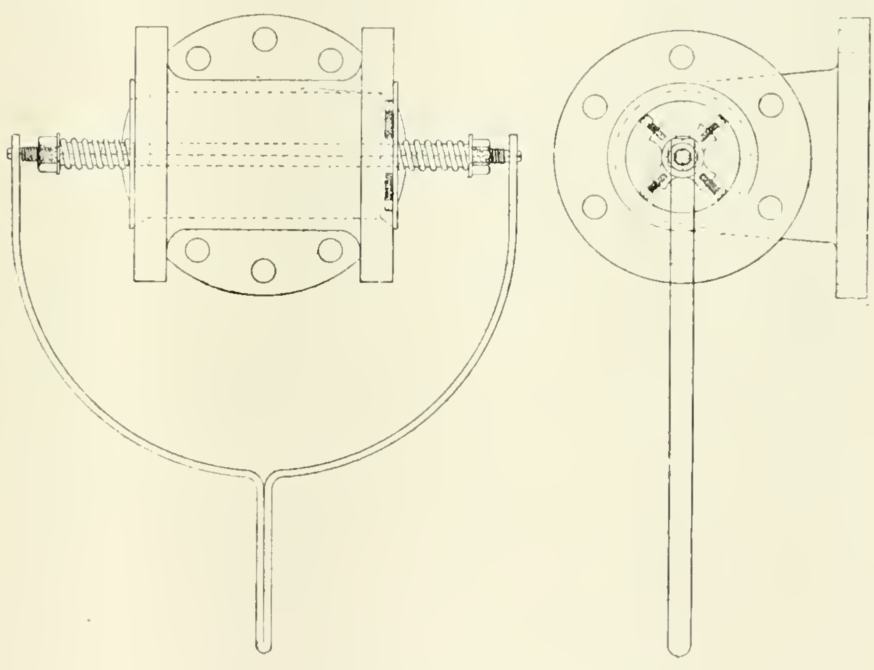
4. This question is similar to the one preceding, and should be handled in a practical way. If the motion work is all right on left side, and should the right back motion eccentric strap break, the question is, can the link-lifter on right side be disconnected and "hook the engine up" on left side and work full stroke on right side. A locomotive could be worked in this way, but there would be no practical use in doing so. The practical thing to do in a case of this kind, would be to "drop" the reverse lever down to about full stroke, without disconnecting the link-hanger; safeguard the bottom of link, as was mentioned in question No. 1, and proceed.

To answer, or give my views, of questions 5, 6 and 7 here, would take up too much space in the columns of your valuable journal and make an article too lengthy. But as these are important questions, I will, if the editor don't object, say something pertaining to them in the August issue.

JAMES SPELLEY,
Road Foreman of Engines,
B. R. & P. R. R. Co.

Du Bois, Pa.

[Mr. Spelley has been requested by the editor to write to us again for the August issue.—Editor.]



APPARATUS FOR GRINDING NIGGER-HEAD RINGS.

Jig for Grinding Nigger Head Rings.

Editor:

Any machinist who has been called upon to grind steam-pipe rings to nigger head while it is in its position on the flue sheet, knows what a slow and tiresome operation it is before the joints are finished, but as a wrist and arm exercise it can not be beaten.

This blue-print shows in detail how Mr. J. McEleney, steam-pipe man at the Clinton shops of the C. & N. W. Ry., overcomes the wrist and arm exercise by holding the two rings by set-screw chucks, driven by square mandrel and lever-arm as shown. The two ring chucks are ⅛ in. larger than the squared arbor which allows the two rings to roll and change their positions, the same as they would do if ground in by hand. The two rings are ground at the the same time, and the springs are of such tension that it grinds very rapidly.

The operator of this grinder simply pulls the lever back and forth and occasionally springs the lever apart and changes it to the next square on the arbor, so as not to grind the ring in one position. This arbor being original at this shop and not seeing anything like it before, I believe it will be of interest to all railway shops.

Chas. Markel,
Shop Foreman, C. & N. W. Ry.
Clinton, Ia.

Testing Steam Pipes, Etc.

Editor:

In your issue of Railway and Locomotive Engineering, Mr. L. A. Strader, R. H. F., So. Richmond, Va., wrote for information as to best method of testing steam pipes, dry pipe, etc. This is a subject that should appeal to all men who have charge of and are responsible for performance of the locomotives. It is a subject that I have always felt did not come in for its proper share of consideration in active railroad service. Why it should not I cannot say, as it certainly is the root of many, many ailments to which a locomotive is subject.

Years of experience in active roundhouse work has taught us all many lessons and one of the most important is, "Don't run an engine with leaky steam pipes." Not ony is it expensive from the most important item in handling a railroad, that of fuel, but detrimental to the life of an engine, which is figured in miles on the same plan as our lives are figured by years. Too much can not be said on the importance of making the proper test on steam pipes and it can be sifted down to simply getting water in around joints. I say water, not air.

A proper test of steam pipes and all joints to steam pipes can only be made by filling boiler, opening the throttle and leave water in steam pipes, niggerhead and exhaust stand. An accurate test of both joints on dry pipe-collar at niggerhead can only be obtained by filling boiler full of water. If the test was made by filling pipes with water through steam chests the joint between dry-pipe collar and flue sheet would not have a drop of water around it.

While boiler is filling with water the opening in top of exhaust stand must be closed, all except a small opening to leave air escape and so arranged by means of a small valve that it can be closed when air has all passed out and dry pipe, steam pipes and stand are full of water.

Let us here discuss proper method of blocking or stopping the opening in exhaust stand. One method commonly used in our roundhouse and shops is that of using small jacks and blocks on top between stand and smoke-box. This is a bad practice. In case of loose exhaust stand the pressure on top of stand would cause the stand to appear tight and leak would not show up. Many different arrangements are used but sifted down the exhaust stand must be corked up like a bottle by any arrangement, as long as the means of stopping up exhaust stand does not exert a downward pressure on exhaust stand joint and tend to mislead one who is making test by causing joint to appear tight.

Now, by means of the above method, we have the boiler, dry pipe, steam pipes, exhaust stand full of water and it simply means pump up pressure and watch for leaks. Some get the idea that a low-pressure test on steam pipes, as long as they are full of water, is sufficient. This is wrong, as steam pipes sometimes will not leak at a low pressure, but will leak badly at high pressure.

I do not think a cold water test of less than 80 or 90 lbs. should be considered a test. In outlining a test for steam pipes there are many short cuts at the same time accurate enough. If you have made previous tests and found all joints tight except top and bottom steam pipe joints or exhaust stand joints, these you have ground in, and want to know that they are tight, make connection at steam chest. This will save time filling boiler and in the roundhouse at times you would have to wait for some certain repair to be made on boiler before you could fill it.

Roundhouse or running repair work requires good management on the part of the man in charge, to keep the boiler and machinery in good shape and work coming up together, and not let a bad boiler or machinery condition cause the necessity of shopping the engine before its proper mileage is made. It is necessary that in the event of holding an engine out of service that all necessary work be done at that time to both boiler and machinery, in order that it be not necessary to hold engine one trip for machinist work and next trip for boiler work.

When an engine is held, good judgment must be used or one department will be waiting on another which, of course, is very expensive in a roundhouse. Hence necessity of sometimes using short cuts in roundhouse work. However, let it be understood that the proper and accurate method of testing steam pipes is by means of filling boiler and opening throttle.

So much for steam pipes, niggerhead, dry-pipe collar joint and exhaust stand. Now we will consider the testing of the dry pipe and the attachments on the boiler.

In a roundhouse we know, as a rule, what we are testing for. A leaky steam pipe or anything that tends to allow steam to escape in front end and fill vacuum made by exhaust and prevent its action on fire in fire-box, which has caused engine crew to complain of "no steam!"

If, on the other hand, the engineer complains of the amount of water working through valves we look for leaky dry pipe. This leak may be found to be a hole in the pipe, loose web in collars on dry pipe or lower joint in throttle stand. The only accurate way of making a thorough examination of these parts would be to have pressure in the dry pipe and examine the parts, but this would necessitate being inside the boiler, flues out, etc. It is not always possible to do this and other methods must be adopted. Many mechanical men consider the proper test for leaky dry pipe is to fill the boiler with water and watch at cylinder cocks for leaks. This test is all right and shows that the leak exists, but we must know which joint. If leak should not appear at place named, then throttle-box and stand must be removed, the end of dry pipe plugged and on engine where space will permit, a man must crawl in on top of flues and locate the leak.

Many, many times we find a leak in collar of dry pipe, where it is riveted on end of dry pipe, and by letting a man crawl in and caulk up leak the expense of removing dry pipe is avoided. The keynote of the whole thing is to be sure you have solid water in and around pipes and joints to be tested at a good pressure and leave pressure on plenty long enough to examine each part closely and give leak plenty of chance to show up.

John F. Long,
General Foreman, Frisco System.
Sapulpa, Okla.

Correction Re Valve Strip Blow.

Editor:

In looking over the June number of your magazine, the article on valve strip blow, page 239, is not quite clear. The first part of the third paragraph should read as follows:

"I would first place one engine on the quarter and place the reverse lever in the center notch of the quadrant to cover all ports on that side."

If consistent I would thank you to correct this in your July number. Insert the word "first" instead of "just" and put period after "side" instead of quadrant.

F. E. Patton.
Southern Railway, Columbus, Miss.

M. M. and M. C. B. Convention Reports

Am. Ry. M. M. Ass'n.

Locomotive Steel Tires.

The Master Mechanics' Committee on locomotive steel tires of which Mr. L. R. Johnson, of the C. P. R., was chairman, presented a very valuable report on subject which had been assigned to them. The committee had communicated with the larger roads in the United States and Canada and Great Britain on the question of handling the purchase of steel tires for locomotives and cars. The report, however, deals more particularly with locomotive tires.

A series of questions was sent out to various roads and a synopsis of the replies were tabulated. Eighteen roads on this continent replied and seven British roads answered. The questions sent out were: (1) Please supply copies of any specification for passenger, freight and switching engines which may be in use on your road, or give suggestions for any points you consider advisable to embody in a specification. (2) Have you any branch or branches running north or south, if so, do you make any difference in your specification or analysis for tires for service in the north and south to meet climatic conditions? (3) If a physical drop test is specified what class of test would you recommend as best showing the quality and condition of the tire? (4) Are you prepared to face the responsibilities of living up to a specification? The replies indicate that out of the total twenty-five United States, British and Canadian replies 19 roads use a specification, and 11 were prepared to take the responsibilities of living up to the test. The majority having branch lines considered that climatic conditions made no difference to their specifications. Concerning the drop test opinion was divided between drop, tensile and no physical test.

Seven British and American manufacturers were asked three specific questions each, the answers amounting to this: In their opinion they should be allowed to draw up the specification and should not be held responsible if a railway officer did it and the majority were in favor of only one grade of tire for three classes of engines.

Softening Feed Water.

Anything that relates to locomotive boiler economy is likely to have decided bearing upon the expense of operating railways. Hard feed water is a deadly enemy to the durability and to the economical operation of steam boilers, yet it has always been extremely difficult to move railway managers to incur much expense in the selecting of soft feed water or in providing means for softening the hard water that nature, unaided by the selecting process of good sense, has generally provided.

Ever since the American Railway Master Mechanics' Association was organized in 1868, information has been sought regularly by members and committees for means to prevent incrustation of boilers by hard water; and in this year of grace, 1911, a committee has reported on the same time-worn subject without coming nearer to a remedy than any of those who have labored in the past. The particular line of inquiry this year was: "The best method of treating water for locomotive use, when the density of traffic does not warrant water treating plants." The committee consisting of Messrs. H. E. Smith, F. O. Bunnell, L. H. Turner, J. E. Meshling and J. J. Conners have done their work very satisfactorily.

The best method of robbing hard feed water of its scale making and corrosive properties is no doubt through the processes followed in water treating plants; but where these prove too expensive for the quantity of water used, the committee in this instance recommend chemical treatment in the water supply. The use of caustic soda is recommended as a universal solvent for the impurities that make water hard, the mixing process being supplemented by thorough washing out of the boilers. It was well to mention the necessity for washing out, as we have noticed a tendency to neglect that important operation until foaming induced by the saturated condition of the water became troublesome. Treating the feed water with compounds that put the impurities out of solution is undoubtedly a sensible action; but the compounds employed should be used on the recommendation of a chemist familiar with the water. The American tendency to do things without knowledge or special training has caused many failures in the treatment of boiler feed waters, and will continue to cause failures as long as the reluctance prevails against employing specialists. "If you are going to do a thing, do it well," is a proverb particularly worth attention in feed water purification.

The committee commends the use of barium hydrate, a poisonous compound for treating water containing sulphates, the worst impurity present in feed water. Barium is certainly an effective reagent for treating sulphate of lime, but it is more expensive than soda and its poisonous character makes its use objectionable. On the whole we think the doctoring of feed water should be left to the people who make a specialty of the business.

Repair Equipment for Engine Houses.

The Master Mechanics' committee on repair equipment for engine houses, of which Mr. C. H. Quereau was chairman, presented an exhaustive report, submitting a list of tools for outlying engine houses, to be expanded to meet the requirements of a larger terminal, and differing only in the absence of some of the larger machines essential to a well-equipped railroad general repair shop. The committee pointed out in their report that the qualifications of an engine-house employee should be quite different from those of the regular repair-shop man. The latter should be accurate, thorough and first-class in every respect, while the former should be resourceful, his aim being to have the engines ready to make the next round trip successfully. His work need not always be exact and often coarser than the shop man should countenance. With this view engine-house work and general repairs easily become classified and separated. The engine-house men should, therefore, have in mind that locomotives should be held out of service as short a time as possible and at the same time be kept in the highest state of efficiency. The facilities and conditions should be of the best, and the committee expressed their gratification that the modern trend of engine-house construction is to make the equipment of them such as to attract a better class of men than hitherto.

Locomotive Frame Construction.

Mr. H. T. Bentley, chairman of the Master Mechanics' Committee on the best construction of locomotive frames, presented a lengthy and interesting report. The report referred to the fact that while material and construction had improved, frame breakages continued. Of recent years repairing has been simplified by the use of thermit, oil, and other welding processes. As to the cause of breakages, the long wheel base, sh curves, and engines not being pr kept up were advanced as the chief

Some instances had been reported where frame breakage was caused by boiler expansion, the expansion pads or sliding shoes being fitted too tightly. Vertical plates were recommended as a safe means of allowing for expansion. Ordinarily breakages did not occur in the earlier years of a locomotive's service. Frequently the binder and bolt was the cause of breakage, and again the wedges were known to be the cause. Stronger bracing was recommended, the adoption of the Walschaerts valve gear rendering better bracing a possibility. Revised valve-setting, with a reduction of compression was said to be helpful. Some reports in the committee's hands stated that forged frames had been found more reliable than cast steel frames. Keyways and fillets were recommended.

Allusion was made to the fact that there is an impression that plate frames are freer from breakage than bar frames. This is a gross error. The committee were unanimously of opinion that plate-frames were undesirable as a substitute for bar frames.

In this connection it may be interesting to give extracts from an article written by Mr. I. Valenziani, of the Italian State Railways, published in *L'Ingegneria Ferroviaria*, for November 1, 1910, which has a bearing on the subject. He says: "Many European railways have purchased American locomotives, and while some details have been found unsuitable for European practice, it is none the less true that in other respects the American locomotives have given excellent results. Among the details which were largely appreciated in Europe must be included the bar frames, which have two great advantages over the plate frames; namely, the very much greater ease of examination and adjustment of parts lying between the frames, and the greater ease and rapidity with which the various parts can be attached to the frames during the construction of the locomotives. The advantage derived from the greater accessibility becomes still more evident when it is remembered that one of the great objections to the use of four cylinders has been the inaccessibility of the inside machinery. Considerable efforts have been made by the American designers of late years to reduce the difficulties and breakages. The excellent results given by the bar frames on the twenty locomotives purchased by the Italian State Railways from the Baldwin Locomotive Works indicate the success attained in this direction. Very good results have also been obtained by Maffei with bar-frame locomotives for various European railways. Maffei prefers wrought-iron bar frames, forged and welded, while Krupp has cut bar frames for the Baden State Railways from a single rolled plate of sufficient thickness. In addition to the facility of inspection of the machinery offered by bar frames they have the advantage of rendering the washout plugs and the fire-box stay bolts more easily accessible."

The report closed with an expression of opinion that the most important need of improvement in frame construction lay in better bracing, which is now possible with the changes that have occurred in valve gearing, and which is already receiving the attention of the leading constructors of locomotives.

Safety Appliance Standards.

The Interstate Commerce Commission having issued a special order in regard to United States Safety Appliance Standards, dated March 13, 1911, the committee on safety appliances of the American Railway Master Mechanics' Association, of which Mr. Theo. H. Curtis was chairman, wisely reported a complete abstract of the sections of the special order relating to steam locomotives in road service. An extension of time to July 1, 1912, has been allowed to change switching locomotives to make them comply with the standards prescribed in the order. These relate to tender and pilot sill-steps, pilot-beam handholds, side handholds and rear-end handholes, the dimensions and location in each case being given. Couplers and uncoupling-levers are also minutely specified, and an attention has been given to details that apparently leaves little to the discretion of the constructors. These changes are all looking towards the saefty of railroad employees, and there is every indication that the order will be complied with as rapidly as the demands of the public service will permit. The order applies to all new equipment built on or after July 1, 1911.

Locomotive Water Treating.

The best method of treating water for locomotive use, when the density of traffic does not warrant water-treating plants, was ably presented by a special Master Mechanics' committee, of which Mr. H. E. Smith was chairman. The report referred to the fact that in locomotive service the difficulty in the use of boiler compounds was in applying them regularly to the water. Separate softening plants have proved their usefulness, but in small stations they involve high fixed charges. A useful compromise is an apparatus which will mix the water with the proper proportion of some chemical solution which will act on the incrusting solids so as to keep them in a soft condition in the boiler. At track-trough stations, soda ash or other material may be thrown into the trough regularly as each train passes. A better plan is pumping the solution with the water. A small branch may be run from the water-pump suction to a tank containing the solution, and the flow of the latter be regulated by a valve. This produces a thorough mixture. The tank with the solution should be near the pump-house. When sediment must be avoided, soda ash, or bicarbonate of soda is the only reagent possible. Blowing off and washing out of the boiler must be done regularly and thoroughly.

Another reagent was specially referred to. Barium hydrate has the advantage of treating sulphates without producing foaming alkali. The main objection to its use is its cost. It is not only higher in price but it requires three times the quantity to be effective, as compared with soda ash. One road reported that the boilers could not be kept clean with 860 lbs. of soda ash per month, costing $9, but was kept clean with 260 lbs. of barium hydrate, at a cost of $80 per locomotive.

Smoke Prevention.

Mr. E. W. Pratt presented the report of the Master Mechanics' committee on smoke preventing devices for firing up locomotives at terminals. The committee strongly favored filling up locomotive boilers with hot water previous to firing up, the temperatures reported varying from 110 degs. F., to over 200 degs. F., the higher being preferred on account of aiding combustion and lessening the time required to raise steam. Fans were referred to as a means of producing draft in the smoke jacks but not generally approved of. Almost every combination of wood, fuel oil, shavings, corncobs, coke, and bituminous coal had been experimented with. Coke was not approved of because the ashes and gases were more objectionable than smoke, especially near viaducts or high buildings, and the cost of coke also adds to its disadvantage. Bituminous coal, carefully added to a wood fire, was approved of, the coal to be added after the temperature in the fire-box had been somewhat raised. The committee acknowledged that while it is possible to reduce the amount of smoke emitted during the period of firing up a locomotive, there is no practical way known at present whereby it may be entirely eliminated.

Cylinder Lubrication.

Considerable interest was manifested in the report of the committee on lubrication of locomotive cylinders to the Master Mechanics' Association, of which Mr. C. H. Rae was chairman. As is well known, a number of enterprising manufacturers have made important changes and improvements in the devices and methods used in cylinder lubrication in recent years. These were necessitated by the increase in steam pressure, the gradual adoption of superheating, and the new problems presented by the Mallet and other compound locomotives. The committee was assiduous in its work of making extensive inquiries in order to secure answers to the questions submitted to it. The answers were unanimous in expressing the fact that there is no serious difficulty now experienced in lubricating modern passenger and freight locomotives with the latest types of lubricators of the hydrostatic-feed type. The automatic steam-chest choke plugs, which feed against a constant boiler pressure in the oil pipe, and not against a pressure that fluctuates with pressure in steam chest, was commended by the committee as an assurance of a high degree of efficiency in the lubricator.

A number of experiments were referred to where mechanically operated lubricators had derived their motion from driving cranks, eccentric rods, Walschaerts links and other movable parts, but the committee approved of the action of the oil pumps being independent of the moving parts of the locomotive. A separate cylinder feed was recommended when working with full throttle and long cut-offs in the case of locomotives using superheated steam, as also was one feed to each end of valve in valve chest. The stop-feed feature was also approved of. The committee strongly recommended a continued active interest on the subject.

Locomotive Safety Appliances.

On March 13 last the Interstate Commerce Commission issued an order concerning safety appliances to be introduced upon locomotives, which has kept a committee of the American Railway Master Mechanics Association remarkably busy preparing a report which will help to prevent railroad companies from violating the law relating to safety appliances.

The new requirements relate largely to hand holds and steps, standards of dimensions and location having been established by the Commission. We notice that the Vanderbilt type of tender receives special attention. All locomotives must in future be equipped with automatic couplers. An unusually sensible provision is made in the case of couplers, a total variation of 5 per cent. in the specified dimensions being permitted to provide for the usual inaccuracies of manufacturing and for wear.

We advise the heads of railway mechanical departments to provide themselves with copies of this report as it puts the new requirements in very comprehensible form.

Sizes of Piston Rods and Crossheads.

An interesting report was presented to the Master Mechanics' Association by the committee on formulæ for diameter of piston rods and size of crossheads for locomotives, of which Mr. J. A. McRae was chairman. The report embraced drawings and tables, illustrating the forms and dimensions of the parts, from which it may be stated that the committee approve of piston rods having an enlarged fit in piston and crosshead, the ends to be approximately ¼ in. greater in diameter than the body of the rod. The sizes of cylinders and the steam pressure were given and the corresponding sizes of piston rods to correspond, were attached. The cylinder dimensions ranged from 16 ins. in diameter to 25½ ins., the necessary piston diameter being placed at 2¾ ins., at 180 lbs. pressure and 3 ins. at 200 lbs. In the case of cylinders having a diameter of 25 ins. the piston should measure 4¼ ins. at 180 lbs. pressure and 4½ ins. at 220 lbs. The intermediate dimensions were in a corresponding ratio to the size of cylinders and the steam pressure.

The report recommended that the center part of crosshead fit of the piston rod be reduced 1/32 in. in diameter, so as to insure having bearing at ends of fit only. The dimensions of the crosshead hubs for cast steel crossheads of the alligator type were given and vary from 5¾ ins. to 7½ ins. in length by 6 ins. to 8½ ins., according to the variations in sizes already given. The dimensions are presented on an allowable working fiber stress in tension of 9,500 lbs. per sq. in.

M. C. B. Reports

Train Pipe and Steam Heat Connections.

The M. C. B. committee appointed to consider the subject of train pipe and connections for steam heat, of which Mr. I. S. Downing was the chairman, brought in a report in which they said that in the report of this committee last year they advised the following recommended practices be advanced as standard: Two-inch train line, location of steam train line, signal and brake pipe, as shown on M. C. B. Sheet Q. of the M. C. B. proceedings; end train-pipe valves, length of steam hose from face of couplet gasket to end of nipple. These recommendations, it was pointed out, have been Recommended Practices since 1903, and in view of this the committee felt justified in recommending that they be advanced to standards. The committee again recommended the 2-in. train line, end valves and location of pipes. The latter recommendation was changed so as to show the dimensions taken from center line of car, instead of center line of couple shank. The nipple recommended last year was again recommended.

In regard to steam hose the committee stated that the present recommended practice is 1⅝ ins. diameter. They found a few roads are using hose larger than 1½ ins., and they believed there would not be any great hardship in adopting 1½ ins. inside diameter as recommended practice in place of 1⅝ ins.

The committee did not feel that they could report on a coupler at this time, but they recommended for adoption as standards the following:

1. Two-inch train line. 2. End valves, with not less than 1½-in. openings. 3. Location of steam, air and signal pipe.

They recommend for adoption as recommended practice the following: 1. Nipple, as shown in print. 2. Steam hose, five-ply, 1½ ins. inside diameter, 25 ins. long. 3. Hose clamp, as shown on print. 4. Each end of hose to be fitted with nipple, as shown on print. 5. Coupler to have not less than 1½-in. opening. The horizontal elevations of nipple to opening through coupler is, minimum, 15 degs.; maximum, 20 degs. Coupler to be tapped with 1½-in. pipe thread, as shown on print. All these prints were reproduced and will appear in the M. C. B. proceedings.

It was further recommended that the manufacturers of steam-hose couplers be asked to appoint a committee to act jointly with a committee of the M. C. B. Association, to report at the next convention on the contour lines of a coupler that will make it interchangeable.

Freight Triple Valves Test.

The committee of the M. C. B. Association having in hand the revision of the code of tests for freight train triple valves brought in a very full and detailed report. Mr. A. J. Cota was chairman of this committee. We are able to give some extracts from this valuable report. First comes the conditions of the tests, and under that heading the committee considered the construction of the rack, stating that triple valves should be tested on a rack representing the piping of a 100-car train. All cocks, angles and connections will be as nearly as possible identical with those in train service. The rack should conform to blue print specified as in the hands of the committee, which gives the proper fittings, piping, cylinders, auxiliary reservoirs, main reservoirs, automatic brake valves, etc. The main reservoir capacity should be approximately 57,000 cu. ins.

The capacity of each auxiliary reservoir should be such as will, with a pressure of 70 lbs., produce 50 lbs. pressure in its brake cylinder when fully equalized in service application with 8 ins. piston travel.

The air supply should come from a locomotive type of air compressor having a capacity of from 80 to 120 cu. ft. of free air a minute. The compressor to be controlled by a single-top pump governor adjusted to maintain 110 lbs. main reservoir pressure. Brake-pipe pressure to be 70 lbs., except when otherwise specified. With brake-pipe and auxiliary reservoirs charged to 70 lbs., the section of branch pipe between the cut-out cocks and triple valves, also the triple valves, should be tested with soap suds and leakage eliminated.

Branch pipe cut-out cocks should then be closed and brake valve placed on lap position; brake-pipe leakage should then not exceed 2 lbs. a minute. All tests shall be made with 8-in. piston travel, except when otherwise specified. The auxiliary reservoirs, brake pipe and brake cylinder of the 1st, 25th, 50th, 75th and 100th brakes shall be fitted with test gauges. Tests shall be repeated three times under the same general condition, a record being taken of each test, also the average result of each three tests. The room temperature at the time of the tests shall be recorded, also humidity. The essentials of a quick-action triple valve are: first, charging; second, service application; third, graduation; fourth, release; fifth, quick action.

When considering individual triple-valve tests, the report said, not less than three triples, selected at random, shall be tested, as follows: With the triple valve cut out at the branch pipe cut-out cock; the auxiliary reservoir empty; and 90 lbs. brake-pipe pressure maintained, the triple valve should be cut in. Under these conditions the auxiliary reservoir should be charged from 0 to 70 lbs. in not more than 90 nor less than 70 seconds. When triple is in normal release position, the auxiliary reservoirs should be charged from 0 to 70 lbs., in not more than 60 and not less than 40 seconds.

The report then deals with service application tests to determine the sensitiveness to service application. Then follows the graduating test, the holding test, the release test and the emergency application tests, the latter to determine sensitiveness to quick action. The same sequence of tests is followed on the rack with the 100 freight triple valves cut in.

Train Lighting.

The M. C. B. committee on train lighting, of which Mr. T. R. Cook was chairman, made their report on this subject. They stated that they had sent out a circular of inquiry under date of December 17, 1910, asking for recommendations as to any changes, additions or corrections in recommended practice and any other points which the members desired the committee to take action on. They received a large number of replies and carefully considered these replies and desired to change their suggestions as to recommended practices given in the report of 1910 to read as follows: That where train line connectors are used, Gibbs' No. 3-G Train Line Connector be used with connections to the battery, dynamo and jumper.

The following was added to Article 2: "If only two wires are used, they shall be connected to the two outside terminals and the female connector on each end of car shall be stenciled 'Not For Use on Head End System.'"

5. That each electrically lighted car shall be provided with two charging receptacles with swivel supports, installed one on each side of the car, the outside angular ring to be the positive.

7. That each electrically lighted car shall be provided on the switchboard in the car, a switch, fused switch, fuses or terminals. The switches, fuses or terminals to protect and completely disconnect the following parts: (a) Train line (where line is used). (b) Battery. (c) Axle dynamo (where axle dynamo is used).

The following has been added to Article 7:

"The positive terminal to be on the right side facing board," also the word "terminals" was added in addition to the words switch, fused switch or fuses.

11. The following voltages should be used:

Sixty volts for straight storage, head end and axle dynamo systems.

Thirty volts for straight storage and axle dynamo system.

The following was added to Article 11:

"The word nominal was added after volts."

12. That the batteries should be preferably installed in double compartment tanks. That battery boxes shall have provided in each door a vent. The word "preferably" was added and the words "as per detailed dimension and design" changed to read "substantially."

Articles 13, 14, 15, 16 and 17 have been added, and are as follows:

13. That the battery boxes shall have provided in each door a vent.

14. That when facing the end of the truck on which axle generator is mounted, the pulley or sprocket shall be on the hight-hand side.

15. That the rules of fire underwriters shall cover all car wiring.

16. That all wiring under car to the switchboard shall be run in conduits.

17. That a straight pulley seat be provided for the axle pulley. That if a bushing or sleeve be used it must be secured to the axle independent of the pulley. Bushing to have an external diameter of 7½ ins. and to be 8½ ins. long, turned straight. That the pulley hub have a uniform internal diameter of 7½ ins., the length of the hub to be 6½ ins., the face of the pulley to be 9 ins. or wider if flangeless, and 8 ins. if flanged.

Contour of Tires.

The report of the Committee of Contour of Tires, of which Mr. W. C. A. Henry was chairman, presented a report approving of the contour of tires already adopted by the M. C. B. Association in 1909, and which is now being generally used for engine-truck and tender-truck wheels. Some roads have already adopted this contour for flanged driving-wheel tires as well. This was approved by the report as desirable for all flanged wheels under locomotives and tenders for the same reason that it is desirable for car wheels, besides the advantage of general uniformity.

In general use there are practically only two widths of flanged tires—5½ ins. and 5¾ ins.—the large majority being the former. In plain tires the prevailing widths are 6 ins., 6½ ins. and 7½ ins. The prevailing limit of wear of tread or channeling for all wheels under locomotives and tenders is ¼ in. for locomotives in road service, and 5-16 of an in. for locomotives in shifting service. The maximum height of flanges approved of is 1½ ins.

The report closed with a reiteration of the recommendation to adopt the practice in regard to steel and steel-tired wheels that has already been formulated and approved by the M. C. B. Association.

Prices for Labor and Material.

The special M. C. B. committee, of which Mr. F. H. Clark was chairman, dealing with the subject of Prices for Labor and Material, in connection with all-steel and composite cars for the M. C. B. Rules of Interchange, did not think it advisable to make any radical changes in the way of submitting prices for repairs to individual parts, on account of it being impracticable to designate the extent of damage to the individual part on the various classes of cars, or establish a stipulated amount to make necessary repairs, for the reason that there are various parts of cars slightly damaged, which do not interfere with the safety for service or impair the strength of the car. On this account the committee considered that where it may be found necessary to make extensive repairs, the rules as now recommended to be changed on the rivet basis, hourly labor charges and material prices will cover all requirements in making necessary repairs to this class of equipment for the present.

The recommendations of this committee are as follows: Eliminate all present rules on page 58 of the 1910 Code of Rules, with reference to repairs to steel cars, and substitute the following: All rivets ½-in. diameter or over, 12 cents net per rivet, which covers removal and replacing of rivets, including removing, fitting, punching or drilling holes when applying patches or splicing and replacing damaged parts, not to include straightening. All rivets ¼-in. diameter and less than ½-in. diameter, 7 cents net per rivet, which covers removal and replacing of rivets, including removing, fitting, punching or drilling holes when applying patches or splices and replacing damaged parts, not to include straightening.

Straightening or repairing parts removed from damaged car, 60 cents per 100 pounds. Straightening or repairing parts in place on damaged car; also any part that requires straightening, repairing or renewing, not included on rivet basis, 24 cents per hour. Paragraph showing steel-scrap credits to be eliminated from Rule No. 111, on page 58; also Rule No. 107, on page 51, to be eliminated, and charges and scrap credits shown in Rule No. 104, on page 51, changed to read as follows: Steel, plate and structural, per pound, charge .03, credit .00½. Steel, pressed and flanged, per pound, charge .04½, credit .00½.

In making repairs to cars on a rivet basis, the cost of removing and replacing fixtures not secured by rivets, but necessarily removed in order to repair or renew adjacent defective parts, should be in addition to the rivet basis; rules covering wood-car repairs to govern. Paint applied, one-quarter-hour labor to be allowed per pound of paint applied and on the basis of Rule No. 105.

M. C. B. Standards.

The committee of the M. C. B. Association charged with the duty of advising on the revision of the standards and recommended practice of the association, of which Mr. R. L. Kleine is chairman, went into this important subject very thoroughly, and although a number of suggestions were made and all were most carefully considered, only a few changes have been recommended in the standards. Some of these are presented below. In the matter of journal box and details, the report says: A member suggested the following:

Journal boxes for the heavier capacity equipment are being made of pressed and cast steel, and in order that the standards may be up to date, the following changes in the notes on Sheet 11 are recommended: Section of box may be made either circular or square below the center line and material may be cast iron, malleable iron, pressed steel or cast steel; provided all the essential dimensions are adhered to. When journal box is made of material other than cast iron, reduction in thickness of metal and coring to lighten weight is permissible, provided all the essential dimensions which affect interchangeability and the proper fitting of contained parts are adhered to.

The committee concurred in these recommendations, and suggested that they be referred to letter ballot.

Dealing with suggestions concerning axles, the committee was not in favor of having more than one limit for the minimum diameter to which the journal and wheel seat may be worn, as this would lead to too much confusion in the shops. It was thought that without increasing the present number of axles and without changing the minimum diameters of journal and wheel seat, the present table of capacity markings for cars could be so amended as to permit variations in the capacity markings of the cars (minimum variations 5,000 or 10,000 lbs.) by adding to the table the maximum load for which the representative axles were designed, and by deducting from this maximum load the light weight of the car and the overload of ten per cent., which would give the correct capacity to be stenciled on the cars.

Dealing with air brakes, a member suggested that to conform to U. S. Safety Appliance Standards the paragraph referring to hand-brake chain should be changed to read: "Brake chain shall be of not less than ⅜ in., preferably 7/16 in., wrought iron or steel, with a link on the brake-rod end of not less than 7/16 in., preferably ½ in., wrought or steel, and shall be secured to brake-shaft drum by not less than ½-in. hexagon or square-head bolt. Nut on said bolt shall be secured by riveting end of bolt over nut." The committee approved of this recommendation.

Several recommendations regarding label for air brake hose were considered, and one of them was recommended. The report said: This matter should be referred to letter ballot for adoption as recommended practice.

In the matter of safety appliances, a member suggested to adopt recommended practice for brake details shown on Interstate Commerce Commission as follows: "Brake wheels both flat and dished 15 ins. and 16 ins. diameter, brake ratchet wheel, brake ratchet-wheel pawl and brake ratchet-wheel pawl plates," also a number of members suggest that the text and sheets be revised to conform to Interstate Commerce Commission requirements.

The committee approved these recommendations and suggested that the U. S. Safety Appliance Standards, adopted March 13, 1911, by order of the Interstate Commerce Commission, be substituted for the present standards.

Concerning height of couplers, a member suggested the following: We would recommend that the paragraph reading, "The standard height of couplers for passenger equipment cars is 35 ins. from top of rail when car is loaded," be modified to conform to the Safety Appliance Act of March 2, 1893, No. 113, amended April 1, 1896, which reads as follows: "Note—Prescribed standard height of draw bars; standard-gauge roads 34½ ins.; narrow-gauge roads 26 ins.; maximum variation between loaded and empty cars 3 ins." in other words, the standard height of 35 ins. specified for passenger cars should be changed to 34½ ins. Also in the second paragraph we should add a clause to cover the standard height for narrow-gauge cars to be 26 ins., minimum 23 ins., and on two-feet gauge railroads maximum height 17½ ins.; minimum height 14½ ins. The committee suggests that the text be modified to conform to the order of the Interstate Commerce Commission dated October 10, 1910.

These form the principal items of the report in which the committee concurred with suggestions made by members of the association. Some of the principal recommendations concerning recommended practice will be found in another column of this issue.

Rules for Loading Material.

The report of the M. C. B. committee on the loading of material on cars, presided over by Mr. A. Kenney, practically contained no recommendations for changes in the present rules for loading material, except to correct some errors, for the most part typographical, that were made in the last issue of the rules. This conclusion was reached as the result of the few subjects for change that have been presented during the year, and the committee also said that this was in order to give every one handling the rules more time and better opportunity to make up their minds what changes are really necessary.

They then directed attention to Rule 26 of the 1910 Revision of the Rules for Loading Material. In the 1910 issue rule 26 provides for the exclusive use of metal spacing blocks. They point out that last year it was decided to continue the use of rule 26 in its old form, that is, making the use of metal or wooden blocks optional. The committee believed it was a mistake allowing rule 26 to go into the new issue of the rules in its modified form. The rule should read: "The cars must be jacked apart by placing one jack on each side of the coupler, separating the cars until the couplers are pulled out to the fullest extent, inserting hardwood or metal blocks (latter preferred) to completely fill the space between the horns of coupler and end of sill, and coupler release-rod chain disconnected.

Another group of rules governing the

loading of rolled material of small sectional area, rules Nos. 98 to 103, inclusive, was considered by the committee and they reported that the suggestion had been made that there was necessity for distinction in the use of center binders on loads of flexible material, pointing out those loads requiring center binders and those which do not. In fact, they said it has been intimated that it might be more advisable to confine the use of center binders only to the loading of small angles, channels and I-beams, and possibly setting a limit for sizes of this material which would require center binders.

The committee further said that there was one suggestion to more clearly bring out the grouping of the rules governing the loading of material of small sectional area, by inserting the subheading, "Single Loads," before the rules governing single loads, and the subheading, "Twin or Triple Loads," before the rules governing loads on two or more cars. This they believe, if done, would make the group of rules a little clearer.

Again the committee pointed out that it has been suggested that possibly Rule No. 121, governing the loading of cylindrical boiler shells and tanks, be studied with a view of reducing the height of side blocking to a minimum consistent with safety. This would require more information than the committee had obtained, therefore the said rule should remain unchanged for the present.

The remaining topic was the correction of several typographical errors in the last issue of the rules. These were given in full and occupied nine paragraphs.

Car Wheels.

One of the most important subjects with which the M. C. B. Association dealt at the recent convention was the report of the committee on car wheels, of which Mr. Wm. Garstang was chairman. The committee it appears had worked jointly with the committee representing the Association of Manufacturers of Chilled Car Wheels, on subjects relating to or affecting the efficiency of the cast-iron wheels, and in an appendix to the report, a communication from the Manufacturers' Association is presented. The point brought out by the Manufacturers' Association is, that under present conditions with high-braking pressures, the limiting factor for each weight of wheel is the temperature stresses set up on account of the rapidity with which heat is generated on the surface of tread of the wheel by heavy and continuous braking.

As the present tendency is toward increased braking pressure, it was thought possible that the present weights should be raised, particularly for wheels used under cars of high tare weight, such as refrigerator cars of 60,000 lbs. marked capacity, for which at present the standard 625-lb. wheel is used.

The committee had been called upon to take up as additional work recommendations in the 1910 report, bearing on diameters of steel and steel-tired wheels in connection with coupler heights, efficiency of brakes, with respect to angularity of hangers and clearances necessary to provide adjustments. The report went on to say:

In deciding upon the minimum diameter to which all-steel or steel-tired wheels should be worn, the question of maintaining a draw-bar height or not less than 31½ ins. 1. Lining under center plate and side bearings. 2. Blocking under spring seat. 3. Lining on top of journal box.

The first-mentioned method can only be used to a limited extent where detachable center plates and side bearings are used. The second method can be adopted in cases where the clearance between the top of the bolster and truck frame is sufficient to allow for wear of journals and bearings and for necessary reduction in the diameter of the wheels. The third method can be used on most trucks except such as have the boxes cast solid with the frames.

Coming to the matter of gauges and limits, the committee recommended that as at present, three standard gauges are shown on sheet No. 16 Standard Practice, M. C. B. Proceedings, 1910, one for mounting, one for inspecting and one for checking wheels, and as these gauges are all slightly different, they are confusing to the shopmen, and it has been proposed that one gauge be used in place of the three gauges.

It was recommended by the committee that the wording of rule on wheel mating be changed to the following: "In no case should two new wheels be mounted on the same axle when the thickness of the two flanges together will exceed the thickness of one normal and one maximum flange, or 2 17/32 ins."

Dealing with the 625-lb. wheel, a slight reinforcement in the rim was recommended by moving the radius, which is 1 5/16 ins., 1/16-in. toward the center of the wheel, the object of which is to improve foundry condition in drawing the pattern from the sand. Also, the fillet in the acute angle of bracket and tread to be increased to ⅜-in. in order to allow the pattern to be drawn from the mold without breaking down the sand.

A slight reinforcement in the rim of the 675-lb. wheel by moving the radius, which is 1 3/16 ins., 1/16 in. toward the center of the wheel, in order to improve foundry condition, and the fillet in the acute angle of bracket and tread to be increased to ⅜ in. in order to allow the pattern to be drawn. Also, change the radius of the intersection of front plate from 2 ins. to 3 ins. to correspond with the 625-lb. wheel.

In the 725-lb. wheel a slight reinforcement in the rim was recommended by moving the radius, which is 1⅛ ins., ⅛ in. toward the center of the wheel. Also the fillet in the acute angle of bracket and tread to be increased to ⅜ ins.

Increase the thickness of the brackets at the base from 1 5/16 ins. to 1⅜ ins.

Concerning the steel and steel-tired wheels for freight service, the report said: It is recommended that the diameter for all new steel and steel-tired wheels for freight cars be made 33 ins., and for high-capacity freight cars built in the future and likely to be equipped with steel wheels, it is recommended that provisions be made in the construction of car and trucks to permit the use of wheels varying in diameter from 33 to 30 ins.

Recommended Practice.

The M. C. B. committee on revision of standards and recommended practice, of which Mr. R. L. Kleine was chairman, made a full report on the subject. We have, however, given a synopsis of the report on standards in another column of this issue and we here subjoin a few of the principal remarks of the committee on recommended practice. In the first place, dealing with journal box and pedestal for passenger cars for journals, 5 by 9 ins., a member suggested that Sheet M. C. B.—A, passenger journal box for 5 by 9 in. axle, be advanced to standard, and the committee recommended the following: (a) Sheet A, 5 by 9 in. passenger journal box, change mouth of box and dust-guard opening to conform to freight box and advance to standard. (b) Pedestal for 5 by 9 journal box shown on Sheet B be advanced to standard.

A member suggested that the axle shown on Sheet M. C. B.—B should have the radius for fillet between the dust guard and wheel seat ¾ in. instead of ¼ in., so that it may be turned with the same tool as the journal and wheel seat fillets and to conform to standard axles shown on Sheet M. C. B. 15. The committee concurred in this recommendation.

Recast Iron Wheels.—A member suggested that the recommended practice for cast-iron wheels for 60,000, 80,000 and 100,000-lb. cars be advanced to standard. The committee believed that the specifications for cast-iron wheels should be advanced to standard, but before doing so should be referred to the wheel committee for any changes or corrections that might be necessary.

Relative to steam and air line connections, a member called attention to air-brake hose, Sheet M. C. B.—Q, being shown as 1 by 22 ins., while specifications for standard hose, Proceedings 1910, page 708, paragraph 6, shows that the inside diameter must not be less than 1⅜ ins. The committee concurred in the recommendation that air-brake hose must be 1⅜ ins. inside diameter. A member called attention to the angle at which angle cock under car ends is set on Sheet M. C. B. 18, being 30 degs. from the vertical, while on Sheet Q it is shown vertical, and recommends that 15 degs. from the vertical be made standard for freight and passenger cars. The committee recommends that the angle cock shown on Sheet Q be changed to show 30 degs. from the vertical.

A member suggested that the uncoupling attachments should be changed to conform to Interstate Commerce Commission requirements also. A member suggests that this be advanced to standard in so far as all clevises and links are concerned, but not the uncoupling lever and attachments, on account of their not being applicable to all of the present equipment. The committee recommends to advance to standard the clevises, links and pin now shown on Sheet C, to include Plate B and text governing the uncoupling levers of the U. S. Safety Appliance Standards, adopted by order of the commission, dated March 13, 1911, in the standards of the association.

A member suggested that the yoke for the twin spring gear, yoke for tandem spring gear and yoke for friction gear be advanced to standard. The committee concurred in this recommendation. Re the drop-test machine.—A member suggested that the drop-test machine for M. C. B. couplers and knuckle pins be advanced to standard. The committee concurs in this recommendation.

A member suggested that door-hasp staple, shown on sheet M. C. B.—F, be increased in length from 5⅜ ins. to 16 ins., to provide for four bolts for fastening staple to door. The present hasp staple, he said, causes trouble, due to pulling through the wood on account of insecure fastening. The committee approved this suggestion.

Refrigerator Cars.

The M. C. B. committee on refrigerator cars, of which Mr. M. K. Barnum was chairman, was instructed to investigate and report on three separate questions, as follows: 1. The uniform height of refrigerator cars from the rail to the floor. 2. Adoption of standard drip cup for refrigerators. 3. Relatively small ice tanks.

On the first subject the committee found that a large majority of the refrigerator cars built within the last ten years or more have the height of floor varying between 48 ins. and 50 ins. above the rail, but the Santa Fe Refrigerator Dispatch has some 6,000 cars with floors approximately 46½ ins. above the rail. They found also that all freight-house platforms of the largest roads and packing-houses vary in height from 42 ins. to 46 ins. above the rail. The American Railway Engineering and Maintenance of Way Association has not yet adopted any standard height for freight-house platforms. In view of these facts the committee suggest that the M. C. B. Association adopt a minimum of 48 ins. as the recommended practice for refrigerator-car floors, and that the matter be taken up with the American Railway Engineering and Maintenance of Way Association with the view of having them adopt 40 ins. as the maximum height of freight-house platforms.

Referring to standard drip cup for refrigerators, the committee state that they have not yet been able to find any drip cup which will meet all the requirements, they are difficult to meet in full, but the committee will continue to investigate.

Dealing with relatively small ice tanks, the committee say refrigerator cars may be divided into two general classes, fresh-meat cars and fruit and dairy cars. The best and most modern refrigerators are provided with ice tanks which have proved amply large. Fresh-meat cars use crushed ice and salt, and a total capacity of 5,000 lbs. a car has been found ample for all ordinary service conditions; the committee recommended that tanks of 5,000 lbs. ice capacity be adopted as the minimum for such cars. For fruit and dairy refrigerators a minimum of 3,000 lbs. per tank, or 6,000 lbs. a car, was recommended. Old cars which had ice tanks too small are rapidly disappearing from service. There seems to be no present necessity for increasing the outside length of the car beyond 40 ft., the present size of the largest refrigerator car.

New P. R. R. Booklet.

Probably more elaborate than any piece of farming literature ever issued by a railroad is a book entitled "Increase the Crop Per Acre," which the Pennsylvania Railroad Company is to distribute throughout the territory traversed by its lines. The book, which describes the use of explosives in farming, has thirty-six full-page and seventeen part-page illustrations. With this latest addition to its agricultural literature the Pennsylvania Railroad now has on hand for distribution eleven pamphlets.

"Increase the Crop Per Acre," in 112 pages, tells of the many economies which may be effected on a farm by the use of dynamite. The first chapter describes methods of clearing the land; the next, getting the farm in shape; then, preparing the land for crops, and last, keeping up the farm. Among the subjects treated in the Pennsylvania's dynamite booklet are blasting stumps and boulders, felling trees, draining swamps, grading roads, sinking wells and digging post holes, blasting hardpan and other soils, breaking up ice gorges, starting log jams, etc.

In closing, the management says: "What does it all mean to the railroad? It means there will be more fertilizers to haul, more farm implements, more raw material from which these tools are made, more crops to haul, and more passengers to carry; it means that the railroad will be doing its duty to the public, to its stockholders in the intelligent exercise of its initiative, and, when reduced to a finality, that the railroad is performing its share of the work which must be done by the newly formed partnership, railroad and farmer, if agricultural communities are to progress and prosper."

Good Order for the G. E.

Messrs. Libbey & Dingley have placed an order with the General Electric Company for the equipment of the Portland, Gray & Lewiston Railway. This road will run from Portland to Lewiston, Me., and is of unusual interest in that wherever possible curves have been eliminated and no pains will be spared to make it an exceptionally high grade installation. For its entire length of thirty miles, with the exception of about one-half mile, the road is located on private right of way. There is but one grade as steep as four per cent., this grade being four and one-fifth per cent. The alignment is very straight, the radius of the shortest curve being seven hundred feet and that of the next shortest one thousand feet. The average radius of curves is about three thousand feet. A car will leave every hour on the hour from both the Portland and Lewiston terminals, every other car being express and making the run of thirty miles in forty-five minutes. The order includes 3 substation equipments each consisting of 300 kw. rotary converter, transformers and switchboard. The switchboard in substation No. 1 will consist of a 10,000 V. incoming line and transformer panel, 1 rotary converter panel, and a 600 volt D. C. rotary coverter panel. The power is received from the Lewiston & Auburn Electric Light Co., at a potential of 10,000 volts, and stepped up to 33,000 volts for transmission to substations No. 2 and No. 3. The switchboard in No. 2 will consist of an incoming line and rotary converter panel, a D. C. rotary converter panel and two 600 volt D. C. feeders. The switchboard of No. 3 is the same as that of No. 2 except that there is but one 600 volt D. C. feeder. The order also includes an equipment for a general utility car which will be used in construction work for the present. The equipment consists of a quadruple G. E. 210 car equipment with type M control.

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M. M. and M. C. B. Reports.

That the work of the American Railway Master Mechanics' and the Master Car Builders' Association is becoming more valuable year by year needs no other evidence than a brief glance at the Committee's Reports presented to the Convention this year, and which we have reviewed elsewhere in our columns. It should be borne in mind that while locomotive and car construction is largely in the hands of mechanical engineers of high training, and consequently fully possessed of accurate scientific knowledge, the real test of the constructors' art lies in the actual performance of the rolling stock, in the daily work which it is called upon to do and in the accomplishment of which the actual value entirely depends. Laboratory tests under special conditions and appliances are excellent in their way, and, as far as they go, may be relied upon, but finally it is the service test which counts.

Taking one of the reports at random as an illustration, the title of which is "Formulæ for Sizes of Piston Rods and Crossheads," every railroad man employed in the mechanical department knows that the breakage of piston rods has almost always occurred either at the point where the piston rod enters the crosshead or by a rending of the rod through the key-way where it is held in place to the crosshead. In spite of the repeated evidences of structural weakness at these points the constructors have been slow to apply a remedy and it has been left to the members of the Master Mechanics' Association through an observing and efficient committee to formulate a table of sizes corresponding to the stresses incidental to the work of the piston rod in modern locomotives. The collar on the piston where it joins the crosshead and the increased thickness of the part attached to the crosshead as well as the increased size of the part attached to the piston proper, may be much larger than the fine calculations of the mechanical engineer call for; but the constructing engineers seems to have overlooked the fact that after a locomotive has been some time in service, and lost motion has developed, the shock incident to the reversing of the piston may be much greater than their calculations included. As we have already stated, practical experience is the real test, and herein lies the great value of the reports that are being presented by the special committees year by year.

Every one of these special reports could be cited in proof of our contention, that the practical expert's opinion is not only of great value but it should be sought for more eagerly than it has been in the past, and to this end the work of the associations deserves the hearty encouragement of all who are interested in improvement in the construction of the mechanical appliances used on railways. It is gratifying to observe that at the conventions this year the selections of the various committees have been carefully made, and the subjects which have been submitted are such that a continued forward movement may be safely anticipated and the good results arising from these meetings will become more and more manifest as time rolls on.

To Prevent Flange Cutting.

Flange lubrication is a subject that has received very little attention till lately. The difficulty of wheel flange cutting has always been present on roads that work their way along by curved lines, but there has been no systematic attempt to remedy the evil until recently. When a movement is made to introduce any subject for the consideration of the American Railway Master Mechanics' Association, the character of the committee having the matter in charge has great influence on the publicity given and on the facts brought to light. A committee appointed last year to investigate the subject of Flange Lubrication appears to have been formed of the proper material, for the investigations carried out were of the most thorough character. The committee of which Mr. M. H. Haig was chairman, assisted by T. W. Haintzelman and D. J. Redding, performed services that put nearly all railroad companies under money-saving obligations.

The committee began their work by sending out a circular of inquiry, which called for the answering of fifty-one queries all relating to the cutting of wheel flanges and the means adopted to remedy the evil. The report that resulted from this line of investigation is one of the most exhaustive efforts ever submitted to the association. If there is any method or apparatus in use on American railways for preventing flange wear that Mr. Haig has not found means of describing it must be carefully hidden from the eyes of the investigators.

Flange cutting has always existed to some extent upon crooked roads, but the evil is yearly becoming greater, owing to the prevalent lengthening of engine wheel base and heavy tires becoming the rule. This condition of affairs has forced the attention of motive power officials to consider methods of lubricating the flanges by efforts to overcome the evil. The committee report that fourteen different forms of lubrication are now in use by different railways. These have been grouped according to the kind of lubricants used into the following classes: 1 crude oil; 2 engine and car oil; 3 solid lubricant; 4 water; 5 exhaust steam.

Crude petroleum and hard grease are the favorite materials in use, but we judge from the report that considerable difficulty has been experienced with all the materials and all the methods tried for lubricating wheel flanges. The results obtained however have been so valuable that railroad companies generally will feel encouraged to persevere in trying to overcome the difficulties of manipulation. The Santa Fe appears to have taken a lead in promoting methods of wheel flange lubrication.

That company have engaged in experiments covering the use of most of the simple devices, such as swabs of oil-saturated waste, water jets operated from the injectors and lubricating blocks. These have all proved to be, in some manner unsatisfactory. In using the simple swab, difficulty was found to keep it against the flange and the waste was frequently lost. When forced against the wheel with sufficient pressure to insure constant contact the pipe was rapidly worn away, sufficient heat often being generated to ignite the waste. The water jet caused clogging of the sand pipes. Water and engine oil have both proved too light to satisfactorily resist the action of centrifugal force, being thrown away from the throat of the flange before reaching the rail. It has been found that the wood block lubricator spreads oil over the tire tread and, consequently, tends to cause slipping of the drivers.

Crude oil is now in general use for flange lubrication on the Santa Fe System. Oil from the Kansas field has not been found heavy enough to properly adhere to the flange, but that from Bakersfield, California, which is now used, has proved very satisfactory.

Experience indicates that the delivery of a proper lubricant to the flange will reduce the wear of both flange and rail. The committee's information is confined largely to the results obtained by lubrication with crude oil. California crude oil contains a high percentage of petroleum asphalt. When delivered to the rail by the driving-wheel flange, it forms a thin coating of paste on the inside of the ball of the rail which does not run or spread over the top. When all engines on a division are equipped with lubricators the rails on the outside of curves will become thus coated, and friction will be reduced on all wheels passing over the track. The resulting reduction in flange wear is noticeable on both passenger and freight car wheels, but data are available for locomotive driving wheels and tender truck wheels only. It necessarily follows that train resistance is much reduced on curves.

The writer years ago had charge of a locomotive that had to work round a ten-degree curve and flange cutting became troublesome. He tried oil-saturated swabs that were hard to keep in position. Finally he used successfully blocks made of tallow and Dixon graphite. Watching flange lubricators puts serious additions to the duties of enginemen.

The Margin of Error.

A matter of very great importance with respect to the carrying out of any description of work is the margin of error. In all work, from the execution of the roughest excavation of the ground up to that entailed in the construction of the finest class of instruments, there is a special allowance for error, and features which play no small part in the efficiency or otherwise of a workman are the extent to which he is conversant with these allowances, and the degree of accuracy with which he is able to adhere to them. It is obvious, indeed, that in the carrying out of any work the most important point is to know how closely it should approach to the exact measurements of the design, in order to ensure the maximum amount of efficiency possible. This is a point, moreover, which augments in importance proportionately as the work increases in magnitude, and that the more so in cases where it is being done by contract, and carried out to specification.

A quarter of an inch, more or less, in the length of a 30-ft. beam will not be a matter of much moment. It is practically impossible for a carpenter to cut off a short length to an exact dimension, and in the case of a long length this difficulty is considerably intensified. In some cases it is found preferable to allow a rather wide margin of error rather than to spend time in endeavouring to attain to a great degree of accuracy. In the case of a fence, for instance, provided the materials, proportions, and fastenings are all satisfactory, any attempt at high accuracy would be only so much time, and consequently so much money, lost. On the other hand, however, a very slight amount of error in a mortise would completely destroy the solidity of the joint. All structures liable to be subjected to severe stresses and vibrations must be fitted with great nicety if they are to have lives of any duration. In some cases, indeed, a certain amount of crushing of the parts becomes necessary in order to reduce the chance of looseness to the lowest possible minimum; this is the case, for example, in all carriage work.

In work requiring great accuracy, such as that put into the movements of high-class clocks and watches, the margin of error should be reduced to the five-thousandth or even to the ten-thousandth part of an inch, and in this case not only are tools of the highest precision absolutely necessary, but a very special amount of skill on the part of the workman is also a *sine qua non*.

Steam Compression in Cylinders.

A certain amount of space between the end position of the piston in steam engines and the cylinder head is unavoidable, but the smaller the space is the less consumption of steam will occur on account of what is known as compression. The irregularities that occur in engine valves and which speedily lead to a compression of steam causing a higher pressure than that of the incoming steam, is of an injurious effect. Many repeated experiments have shown that an increase of the amount of piston clearance increases the consumption of steam. A moderate degree of compression in a minimum of space is accompanied with a slight improvement in the performance of the engine, but beyond this very limited degree of compression there is a marked increase in steam consumption. The loss is owing to what may be called the anticipatory condensation of the exhaust steam as its pressure and temperature rises during the period of compression.

It can be readily understood that it is more economical to reheat the walls of the cylinder by live steam than by the work of compression, because this work, being derived through a lower degree of efficiency, necessarily involves a large expenditure of heat. The ratio of loss will be in proportion to the ratio of compression to that of the live steam.

With regard to compression aiding in steadying the motion of the piston by providing a cushion to lessen the shock of the piston, which must necessarily come to a stopping point before moving in the opposite direction, it may be stated that any benefit derived from this source has been much overestimated. Those who are familiar with locomotive running while the steam is shut off will readily admit that there is no preceptible shock to the piston at the end of the stroke provided that the main rod and other attachments are in good condition. The question is one which is receiving the serious attention of engine builders and the tendency is to reduce the clearance space to the nearest point to absolute safety and the degree of compression to much less than that of the incoming steam.

Heated Bearings.

As summer and an increase in temperature approaches, the tendency of the bearings of a locomotive to become heated, increases. In addition to the greater heat of the atmosphere there is also a marked increase in the amount of dust incident to all vehicular traffic in dry, warm weather. The heavy particles of sand and other substances of an abrasive kind that rise with the dust, are apt to get in between the rubbing surfaces of the bearings. This may cause cutting of the bearing and may be impossible to discover without removing the bearing. Whatever the cause of the heating of the bearing may be, a liberal supply of oil should be applied, and if water pipes are attached, those leading to the heated box or bearing should be opened and a stream of water poured upon the heated parts.

If the heating continues, and if the trouble is in a driving box, it should be examined to see if the wedge is jamming the driving box. The slight expansion of the box and wedges, owing to the increased degree of temperature, may be sufficient to bind the box in the wedges, in which case the wedge should be slightly loosened, care being taken not to loosen the wedge too much, which may lead the way to frame breakages and other troubles, and also remembering to set the wedge up again in its proper place when the box has sufficiently cooled. If lubrication and cold water and wedge-loosening does not have a permanent effect in cooling the box, a remedy may be found in relieving the bearing of some of the load resting upon the box. Wedges should be carried on the locomotive suitably formed, so as to be readily driven in the space between the frame and spring saddle. A slight raising of the saddle will considerably diminish the weight on the bearing.

In the case of overheating the rod brasses the matter may be more readily handled, but there is an added trouble in the readiness with which babbit will melt in the brasses before any evidences of heating may have come to the notice of the locomotive engineer. Under such conditions it is generally advisable to keep the engine running until the babbitt is all melted out. Any attempt at cooling while the babbit is in the melted state rarely fails to close up the oil holes and adds to the work to be done. A loosening of the rod key and liberal lubrication generally has the desired effect, with water cooling if necessary.

In regard to the heating of eccentric straps it should be remembered not to suddenly cool a heated cast iron eccentric strap with water. The tendency to crack the strap is very great. The best method is to slacken the bolts joining the two halves of the eccentric together and insert one or more tin liners. Lubricate well, and do not move the reverse lever until the strap is fairly cooled.

The Tempering of Tools.

Every mechanic understands to a greater or less degree the science, for it is a science, of tempering and "drawing" steel tools, but in these days of specialists, when the tool dressing is largely delegated to the blacksmith, the workman in the machine room sometimes labors at a disadvantage.

The mechanic who uses the tools should understand his own requirements with their whys and wherefores, and should be able to appreciate the condition of his tools even if it is not his duty to dress and temper them.

In the old days when a machinist was more or less a jack of all trades, a machine hand made his own lathe and hand tools, but now when economy of production and the constant operation of a machine are imperative, the workman must of necessity depend upon others for this work.

The tempering of English steel and of American steel is essentially different, in that the initial heat usually required to harden a piece of English steel is of a lower temperature than that required in the case of the average American steel. We are not at this moment dealing with the self-hardening and special steels, but with the ordinary commercial article, and the best results obtained in hardening and drawing the average run of tools are as follows:

If the tool is to be made of English steel it should be worked at a low heat and drawn into shape upon the anvil, frequently applying the fire rather than to overheat in order to form in the first dressing by hammering.

Then heat to a cherry red in the dark and plunge into cold water. Immediately withdraw from the water, polish a space near the cutting end with a piece of pumice stone and watch the color turn to the various shades of straw, purple or blue, as the case may require. As soon as the temper is drawn to the desired color, again plunge quickly into cold water and allow it to remain until the tool is thoroughly cooled.

The tool is now ready to be ground and a wet grindstone is far better than any other device for this purpose, unless it may be the wet emery grinder, but a great many good tools are ruined in the sharpening by heating against a dry wheel.

The manipulation of American steel differs from that of the English only in the first color for hardening. An ordinary American steel should be hardened at a cherry red in daylight.

Of course, it is not expected that a man is to sit up at night to temper English steel, although some tools might make even that worth while, but the workman can easily lift the tool up under the hood of the forge where it is dark and there when he gets the comparison of color in the room wherein he is working, he is at once enabled to judge the proper daylight color.

It is occasionally found that water will not satisfactorily harden the tool. When this is the case, add sulphuric acid, or lye, or salt, or some of the numerous tempering compounds and the difficulty will be overcome.

Oil is used by some as a superior tempering fluid, but good oil is expensive, soon becomes foul, and really is of no special advantage except in the tempering of springs and of close-grained fine steels.

Particular attention is called to the method above mentioned for drawing the temper, and the quite common practice of allowing the tool to cool after the first plunge, is condemned for the reason that a reheating to draw the temper causes a new molecular activity, every repetition of which is detrimental to the life and tenacity of the steel.

The following table of temper drawing colors may be of interest in the study of this subect:

Tools.	Color.	Degs. Fahr.
For tuning hard metals and scaled castings	Pale straw	465
For tuning bronze and soft steel or iron	Straw	470
Lathe hand tools	Dark straw	490
Bench tools	Purple	525

The "Fatal Blue" Heat.

Every man engaged in the construction and repair of railroad machinery, and especially boilermakers, should understand the "fatal blue" heat. Many plates of iron and steel have failed through the ignorance of the workman who was not familiar with the disastrous results which may at any time be brought about by hammering or bending a plate while it showed a blue color. An actual test is easy and instructive and can be made in the following manner:

Take a piece of steel 2 ins. wide and 3 ft. or more in length, 1/4-in. or 3/8-in. in thickness. Polish the surface of the metal on the emery wheel or grindstone until it is bright for a distance of 10 or 12 ins. on one end. Hold it over a blasksmith or flange fire which is free from smoke. Move the piece slowly back and forward over the fire and watch it closely until the blue color appears over the surface of the brightened metal. Then while thus heated take the piece to the anvil and try to bend it over double. The piece will invariably break and with a degree of readiness that is surprising. The other end of the piece, which has not been heated, may be readily doubled without breaking, that is, if it be not of the very hardest kind of steel. Soft firebox steel will readily bend when cold.

The experiment will readily show that the fatal blue heat, so-called, is a point at which steel or iron should be let severely alone, and if work has to be done upon the metal it is better to attempt the operation while the steel is cold rather than when slightly heated to a blue color, and if the operation necessitates any great degree of bending it is necessary not only to heat the metal to any easy degree of ductility but to repeat the heating if necessary, and under no condition attempt alterations in the form of the metal while at or near the fatal blue heat.

Consuming Aqua Pura.

There are many curious things brought out from time to time concerning matters connected with railways which look very small when viewed in detail, but which have a totally different aspect when viewed in the aggregate. It is like the firing of a rifle, one rifle throws one bullet at a time; however short a time it take there is just one bullet. If a whole regiment fired a volley there would be the delivery of 800 bullets in the same time. With the view-in-aggregate spectacles on Mr. Harold MacFarlane in a recent number of the *Railway Magazine* gives some interesting statistics of what he calls the "railway thirst," taking some of the leading English railways as his text. For instance, it seems that the Great Western used up for locomotive consumption about 100,000 gallons of water daily, and this amount would be sufficient to flood a piece of permanent way 20 ft. wide and 800 ft. long to a depth of 1 ft.

We are told that an express locomotive pulling a heavy passenger train between Crewe and Carlisle uses about 5,500 Imperial gallons of water, or very nearly 40 gallons to the mile. On the fairly level track between Holyhead and Crewe, the same engine boiled about 35 gallons to the mile. That much water would fill a tank 3 ft. x 1 ft. x 1 ft. 10½ ins. This makes a block of water containing 3.9 cu. ft. The writer further calculates that if the average consumption of water for all the locomotives in the United Kingdom be taken at 25 gallons a mile, a lake 10½ miles long, half a mile wide and about 78 ft. deep, which is practically the size of Lake Windermere, would keep the engines of Great Britain going for about seven years.

In our issue of August, 1904, on page 343, we gave some interesting particulars of Pennsylvania Lines Atlantic type engine which served as the model for our educational chart No. 7. This, as our readers know, is a sectional drawing of engine No. 8476, in which every part is shown, named and numbered. At that time we were able to obtain from the railroad some most interesting statistics concerning the water consumption of this engine. A brake test made with practically the same engine on the New Jersey & Seashore division of the P. R. R. consisted of a run over 28 miles of good road. A measured mile of level track was fitted with electrical recording apparatus so that the speed was accurately measured.

With eight coaches a speed of 80 miles an hour was reached. The fastest speed attained was something less than 90 miles an hour. The light engine got up a speed of 95.1 miles an hour. There were two No. 11 injectors on the engine either of which can deliver about 83 gallons a minute. Where the heaviest work was done we were informed that probably 125 gallons were consumed every minute. That is about equal to 100 Imperial gallons. A cubic foot of water contains about 7.48 U. S. gallons. An ordinary bath tub in a private house when filled almost to overflowing may be roughly or on the average estimated to contain 10 cu. ft., so that at this rate of consumption the P. R. R. machine hauling eight heavy coaches at 90 miles an hour took about a bathfull and a half a minute to provide the steam at 205 lbs. to the square inch. This was before the superheating came into vogue in this country, and the figures here given, as this engine was pushed to its utmost capacity, probably included steam at the dew point, and also a very high percentage of entrained water.

Meaning of the Word Gauntry.

Some curious illustrations of the development of language are frequently seen in mechanical and engineering expressions. There is a little word, "gaun," which has undergone some curious changes. In old provincial English the word means a small tub. The frame used for lifting this tub was called a gaun-tree, another word that had wide application such as axle-tree, saddle-tree, roof-tree, swingle-tree, etc. In time the word gaun-tree became shortened to gauntry, an expression used in the Scots' dialect for the framing of a roof. Under modern practice the word gauntry has gradually come to mean the iron or steel framing used to support and operate cranes.

Book Reviews

Up-to-date Air-Brake Catechism, by Robert H. Blackall. Published by the Norman W. Henley Co., New York. 352 pages, cloth. Price, $2.

Mr. Blackall has long been looked upon as one of the leading air-brake experts in America and the appearance of a new edition of his excellent book is sure to meet with a cordial reception. The entire work is rewritten and the most recent changes and improvements in the air-brake are fully described and illustrated. The rapid changes that have been made in the devices used in air-brake mechanism are the natural outgrowth of the necessities arising from the constantly increasing weight of railroad rolling stock, and those who have copies of previous editions of Mr. Blackall's book should not deceive themselves by imagining that the present edition is the same book with a few pages added. It is literally a new work improved in manner and in method, clarified by experience and illustrated in the highest style of the art. Whether we have yet reached the limit of weight in railroad equipment may be doubted when we see each new Mallet compound exceeding the last in tractive power. All we know is that the air-brake is meeting the requirements of the hour and we would advise those who wish to keep informed fully in regard to the details of the masterly invention to procure a copy of the new edition of Mr. Blackall's excellent work.

A Pocketbook of Mechanical Engineering, by Charles M. Sames, B. Sc. 220 pages, illustrated, flexible leather. Price, $2.

A book that has passed through three extensive editions and appears in a fourth edition, revised and enlarged by having nearly one hundred new subjects added, may be taken not only as a work that has stood the test of time and met with popular approval, but is growing in favor from the fact that each new edition meets the growing requirements of the time. The book possesses several advantages that account for its popularity. It is compact in form and clear in method and luminous in the kind of information that is most essential to the work of a mechanical engineer. The classification and arrangement are so nearly perfect that there is no time lost in looking up the subjects. The tables and formulæ and descriptions have all been carefully prepared and are consequently reliable. In addition to the happy faculty of condensation the author has brought to his work a lengthened and wide experience which many learned theorists sadly lack. The paper, presswork and binding are excellent. Copies of the book may be had directly from the author, 542 Bramhall avenue, Jersey City, N. J.

Train Rule Examinations Made Easy, by G. E. Collingwood. Published by the Norman W. Henley Publishing Co., New York. 234 pages, cloth. Price, $1.00.

Train rules and train orders are so important a department of railroad operation that the author of this work has done a notable service to explain them in such a way as to make them as clear as possible. As the author states, it is not the purpose of the book to take the place of the rulings which the management of any road sees fit to make. The intention is to make the rules clear so that trainmen may be thoroughly prepared to pass an examination successfully and undertake the duties in a manner that will be creditable to themselves and satisfactory to the management. The rulings are in harmony with the most recent decisions of the American Railway Association, so that the student may rely on the correctness and safety of the interpretations in every case. The author shows a complete familiarity with the subject and the book is of real value to all who are interested in the subject of train rules.

Practical Instructor and Reference Book for Locomotive Firemen and Enginemen, by Charles F. Lockhart. Published by the Norman W. Henley Co., New York. 356 pages, cloth. Price, $1.50.

This book is a valuable addition to the works published for the instruction of firemen and enginemen generally in regard to the details of the modern locomotive. In addition to a carefully written description of the locomotive with full details of its construction and operation there is an extensive series of questions and answers in regard to the duties of firemen and enginemen. Breakdowns are treated in a brief and clear manner, showing that the author has had a wide experience as an engineer. The frequent causes of failure of the air-brakes and the remedies are also presented, and the book closes with a comprehensive review of each subject. The presswork and illustrations are excellent and the work has the rare merit of presenting a complete general description of the entire locomotive, with particular emphasis on the facts most likely to engage the serious attention of those engaged in the important duties of operating the complex machine.

Catechism of Railroad Operation

By Angus Sinclair

Questions and Answers.

Second Series.

(Continued from page 245.)

90. Under what circumstances is it proper to keep the fire door partly open when an engine is working?

A. When the fire becomes fouled by clinkers and ashes and the grates are stuck so that nothing can be done to increase the admission of air through the grates. When an unexpected call comes to shut off steam and the fire is burning vigorously.

91. Why is it necessary to carry a thicker fire in some engines than in others?

A. Engines with small nozzles and limited grate area will tear holes in a thin fire unless there is plenty of coal on the grates.

92. Is it possible to admit too much air to a fire?

A. Yes. The steam making for any train calls for a certain volume of air to be used up in combustion. If more air is used it cools the gases and tends to keep them below the igniting temperature.

93. How much air should be admitted to burn coal to the best advantage?

A. The volume of air that will make the boiler steam most freely. That may be counted on as giving the best results in the combustion of coal.

94. When the fire gets clogged up with ashes and clinkers during a long run, which is the better plan, to struggle along with dirty fire or to stop and clean the fire?

A. Much more time may be wasted struggling to make steam with a dirty fire than will be lost in stopping long enough to clean the fire.

95. Are any precautions necessary before beginning to shake the grates or to operate self-dumping ash pans?

A. Neither of these operations should be carried on when the engine is passing over bridges, cattle guards, or while crossing switches, interlocking connections, or places where fires might readily be started.

96. What is wrong when smoke trails back over the train when steam is shut off?

A. That annoying condition is due principally to heavy atmospheric conditions which prevent the smoke and gases from rising. The fireman ought to do his best to prevent the emission of smoke by following the most approved rules concerning the prevention of smoke.

CONCERNING INJECTORS AND WATER FEEDING.

97. What is an injector?

A. An apparatus employed to force water into a boiler.

98. Explain the principle upon which the injector works.

A. The action of the injector is the utilizing of the principle of induced currents to perform the work of moving water against resistance. The mechanism of the injector makes it possible to use a jet of steam to transform its high velocity to put a body of water into such high motion that it overcomes the pressure inside the boiler and keeps pouring inside the same. Two forces are represented, the pressure upon the check valve tending to resist any effort to push it away from the seat, and the water passing through the injector at high speed representing great momentum which the pressure upon the check valve is too light to resist. The scientific explanation is that static energy is overcome by kinetic force, like the quiet repose of a mill wheel being forced into motion by a rush of moving water.

99. What is the purpose of providing an injector with an overflow arrangement?

A. The overflow opening, which offers no more than atmospheric resistance, permits the water to be forced into rapid motion, thereby acquiring the momentum that enables it to force its way into the boiler.

100. What is the difference between a lifting and a non-lifting injector?

A. In a lifting injector a partial vacuum is created which raises or sucks the water from the level of the feed pipe to the level of the injector. In a non-lifting injector, the instrument is so located that the feed water will flow into its tubes by gravity.

101. What structural difference exists between a lifting and a non-lifting injector?

A. A lifting injector is provided with two tubes, one for raising the water, the other for giving it the motion which sends the water into the boiler. The non-lifting injector has not any water lifting tube.

102. What are the principal parts of an injector?

A. The principal parts of an injector are: the nozzles, which perform the functions of delivering or forcing the water into the boiler, and the operating mechanism, such as the lifting valve, steam valve, water valve and overflow valve.

103. Will an injector work with a leak between the injector and the tank?

A. A lifting injector is not likely to prime when there is such a leak.

104. Why will an injector fail to prime having a leak between the instrument and the tank?

A. Because the lifting suction tube will draw air instead of lifting water.

105. If it primes well, but breaks when steam is turned on wide, where would you expect to find the cause of the trouble?

A. In the supply of water. Would disconnect the hose and examine all its sources of water supply. The injector might prime with a limited supply of water but would break when steam was turnred on full.

106. If the injector will not prime where would you look for the cause of trouble?

A. First to the water supply. If that were found good, would look elsewhere.

107. What are the principal causes which prevent an injector from working?

A. The most common causes are: Leak in the suction pipe. Obstructed strainer or strainer too small. Coating of the nozzles by incrusting matter. Loose hose lining. Obstructions in the nozzles, such as pieces of coal or other foreign matter washed in from the tank. Obstructions in the delivery pipe, such as a sticking boiler check which will not open freely. Tank cover closed so thoroughly that air cannot enter to replace the space the water occupied. Leaky steam valve and leaky boiler, which will prevent the starting of the injector through heating the suction pipe. Hot feed water will also sometimes prevent the injector from operating.

108. Will the injector prime if the check valve leaks badly? If the injector throttle leaks badly?

A. No.

109. If steam appeared at overflow when priming valve was closed, how would you tell if the leak was from the throttle or priming valve? How would you know if the check valve was leaking?

A. Opening the frost cock, with which most delivery pipes and check valve cases are provided, will give indication if the check valve is leaking. To find out if the injector steam valve is leaking, close the valve, and that will stop the leak if the throttle was at fault.

110. Will an injector prime if primer

valve leaks? Will such a leak prevent the injector from working?

A. Leakage of priming valve will not generally prevent the injector from priming, and it will not interfere much with the action of the injector.

111. Will an injector work if all the steam is not condensed by the water?

A. The injector will work defectively and there will be some loss of water by the overflow pipe.

112. If you had to take down tank hose, how would you stop the water from flowing out of the tank that has a syphon connection instead of the old-style tank valve?

A. Would open the vent cock at top of the syphon before taking the hose down.

113. How would you prevent the injector and attachments from freezing during severe frosty weather?

A. Would keep the steam valve of the injector slightly open to induce a slight circulation of steam through the feed and delivery pipes. The drip cocks in the branch pipes should be kept open to permit passage of the steam through these pipes and the heater cock should be closed.

114. How would you prevent the waste pipe of an injector from freezing while the injector is shut off?

A. By keeping the overflow valve slightly open to permit some steam to escape through the overflow pipe.

115. What should be done if a combining tube is obstructed?

A. The most expeditious manner to deal with an obstructed combining tube is to take the injector apart and remove the cause of trouble.

116. How may it be determined if trouble is caused by a leak in the suction pipe?

A. When the suction pipe leaks, the injector works with a hoarse, rumbling sound, caused by air being drawn through the leaks. A leak in the suction pipe may also be identified by closing the tank valve, opening the steam valve of the injector slightly with the heater cock closed. If any leak exists in the suction pipe, steam will blow through the leak.

117. What should be done in case of an obstructed hose or strainer?

A. Connection between the hose and strainer should be broken, and water allowed to flow through the open hose, when the obstruction is likely to be washed out. In most cases it will be sufficient to remove the waste cap.

118. Is there any advantage in heating the feed water in a locomotive tender?

A. There is. The heat put in the feed water is saved in the work of steam making.

119. Can you tell what amount of heat saving results from heating the feed water?

A. Experiments have shown that a locomotive will generate one per cent. more steam for every 11 degs. of heat put into the feed water. Should the feed water be raised from 56 degs. to 100 degs. Fahr., there will be a saving of 4 per cent.

120. Why is so little done in locomotive practice to heat the feed water by the steam so profusely blown away through the safety valves?

A. Because feed water raised above 100 degs. Fahr. can seldom be operated by an injector. Where arrangements have been in use to blow the waste steam into the tank, the water frequently got overheated, causing train delays that wasted more than the hot water saved.

121. What should be done when the water in the tank gets too hot to be worked by the injectors?

A. It will be necessary to obtain a supply of water to reduce the temperature.

122. When a boiler is foaming is more water used than when the steam is dry? Why should there be any difference?

A. When a boiler is foaming, the steam that does the work of moving the engine and train, is more or less mixed with water that has not been converted into steam. A mixture of water and steam contains more water than steam alone.

123. What should be done when a boiler is found to be foaming?

A. The blow-off cock should be used freely.

124. What is meant by the heating surface of a boiler?

A. The heating surface of a boiler is the parts covered with water over which the fire gases pass. Heating surface is generally the firebox inside sheets and the flues. When a brick arch is supported by tubes these also form heating surfaces.

125. What is generally the cause of failure of the second injector? What is the remedy?

A. Want of use, which causes the various parts to become incrusted with lime, which makes the movable parts sticky. Frequent use is the proper way to keep the second injector in working order.

126. How should an injector be started?

A. In starting a lifting injector, the lifting valve should be opened first, and when the water appears at the overflow, the forcing valve of the injector should be opened gradually to its full extent. In starting a non-lifting injector, the water should be admitted to the injector first, and when it appears at the overflow, the steam valve should be opened gradually to its full extent.

127. How should an injector be stopped?

A. The steam valve should be pressed gradually but firmly on its seat, avoiding the closing of the valve by a sudden shock which is liable to injure the valve and its seat, and has a tendency to loosen these seats when they are inserted in the body of the valve.

The Heat Unit or the B. T. U.

The unit of heat on British thermal unit equals the quantity of heat necessary to raise the temperature of 1 lb. of pure water 1 deg. on the Fahrenheit thermometer when the water is near the maximum of density. Assuming water to be at 39 degs. Fahr., one thermal unit will raise the temperature of the water up to 40 degrees. In order to know what effect this unit of heat would produce on any other substance, it is necessary to find its relative capacity for heat, commonly called the specific heat of the substance. The specific heat of air as compared with water is 23.75, water being rated at 1. It will thus be seen that one thermal unit will raise the temperature of the atmosphere more than four times that of water. The value .48 is in the same manner the specific heat of steam, or the quantity of heat necessary to raise 1 lb. of steam, considered as a gas, 1 deg. Fahr. Mercury and lead among the metals have very low co-efficients. One thermal unit will raise the temperature of mercury 30 degs. and lead 34 degs. Fahr.

How Cars Round Curves.

Many people are puzzled as to how a car truck with four wheels held in axle boxes manages to round curves without jumping the track. Here is an explanation given by a mechanical expert:

"The two axles of a car must be capable of all manner of motions with reference to each other. As a car rounds a curve the two axles must tend to take a position somewhat radical to the curve instead of parallel to each other. Railroad tracks are never in a true plane and the action of the two axles with reference to each other as the car proceeds over the inequalities of the track, is as if two mighty giants, each at one end of the car were seeking to twist the car into the form of a rope. The movements of the car axles are small, but of almost irresistible power. If the two axles of a car were mounted unyieldingly with reference to each other, the car would be hammered out of shape, past all possibility of maintenance. Therefore, the two axles of a car are always arranged for perfect freedom of motion with reference to each other, and care is taken that the rigidity of the car body shall not negative the desired conditions."

The new series of illustrated post cards issued by the Locomotive Publishing Company, 3 Amen Corner, Paternoster Row, London, are the best that that enterprising company has issued. There are twelve cards in the set, each showing in rich coloring a separate type of British locomotive.

Air Brake Department

Conducted by G. W. Kiehm

Air Brake Convention.

The eighteenth annual convention of the Air Brake Association was called to order in the convention hall of the Auditorium Hotel, Chicago, Ill., Tuesday a. m., May 23, with the president, Mr. T. L. Burton, in the chair. After the opening prayer, offered by the Rev. Frank G. Smith, the convention was welcomed to the city by Mr. Maclay Hoyne, first assistant corporation counsel of Chicago, who represented the mayor, Carter H. Harrison.

Mr. W. L. Park, vice-president of the Illinois Central Railroad, then addressed the members, and his remarks were along mechanical lines, touching briefly upon the advancement of the air brake art and upon the development of the Illinois Central Railroad, and at the conclusion of his instructive talk the annual address of the president was heard. Mr. Burton's address was ably delivered and was generally considered to be one of the most interesting ones the association has had the pleasure of listening to in recent years.

After this formal opening of the session, the presentation and discussion of papers on technical subjects was proceeded with in the following order:

"Air Brake Examination and Rating," T. T. Clegg, chairman; T. F. Lyons, H. A. Wahlert, H. H. Burns and G. A. Wyman, committee.

"Brake Cylinders and Connections," by H. A. Wahlert.

"Friction of New and Worn Brake-Shoes on New and Worn Wheels," by A. S. Williamson.

"Adequate Braking Power for Freight Cars," by John P. Kelly.

"Running Triple Valves Without Lubricant," by Lincoln Leonard.

"Strength of Foundation Brake Gear," by George O. Hammond.

Committee report on "Recommended Practice," S. G. Down, chairman; G. R. Parker, H. A. Wahlert, J. R. Alexander and N. A. Campbell, committee.

"The Problem of Controlling Modern Passenger Trains—A Statement of Conditions and Requirements and the Solution as Achieved by the P. C. Equipment," by W. V. Turner.

Smoker and informal discussion on topical subjects.

Topical subject, "Break-in-two of Trains," opened by P. J. Langan and S. H. Draper.

The first paper was submitted as an amendment to a previous paper upon air brake examination and rating, which was read before the Indianapolis convention in 1910, at which time methods of instructing and examining railroad employees were discussed during the major portion of two sessions, during which time representatives of the majority of the roads in the country outlined their individual methods.

During the discussion following the reading of this amendment, questions were raised as to the average instructor's qualifications and authority to examine and rate an engineer when the rating is based upon his experience as well as knowledge, and the subject was closed with the expressions of differences in opinion that are inevitable owing to the various methods employed by the instructors.

The paper on "Brake Cylinders and Connections" was read by Mr. Wahlert, and the relative merits of different types of expander rings, tannage and manufacture of packing leathers and methods of lubrication were dealt with. The paper was profusely illustrated with tables, diagrams and photographic views and must be studied in order to be thoroughly appreciated. It is the result of a carefully conducted series of tests, which among numerous conclusions developed the fact that the life of the average packing leather in freight service may be taken at approximately twenty-two years under favorable conditions, with proper care, and during the discussion following the reading of the paper it was further shown that, based upon the average freight car mileage, and average number of applications of the brake per mile, the average packing leather would not be worn out during eighty-seven years' service. The number of brake applications that can be made with a single leather was obtained by a "stroke counter" which registered the number of strokes or applications required to wear out a packing leather and while the results as set forth may appear, at a first glance, to be somewhat problematical, it certainly serves to emphasize the importance of properly lubricating a brake cylinder, and obviously suggests the possibilities of economy in the consumption of packing leathers.

Apparently improved types of expander rings did not in all cases manifest the improvements that might have been claimed for them if the reader fails in an analysis of the results, but no type of expander ring can be expected to eliminate brake cylinder leakage if said leakage is through the leather itself or past the follower studs and at least one air brake company recognizes the necessity of constant improvement in brake apparatus and is prepared to furnish special types of cylinder leather expanders or insert them in cylinders upon request. An improved type of expander was indorsed, especially for a class of service in which the intense heat from a locomotive cylinder or firebox tends to curl the edges of the leather over the expander ring and away from the wall of the cylinder which causes excessive leakage.

As representatives of manufacturers of expander rings and leather tanning experts were heard, the paper was accorded the complete discussion that it was worthy of.

The third paper presented was "Friction of New and Worn Brake-shoes on New and Worn Wheels," and the tests were conducted on the Master Car Builders' brake-shoe testing machine, which consists of an apparatus for revolving a car wheel with a brake-shoe in contact. A fly-wheel, storing the energy desired, is operated by a motor which is disconnected when the desired speed of the wheel is attained, when the wheel can be brought to a state of rest by the application of the brake-shoe. The shoe is pressed against the wheel by means of weights, which can be varied, and the shaft holding the shoe in position is connected with a dynamometer which records the actual pull of the shoe on the wheel and simultaneously the distance traversed by the wheel tread while coming to a stop, thus the distance of stop and coefficient of friction obtained can be readily noted. The co-efficient of friction is, of course, the actual pull of the shoe on the wheel, as registered by the dynamometer, divided by the weight holding the shoe against the wheel.

The diagrams in connection with the paper show the co-efficient of friction obtained and the distance in which the wheel was stopped by the application of the shoe, and indicate that friction increases and the stop is consequently shortened, as the shoe and wheel are worn, that is, as the shoe and wheel are new every succeeding application shortens the stop until a time that the shoe and wheel are considerably worn, then the length of stop has reduced to about 50 per cent. of the original distance required to stop the wheel when it and the shoe were new.

This brake-shoe proposition is a very serious one in high-speed service, especially where a very high shoe pressure is employed on the heavy cars, as the shoe tends to warp and break down under the severe conditions imposed. A serious loss in the co-efficient of friction obtained during high-speed emergency stops has been found due partly to types of brake-shoes that warp while the temperature is lowering, that is, they warp in a manner that only the extreme ends of the shoe come in contact with the wheel tread during the beginning of the following application and the entire face of the shoe cannot come in contact with the wheel until the points caused by warping are worn off and during this time there is a loss in the co-efficient of friction which is a loss in brake efficiency.

Mr. Kelly read his paper, entitled "Adequate Braking Power for Freight Cars," and very ably stated what he considered to be an adequate braking power and recommended that the braking power be based upon the weight of the loaded car instead of the present practice of arranging the foundation brake gear to develop a maximum pull on the shoes that is equal to a certain per cent. of the light weight of the car, which usually ranges from 60 to 90 per cent.

Mr. Kelly further recommends a leverage whereby a maximum brake-shoe pressure, equal to 35 per cent. of the total weight of load and car, would be obtained.

The association as a body recognized the fact that the present braking power available in freight service is inadequate and the problem lies in the manner of obtaining the increase without encountering further effects of unequal braking power and the tendency to produce slid flat wheels.

As an average condition a total leverage that would produce 35 per cent. braking power, based on the total weight of load, would produce a calculated or nominal braking power of 120 per cent. of the light weight of the car, if the maximum brake force was exerted and to obtain this force may require a larger brake equipment for freight service.

During the discussion, members on the floor professed to have had different experiences with high-leveraged freight cars, some cars braking at 100 per cent. of their light weight being referred to, this high per cent. of braking power being the result of a mistake in some cases and intentional in others and with such cars in trains some speakers testified that no difficulty in train handling was experienced, while other members stated that some difficulties they had experienced in train handling was apparently traced to the presence of such cars in the train.

While freight trains are running at passenger speeds it is evident, from a theoretical point of view at least, that a more efficient brake must be used to insure the same degree of safety that is provided for passenger trains and even the passenger car brake is not always as efficient as it should be.

There are several different methods of increasing the freight car brake efficiency, but there is an expenditure attached to any improvement, and while we believe that the best brake is the cheapest at any cost, any kind of a brake can be made an unnecessary expense.

A very carefully prepared paper was the result of Mr. Leonard's investigation along the lines of "Running Triple Valves Without Lubricant" and some points of considerable importance were brought out during the discussion of it.

For the benefit of many of our readers who were unable to attend the convention we will briefly state the conclusions without any particular explanation as to reasons. A triple valve can be successfully run without lubricant and it is evident that in years past many have done so, but the most approved practice of today is the use of graphite as a lubricant for the slide valve and seat. The valve should first be cleaned with some agent such as gasoline or something that will evaporate and not leave any deposit that will interfere with the graphite. After the graphite is sparingly applied to the perfectly dry slide valve and seat and with the piston and valve in the body, a film of oil or suitable grease should be applied to the piston bushing; then the triple piston can be worked back and forth a few times to distribute the small quantity of lubricant. While this is the approved method there may be some difficulty in testing the packing ring for leakage on the modern test rack on account of the low friction resulting from the use of graphite, as the triple valve remaining in lap position during the test depends upon the frictional resistance of the slide valve and piston, but this will no doubt be provided for by a slight change in the test rack.

One important point in connection with the packing ring test is that with some types of triple valves the feed groove opens a trifle in advance of the exhaust port and it is obvious that with low friction in an event of this kind a perfectly fitted ring may fail to pass the test, while the exhaust port remaining closed would not indicate that the valve had moved far enough toward release position to open the feed groove.

A liberal use of oil on the packing ring should also be avoided as the oil will act as a packing and allow a poorly fitted ring to pass the test which it could not pass if dry. We have noticed that in many instances triple valves go into service because a freely lubricated ring has enabled it to pass the test and in a few days this excess of lubricant is blown out of the bushing or absorbed by dirt, and the valve if removed a few days later will fail to pass the test. The same valve can then be oiled and made to pass the test, which would not be the case if the lubricant was properly applied.

The sixth paper, on the "Strength of Foundation Brake Gear," by Mr. Hammond, was a very technical one, dealing with various calculations to be used as a guide in establishing and maintaining a properly proportioned foundation brake gear for both heavy passenger cars and locomotives. The paper is interspersed with tables, formulas and diagrams that are used in determining the factor of safety in the design of brake gear.

To determine the fibre stresses and points of deflection for various metals entails the use of higher mathematics, but it was the author's aim to reduce the formulas to the simplest possible form, and where possible to prepare tables and diagrams to indicate at a glance the proper sizes of rods and levers where the fibre stresses are known.

Similar to Mr. Burton's contribution to the 1910 convention this paper contains a year of profitable study for the average air brake man.

The report of the committee on "Recommended Practice" was then heard, and the suggestions for changes received during the intervals of the past meetings were considered. The adoption of any additional clause or any change in wording requires the consent of the majority of the members present and as a result the character of those recommendations is such that they do not conflict with any good practice, and as they are almost universally accepted by air brake men, master car builders, master mechanics and the Interstate Commerce Commission, any comment upon this phase of the association's work is unnecessary.

The feature of the eighteenth convention and undoubtedly the particular cause of the unusually large assembly, was the paper and lecture on "The Problem of Controlling Modern Passenger Trains and Its Solution," by Mr. W. V. Turner. Along with a statement of conditions and requirements, the paper contained a complete illustration and description of the P. C. equipment, the principal part of which is the control valve and reservoir.

To those of our readers who do not know Mr. Turner, we wish to say that he is the recognized authority on air brake subjects.

From 1889, for a period of about six years, Mr. Turner was manager for a cattle and sheep company in New Mexico. Following this he went into the stock business for himself which was destroyed by the legislative disturbances during this period; then he went to railroading. Advancing from the position of car inspector on the A., T. & S. F. R. R. to chief engineer of the Westinghouse Air Brake Company, alone entitles him to more than ordinary consideration as an air brake man, and during this time he has not only conceived the ideas and recognized the requirements upon air brake apparatus but has designed and perfected the modern brake equipments that are in use. Among his contributions to air brake literature are "Brakes for Freight Cars," "Brake Operation and Manipulation in Freight Service" and "Developments in Air Brakes for Railroads," the latter being the most advanced and comprehensive treatise on the air brake that has yet been printed and it will be used as a reference and authority as long as the air brake is in existence. There are many air brake men, who have named some of the requirements of an air brake and who have cited problems confronting the air brake man, but a great many of the problems were left to be solved by Mr. Turner, therefore the Westinghouse Air Brake Company, the Air Brake Association and RAILWAY AND LOCOMOTIVE ENGINEERING are among those who consider that he has demonstrated his ability and is entitled to say the last word on matters pertaining to the air brake. As Mr. Turner is still a young man there are many possibilities before him, and unlike many of the great master mechanics he lives to see the results of his mental achievements, and with a knowledge of improved brake equipments that are now being perfected we do not hestitate to say that he may continue to solve air brake problems for some years to come.

During the course of his lecture the chair was informed of the presence of Mr. W. E. Symons, who was called upon to say a few words from the standpoint of a successful railroad man, and he responded by saying that the success attained by him was due to the character of the men who assisted him and took occasion to compliment the President and Mr. Turner, who were in his employ some years ago, and stated to the members present that Mr. Turner had just been awarded a medal as a token of appreciation by the Franklin Institute of Philadelphia, one of the most scientific bodies of men in America.

Mr. Symons also complimented the association upon the fact that a general passenger agent of a certain railroad claims the carrying of 49,000,000 passengers without a loss of life or injury, while another agent claims the transportation of 136,000,000 passengers without a loss of life or injury to a passenger, and Mr. Symons is of the opinion that a portion of the credit can be rightfully claimed by the efforts of the Air Brake Association.

Mr. Turner then continued his description of the control valve with the aid of stereopticon views, and those of our readers who have heard him know in what manner he can handle his subject.

We have, for several reasons, delayed a detailed description of the control valve and reservoir in these columns and one of them is that the first design of any piece of mechanism is seldom perfect and in all mechanical appliances there are some features that may possibly be improved upon or some subsequently discovered action may be modified, but as the control valve has now passed into the third stage and is generally supposed to have attained about the same degree of perfection that has been reached in the sixth design of the distributing valve.

At least, it is understood that the only change to a No. 4 control valve would mean the embodiment of all exhaust ports in one common outlet to prevent the freezing up of exhaust ports due to the act of scooping water out of the troughs between the tracks.

In connection with this subject, Mr. L. H. Albers stated that the New York Central Lines had a large number of control valves in service and that they were getting excellent results and that any slight difficulties that had been experienced had been, or were being corrected.

We wish to state that this control valve does not in any way conflict with the application of a clasp brake and like the distributing valve on a locomotive, there is but one size for all styles and weights of cars. Like a distributing valve it also has a brake cylinder pressure-maintaining feature in service operations up to the capacity of the service reservoir. This production of a uniformity in braking effect will be appreciated by every air brake man.

The August, 1910, issue of RAILWAY AND LOCOMOTIVE ENGINEERING contains several photographic views of the general arrangement of the first type of control valve, and a brief description and the general arrangement and the principal features of the control valve are retained in the No. 3 valve, those features having only been improved upon.

The No. 3 valve overcomes any trouble due to brakes "sticking," or "brakes creeping on." Briefly stated, it requires a 6 lb. brake-pipe reduction to operate the valves in service but at this time the application of the brake is positive as the movement of one control valve piston compels the movement of the other, which entirely eliminates the "creeping on" of a brake, due to a triple valve being a trifle more sensitive to brake-pipe variations than the feed valve.

The release is also positive on all cars, in that the first piston's movement compels that of the second one and the only part of the equipment that can be recharged during a release of brakes is a small pressure chamber similar to that in a distributing valve reservoir. The large reservoirs absorb no brake-pipe air during release until such time as the small brake-pipe volume almost reaches its maximum while the emergency reservoir constantly provides a factor of safety hitherto unattainable.

The service-brake cylinder develops an 86 lb. pressure under the influence of a full service reduction and there is no "blow-down."

The 86. lb. pressure results from a 110 lb. brake-pipe pressure, and of course requires a 24 lb. brake-pipe reduction and if the reduction is then continued, or if brake-pipe pressure falls below a predetermined point, whether due to leakage or failure on the part of the compressor, the emergency application operates regardless of the engineer.

Undesired quick action during a service reduction, so often experienced with triple valves, is almost an impossibility, as it requires something positive in the way of a reduction to operate the service mechanism, but there is no interference in the rapidity with which the desired quick action can be obtained, which is proven by the fact that this is the only type of air brake that can sufficiently reduce the time that elapses between brake application and brake effectiveness to produce an 1,100 ft. stop from a 60-miles-per-hour speed with modern equipment.

A "graduated release cap" provides a means of cutting out the graduated release feature at times when it might be undesirable, that is, at times when the majority of triple valves in a train are not of a graduated release type, but when all cars in the train are equipped with control valves, or all control valves and graduated release type triple valves, the graduated release cap in its proper position permits of the graduated release of brake-cylinder pressure.

Service and emergency cylinders operate under the same general arrangement as that described in the August, 1910, issue, but as before stated, we will endeavor to publish a complete description with illustrations in the near future. At the time stated, the necessity for a brake equipment of this kind was mentioned and as the weights of some new passenger cars are about 150,000 lbs., this brake is even a greater necessity, and we attempted at that time to state clearly why a lower total leverage was of the utmost importance in stopping heavy cars from high speeds, as well as the principal difficulties that would be encountered in attempting to use a brake cylinder larger than 18 ins. in diameter.

The topical subject, "Break-in-two of Trains," to be led by Mr. Langan and Mr. Draper, was left over until the morning of the fourth and last day. After this the usual business of the association was transacted.

This was followed by the election of officers, the time to meet again in 1912, and place to be selected by the members of the executive committee.

Electrical Department

The Development of the Electric Motor.

By A. J. Manson.

(*Continued from page 262.*)

In our last number we outlined the history of the electric motor beginning with the discovery of the principle by Faraday in 1821, through the development of the electro-magnetic engine, describing the locomotive built by Davidson of Scotland in 1842 and that built by Page of Washington, D. C., in 1851, and through the development of the dynamo electric machine, to the first real electric locomotive built by Siemens & Halske Co. of Germany and which was exhibited at the Berlin Exposition in 1879.

Two of the Siemens dynamo electric machines were used, one mounted on a truck which was the locomotive and the other coupled or belted to a steam engine generating the electric power for the operation of the locomotive. This locomotive which is shown by Fig. 3 ran over a narrow gage track on one meter or 39.37 inches, laid in a circle, the length being 300 meters. The motor was one of the Siemen's dynamo electric machines and consisted of a Siemen's armature rotating in a long flat magnet energized from the power supply and forming a shunt motor. This armature was connected to the driving wheels, on one axle, through flat and beveled gears which at the same time were of such size that the speed was reduced greatly, this being necessary on account of the high number of revolutions per minute of the motor armature. The locomotive was approximately 5 feet long and 3 feet high with wheels 16 inches in diameter. It was capable of making a speed of 15 miles per hour and developed about 5 horse power.

The negative terminal of the generator was connected to the track rails and the other to the insulated third rail which was a strip of iron laid vertically in wooden blocks located midway between the two running rails. It was slightly higher than the running rails so that currents could be easily collected from it and conducted to the motor. This was accomplished by means of a pair of brushes made of very fine copper which were fastened to the locomotive and which were kept in contact with the third rail, one on either side. Current passed from the generator through the third rail through the brushes to the motor and returned to the generator through the driving wheels of the locomotive and the running rails. To insure good contact between the wheels and the rails, the wheels on the cars which the locomotive pulled were connected electrically with the locomotive so that the current could pass through all of the wheels in multiple. The locomotive was started and stopped by means of a lever which connected and disconnected the current from the motor. It was run during the summer at the Berlin Exposition and probably carried as many as 100.000 persons in the three cars which made up the train, each car capable of seating six.

Siemens at this time recognized the fact that it was possible to regenerate power from the locomotive if same ran faster than normal speed and the advantage this would have on railway operation, for he stated that when the motor ran over its regular speed it would begin to generate current and could supply other locomotives using power, thus helping out the generator, and that at the same time this generation of power by the locomotive would serve as a means of braking. If a locomotive was running down grade for instance, this regeneration would hold the locomotive at a certain speed, for it takes power to generate an electric current and this is done at the expense of the speed of the locomotive.

Thomas A. Edison had been working on dynamo electric machines and shortly after Siemens's generator had been built he had designed a machine which had an armature similar to Siemens's, but the electro-magnets were somewhat different. Instead of a long flat magnet his was short, and the coils of wire were wound on very long spools of iron as much as six to eight times the diameter of the armature. To increase the capacity of the machine the armature was made 5 or 6 feet long and as many as three sets of these poles or magnets were applied to the same armature.

While Siemens & Halske had been perfecting their locomotive and were exhibiting it at the Berlin Exposition, Edison had been experimenting with his dynamo electric machine for use as a motive power. In the spring of 1880 he had mounted one of his machines on a truck resembling a hand car and was operating same pulling a car over a track which he had built at Menlo Park, New Jersey, where his factory was located. This track was built over natural ground with very little grading. He had built one half mile and was planning to extend same forming a large closed circle.

It was Edison's plan to simplify matters and do away with needless expense, so he discarded the third rail, using one of the track rails for the positive and the other track rail for the negative current. He used about 90 volts on his track. He ran this locomotive up to 1882 during all seasons of the year and operated trains during all kinds of weather. Owing to the track having many heavy grades, etc., he built a new graded road commencing at Menlo Park and extending to Plainfield, a distance of three miles. This road was built with a gage of 3′ 6″, being a few inches less than his first road. In the early part of 1882 he had completed a part of this road and also had just completed a second locomotive of larger power which was made to resemble a steam locomotive. There was a cab, a boiler in which was mounted the dynamo electric machine, but no smokestack and only one pair of drivers. It was 15 feet long and 9 feet high. The motor was connected by means of gearing to a shaft located in the rear of the locomotive and below the cab floor, and power was transmitted by gearing from this shaft to the driving wheels. The rim of one of the driving wheels was insulated from the center by an insulating material and was connected by means of three straps to a plate placed away from but opposite the hub of the wheel. In contact with this plate was a copper brush fastened at the end of a longitudinal rod, resembling a side rod. Current passed from the rail through the rim of the wheel to the copper brush and by means of cables to the motor returning through the other wheel to the other track, no third rail being used. Current could be disconnected from the motor by means of this rod which was operated by a lever. This locomotive operated very successfully and was able to make a speed at the rate of 29 miles per hour. Edison was planning to build a large motor of 300 h. p. and work was progressing while this second locomotive was tested. It was not completed owing to certain conditions which will be mentioned later.

While Edison was experimenting with his locomotive, Siemens & Halske's locomotive, which was exhibited at Berlin in 1879, was exhibited again at the Düsseldorf Exhibition in 1880. It met with such success and Siemens & Halske were so confident in their belief that electric traction was assured they decided it was possible to electrify the elevated road in Berlin and that this would be of immense advantage to the city on account of no smoke. They laid their plans before the

Berlin authorities and although they were not granted permission to electrify the elevated they were allowed to build a railway on the ground from Lichterfelde, a suburb of Berlin, to the Military Academy, a distance of 1½ miles.

This road was opened May 21, 1881, with two motor cars. Each car was of the regular box type, 9′ 6″ long with gage of 1 meter and suitable for 26 persons weighing complete with motor and passengers nearly 5 tons. One of Siemens's dynamo machines was mounted under each car on a platform or cradle hung between the two axles. Power was transmitted to the wheels by double belts. The third rail was not used on this road, only the running rails being used, one connected to the positive and the other to the negative wire from the generator which was located a few hundred feet back from the track, current being carried by means of cables placed underground. This generator fed into the road about ⅓ of a mile from Lichterfelde. The tires of the wheels on the cars were insulated from the centers and were connected electrically to brass rings fastened to the axle but insulated therefrom. Current was supplied to the motor by contact brushes bearing on these brass rings. To decrease the resistance of the rails iron wires were used to connect the rail lengths together in addition to the fish plates.

There was a great deal of discussion among the Berlin authorities as to the proper rating for these cars, as the question of traffic depended on the class, etc., of the motive power. It was finally decided that these cars should be classed as one horsepower each and it was therefore necessary to run at a speed which would not at any moment exceed 12 m. p. h., and which would average not over 10 m. p. h. It was therefore necessary to take about 10 minutes to make the run, although the cars were capable of doing it in one half of the time with full number of passengers. 100,000 passengers were carried yearly.

Shortly after the above road in Berlin was built an electric railway was installed by Siemens & Halske at the Electrical Exhibition at Paris, France, in 1881. The gage of this track was 4′ 8½″. The motor was mounted underneath the tram car and belted to the axles. Owing to the danger in this particular case of having the current on a third rail lying on the sleepers or using the running rails as positive and negative, the current was collected from overhead conductors located at one side of the car and held up by poles. Siemens & Halske had been experimenting with overhead conductors and had collected current from wires by means of a small carriage which would run on the wire, being pulled along by the wire cable which conducted the current from the wire to the car. They had not met with very great success due to the difficulty of keeping the carriage on the wire and so in this case two hollow tubes were used as conductors, one for the positive and the other for the negative. These hollow tubes had a longitudinal slit the whole length. Metallic bolts to which were fastened wire cable, were drawn through these tubes, a spring arrangement keeping the head of the bolt against the inside of the tube and thus preventing flashing and burning. The two cables passed through the roof of the car connecting to the motor underneath. In seven weeks' time about 95,000 persons rode on this railway.

In 1883 a road was built and operation commenced between Portrush and Giants Causeway, Ireland. It was the first electric road in Great Britain, was laid with 3-ft. gage, and was six miles long of single track. Power was furnished from a 20 h. p. dynamo driven by water power, and was connected to a third rail located at the side of the track mounted on hard rubber insulators, the running rails forming the return circuit. This third rail of 1 section was placed 17 inches above and 22 inches from the track. Two sets of steel springs, one at each end of the car, collected the current for the motor. These two sets of collectors allowed the car to span the gaps which occurred in the third rail at the crossovers, etc. At these gaps the rails were connected by a cable passing underground. The grades were extremely heavy, there being one of nearly 3% for 2 miles. The running speed of the cars, of which there were four, was 10 m. p. h.

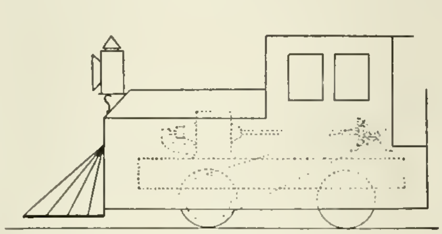


FIG. 4. THE "JUDGE" 1883.

Edison, Field and Siemens had each built a railway and each had really run an electric locomotive. Naturally each claimed to have been the first to have adapted electricity to a railway, and legal suits followed. After nearly two years the court decided in favor of Field, the decision being based on the caveat which he filed in 1879, together with a rude sketch, as the first official plan for operating an electric railway. A short time after this decision was handed down by the court an agreement was reached between Field and Edison and on May 8, 1883 the Electric Railway Company of America was incorporated with Field at the head. This company was formed to work up the ideas of Edison and Field, and the company was very active. This was the year of the Chicago Exposition and two weeks before the opening it was decided to exhibit an electric railway. Work was rushed by the Electric Railway Company of America and an electric locomotive was built and made its first trip on the 9th of June. This was the first electric locomotive in America used for commercial purposes on a public electric railway. The track for this locomotive was of 3 ft. gage and 1,553 ft. in length and was laid around the gallery of the main building. One passenger car, having a seating capacity of 20 persons, was hauled around the track at a speed not exceeding 9 miles per hour, as it was not deemed safe to exceed this speed. During the time the locomotive was exhibited from June 9 to June 23 between 450 and 500 miles were covered and nearly 27,000 persons rode. The greatest mileage in any one day was 194 trips and almost 3,600 people were carried. During the exhibition of the locomotive not a single failure or accident occurred.

The outline of this locomotive, which was named the "Judge" by Field himself, is shown by Fig. 4. It was 12 ft. long, 5 ft. wide, with driving wheels of 30 ins. diameter, and weighed 3 tons. A No. 6 Western Electric, 100-light dynamo of 75 volts and running at 1100 r. p. m., weighing 2,700 lbs., was used as the motor. The motor, as shown by the figure, was connected by a shaft to a counter-shaft and this counter-shaft was connected to the front drivers by means of pulleys and belts. There were two belts used and the pulleys and gears were of such size that there was a speed reduction of 3 to 1. The pulleys, 26 ins. in diameter, on the driving axle were free to turn. On the axle were fitted two cone friction pulleys which were made to fit into the interior of the rim of the loose pulleys. These cone pulleys revolved with the axle but were free to slide, keys and keyways being provided. By means of a lever projecting into the cab the cone pulleys could be pressed into the rims or withdrawn.

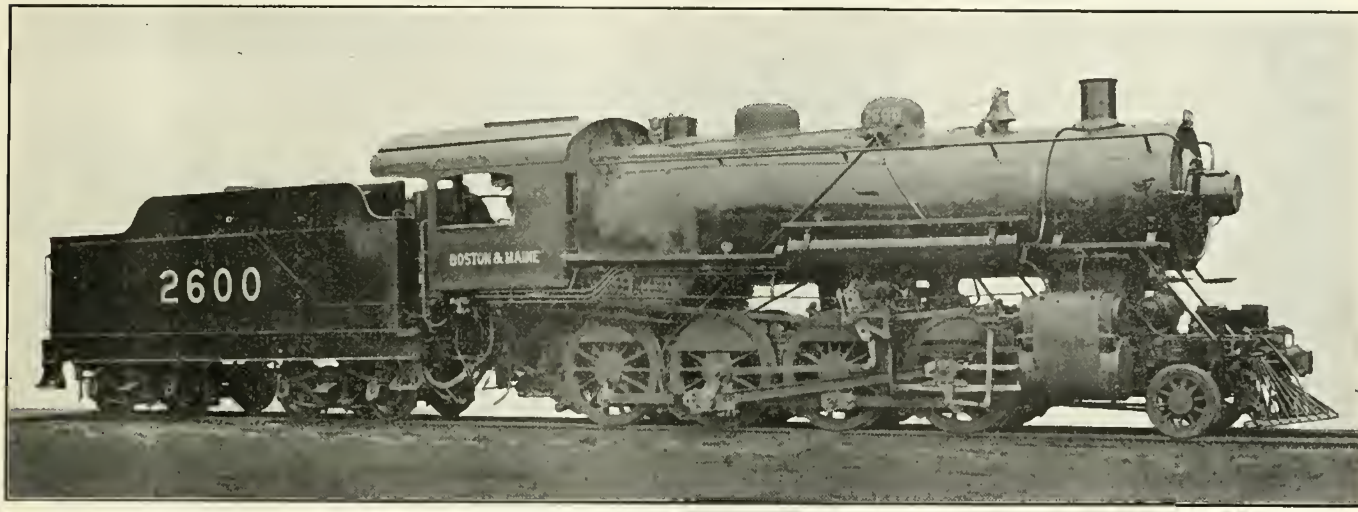
Orders for Westinghouse.

The New York, New Haven & Hartford Railroad recently purchased four quadruple equipments of No. 409 alternating current railway motors, with unit switch control, from the Westinghouse Electric & Manufacturing Co., of East Pittsburgh, Pa. The Guelph Radial Railway Company of Canada recently placed an order with the Westinghouse company for one 27-ton lomomotive with four No. 101-B-2 railway motors and type K-28-B control.

We endorse the philosophy of Elbert Hubbard when he says: "The most precious possession in life is good health. Eat moderately, breathe deeply, exercise outdoors and get eight hours' sleep. Cultivate charm of manner as a business proposition."

Consolidation Engines for the B. & M.

The Baldwin Locomotive Works recently completed forty consolidation type locomotives for the Boston & Maine Railroad. This order constitutes an important addition to the motive power of the line; and the engines, although not of exceptional size, are excellent representatives of a straight-forward design using saturated steam in single-expansion cylinders. The tractive force exerted is 40,500 lbs., and with 180,300 lbs. on the drivers, the ratio of adhesion is 4.45. The locomotives should thus be able to develop full tractive force under all conditions of service; and at the same time, with driving wheels 61 ins. in diameter and ample boiler power, they are capable of maintaining good speed over the road.



HEAVY CONSOLIDATION TYPE FOR THE BOSTON & MAINE.

H. Bartlett, General Superintendent of Machinery Department. Baldwin Locomotive Works, Builders.

The boiler is of the extended wagon-top type, with a radially-stayed wide firebox. The boiler center is placed 9 ft. 6 ins. above the rails, while the maximum height over all is limited to 14 ft. 6 ins. With this restriction there is but little space available for the dome, and it is formed of a single piece of flanged steel. The longitudinal seams in the barrel have diamond welt strips. The fire-box is stayed entirely by flexible bolts, with the exception of the radial stays which support the crown. The box is provided with a brick arch supported on water tubes. A self-cleaning front end is used, without spark hopper. The stack is 16 ins. in diameter, and has an internal adjustable extension. The spark arrester consists of a perforated plate.

The frames are of steel, each cast in one piece with a single front rail, and are strongly braced transversely, especially at the driving pedestals. There is a continuous equalization system on each side of the locomotive, but the spring links back of the second axle are pinned to the frames, thus providing a positive support at that point There are five driving springs on each side. The cylinders are lined with cast-iron bushings and are arranged for inside admission piston valves. The valves are of the built-up type, 12 ins. in diameter, and are set with a lead of 3/16 ins. They are actuated by a simple arrangement of Walschaerts gear, having all moving parts located in one vertical plane.

The tender trucks are of the arch-bar type with rolled steel wheels and cast-steel bolsters. The longitudinal frame sills consist of 13-in. steel channels. The tank is of the water-bottom type, with capacity for 7,000 gallons of water and 12 tons of coal. The principal dimensions of these engines are presented in the accompanying table.

Cylinders, 22 x 30 ins.
Valves, balanced piston.
Boiler.—Type, wagon top; material, steel; diameter, 70 ins.; thickness of sheets, 11/16 and 3/4 in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.
Firebox.—Material, steel; length, 108 ins.; width, 71¼ ins.; depth, front, 70½ ins.; back, 58 ins.; thickness of sheets, sides, 3/8 in.; back, 3/8 in.; crown, 3/8 in.; tube, ½ in.
Water Space.—Front, 5 ins.; sides and back, 4 ins.
Tubes.—Material, iron; thickness, 0.109 in.; number, 366; diameter, 2 ins.; length, 15 ft. 8 ins.
Heating Surface.—Firebox, 175 sq. ft.; tubes, 2,986 sq. ft.; firebrick tubes, 28 sq. ft.; total, 3,189 sq. ft.; grate area, 53.4 sq. ft.
Driving Wheels.—Diameter, outside, 61 ins.; journals, main, 10 x 12 ins.; others, 9½ x 12 ins.
Engine Truck Wheels.—Diameter, 33 ins.; journals, 6 x 12 ins.
Wheel Base.—Driving, 17 ft. 0 in.; total engine, 26 ft. 0 in.; total engine and tender, 58 ft. 0¾ in.
Weight.—On driving wheels, 180,300 lbs.; on truck, 23,600 lbs.; total engine, 203,900 lbs.; total engine and tender, about 350,000 lbs.
Tender.—Wheels, diameter, 33 ins.; journals, 5½ x 10 ins.; tank capacity, 7,000 gals.; fuel capacity, 12 tons; service, freight.

Nickel Plating.

Light nickel plating can be accomplished by heating a bath of pure granulated tin, argol and water to boiling and adding a small quantity of red hot nickel oxide. A brass or copper article immersed in this solution is instantly covered with pure nickel.

Development of the Boring Tool.

The first boring tool used was some form of awl. Tools of that description were used during the infancy of civilization for awls are shown in Egyptian tombs built 1700 B. C. Pliny states that the gimlet was invented by Dædalus 1240 B. C. It was destitute of a screw point, but it may have had a hollow pod and a cross head forming a handle. The screw point was added to the gimlet in course of time, and within our own recollection the twisted shank which makes it self-discharging. The point was taken from the auger proper, which may be called a magnified gimlet, now that their specific features have become so closely assimilated in form and function.

The auger was a Greek tool. From the early description of the auger (terebra) it seems to have been considered a shipwright's tool, work for which it was well adapted since ship's planks were fastened by wooden trenails. It formerly had a sharpened end and concavity to hold the chips; this was a pod auger. To this a tip was subsequently added for some kinds of boring, and in course of time the depression grew into a spiral which allows the chips to escape while the boring proceeds, instead of withdrawing the tool as the pod fills. These improvements of the tool represent ingenious inventions of nameless workmen.

The twisted auger is an American invention, and was first made by Lilley, of Mansfield, Conn., about the beginning of last century, and afterwards by Gurly, of the same place. Augers may be classified as augers, annular augers, taper augers, augers with secondary borers, reamers or countersinks, or having expansive cutters. The number of uses to which the auger can be put makes us wonder how people ever got along without it.

General Foremen's Department

The July Convention.

The iron horse is ready to take you to the seventh annual convention of the International Railway General Foremen's Association.

July 25 to 27 inclusive, is the time when all the members of the International Railway General Foremen's Association should be at Chicago to attend their seventh annual convention. All arrangements in connection with the convention are completed. The topics for discussion are under direction of able committees, who will give us the very best knowledge in locomotive construction, shop efficiency, shop kinks and shop organization. There should be no excuse for you to stay away from this convention, excepting sickness. Your presence at this convention will increase your efficiency and enable you to hold a higher position. It will also show the officials of your company that you are interested in their business—that you are willing to give three days of your time to attend a convention where the latest facts pertaining to your work will be discussed. If you cannot be absent from your shop for three days, then there is something radically wrong, either with you or your organization; in either case we can help you out if you will attend this convention.

We are in receipt of a communication from one railroad company in which they request us to send them twenty-five application blanks to be distributed to their foremen. So far as we know these men will all attend our convention. This is only a small item compared with the list we have from different railroad companies. That is why we are positive of the largest attendance we have ever had.

If you are not a member of this association, come to Chicago and attend our convention. General foremen, roundhouse foremen, gang foremen and machine formen are eligible to joint this organization. If you are interested in your work and your future, do not fail to attend the seventh annual convention of the International Railway General Foremen's Association.

We want everyone to bring his wife or sweetheart to this convention. A splendid programme has been arranged for the ladies, and we feel sure they all want to go. There are beautiful parks and theatres in Chicago, and boating, etc.

Remember the date, July 25 to 27 inclusive, at the Hotel Sherman, Chicago,

Respectfully and fraternally yours,

C. H. Voges, President,
The I. Ry. Gen. For. Ass'n.

Car Wheels and Axles.

By W. H. Markland.
General Shop Inspector, P. R. R., Altoona, Pa.

Boring car wheels, turning axles and mounting wheels on axles is a question that for some reason has not received the attention in railway shops that work of similar nature is receiving in other shops. With the object of introducing new devices and methods into the P. R. R. shops, a careful study of this question was made in the hope of reducing costs. Many experiments and tests were made

FIG. 1. GRINDING MACHINE.

and a few devices introduced which may be of interest to railways generally. The majority of axles and wheels machined in railway shops are for repair work, i. e., fitting new wheels to axles or refinishing cut journals, therefore, this class of work will be mostly considered.

It is of course recognized that safety is of the utmost importance and that wheels must be fitted to axles in such a manner as to insure their not working loose in service. However, the question of cost of work of this nature is also a consideration. The fact that in no case has a wheel been reported loose when mounted by methods explained below, would indicate that the system is entirely safe and considered as a whole more economical than most of the previously used methods.

To properly machine axles and wheels several points are necessary to be observed in order to obtain the best results, and attention has been given to the following in the shops on our road. speed of turning, centers in axles, lathe centers, turning tools, micrometer calipers, lathe centers in line, boring bars, etc. The importance of true, properly ground and fitting lathe centers cannot be overestimated. In fact, no lathe center in any shop should receive more attention, for the reason that axles during their life may be turned several times and on different lathes, and, if the angle of centers is not uniform, the center in axle will be badly and unevenly worn and make it difficult to do good turning. A case came to hand where a few axles were turned some .01 in. out of round. Investigation showed that the lathe on which they were turned had centers about 85 degs. included angle, and that the axles were centered 60 degs. As a result the axle only bore on the lathe center at end or had a line bearing. This line bearing soon wore unevenly, allowing the axle to work back and forth, and this was responsible for eccentricity of axle. Recognizing the fact that where ready means are provided for grinding centers that they will be kept in better order, the grinding machine, Fig. 1, was designed. This machine will only grind to 60 degs., included angle being made this way purposely to prevent possibility of being set wrong. This machine is not expensive and would be a desirable addition to any shop.

Another point was brought out which was the necessity of lathes in proper alignment to insure turning a journal or wheel seat the same diameter for the entire length. In some shops a burnish wheel is used to smooth journals where a heavy strain is exerted on lathes that is liable to wear the lathe shears and make frequent repairs necessary to insure satisfactory work. The importance of a lathe in proper alignment can be appreciated when we consider that to mount a steel wheel having 7-in. hole or cast iron wheel of the same size, the axle should be .007 and .015 ins. approximately larger than the wheel bore and also each .001 of an inch variation will affect the mounting pressure some 10 per cent. If the wheel seat be turned taper it is not possible to properly caliper except the average diameter which will rarely be a true indication of mounting pressure. If turned taper, an extra strain may be exerted on one part of the wheel with the possibility of no pressure on other parts.

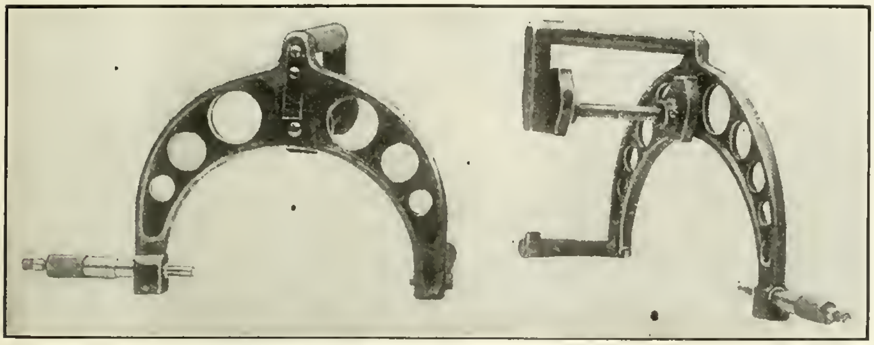


FIG. 2. MICROMETER AXLE CALIPERS.

Actual cases have come up where wheels have been removed that only had bearing for part of their length owing to taper-turned axles, and while the wheels did not come loose in service it is a condition which, if known to exist, would be bad for one's peace of mind.

A very satisfactory test for lathe alignment is to take two or three light cuts for the entire length of wheel seat and measure the diameter with micrometers. For wheel seats there should never be a difference in diameter exceeding .002 in. In every case after repairing lathes to this standard the results have been so much better that the method cannot be too strongly recommended.

Tests made to determine the speed that axle lathes should be run at, developed the fact that 45 r.p.m. was about the limit for car axles. The limit being the chattering of axle rather than cutting tool.

The question of low speed and coarse feed and fast speed and fine feed was also considered. For good work there is no question that the fast speed and fine feed is the more desirable on account of avoiding large humps and hollows. A broad-faced tool fed slowly may look satisfactory, considering the fact that there is always a possibility of workmen not setting tool nose square which is liable to result in wheel not having a few points for bearing, and on the journal the burnishing wheel or other finisher will have to push down or remove the high spots, whereas with fine speed the humps and hollows will be less in magnitude. The latter method is decidedly the better. In the writer's opinion, the final cuts should never be taken with feed less than 16 pitch.

Proper inspection of axles is, of course, important, but to be of value and keep a shop up to proper standard, limits should be established. Inspection for diameters cannot well be made with machinists' calipers on account of being too slow and there being too much personal element involved. Without question, micrometer calipers are the more satisfactory for calipering axles such as are generally handled in repair shops. At first glance this may appear a refinement but experience has proved their value

In order to reduce time necessary to make micrometer caliper measurements, the calipers, Fig 2, were designed by the writer. These have in addition to the ordinary micrometer, an extra anvil set at right angles to the object measured, also the stops that may be turned so that the distance from top to center of axle shall be approximately the radius of axle. This admits of quickly setting the caliper in place. With the calipers illustrated, one set of stops is approximately correct for axles 6¾ to 7 in., one set for axles 6¼ to 6½ ins.

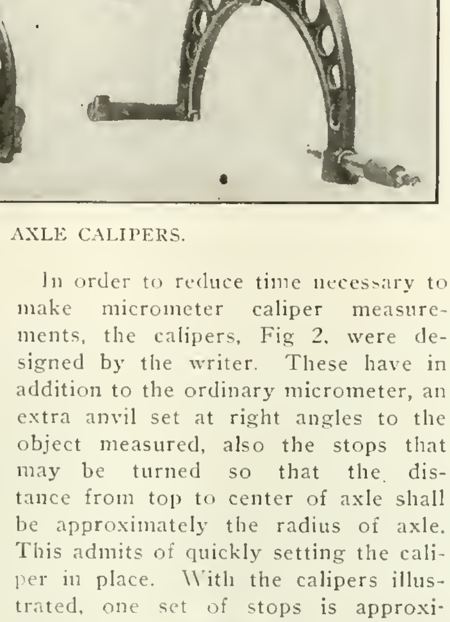


FIG. 3. BORING BAR.

A method of inspection that has worked out very well in practice has been as follows: Each wheel seat was calipered about 1 in. from dust guard seat, at the middle, and about 1 in. from end nearer the cutter. These readings to agree within limit of .003 of an inch, the average size being chalked on the axle for information when mounting wheels. Should these readings vary over .003 in. the axle would then be rejected for returning. The journal to be inspected in a similar manner but without recording sizes. No particular trouble can result from the two ends of axles not being similar, and any attempt to make them alike would result in many cases in removing unnecessary metal.

Investigation brought out the fact that with proper boring bars, wheels may be bored to varying sizes to suit axles, cheaper than axles can be turned to suit the wheels. To accomplish this called for a boring bar that should be readily adjustable to varying sizes to suit different axles.

This refinement calling for boring bar is new in some respects for wheel work. Fig. 3 shows a bar that was designed by the writer to meet these requirements. The roughing cutters at lower end are held by set screws and are only adjustable by loosening screws. This is very satisfactory for large shops boring many wheels to nearly one size. However, for small shops where sizes are changed often, more ready means for adjustment is desirable. The finishing cutters shown above the roughing cutters are adjusted as to size by a wrench turning a micrometer screw. On the micrometer screw there is a dial graduated into 100 divisions, each division equalling .001 in. in diameter of finish screws. This number of divisions being chosen on account of allowing large spaces between divisions which may be easily read. In case an adjustment over 100 in. is required, the micrometer screw is turned more than one turn. The index plate is held to micrometer screw by two screws. By loosening these it can readily be revolved in reference to micrometer screw. The finishing cutters also have adustment by which they may be adjusted true with the bore in wheel, this being desirable to avoid too close grinding of cutters, and also on account of ram of boring mill and table not always being in line. The finish cutters may be ground, one fully 1/16 in. longer than its mate or the bar may be 1/16 in. out of line and compensated for in adjustment.

Dissolve 4⅜ ozs. of hyposulphite of soda in a quart of water and 1⅛ ozs. of acetate of lead in another quart of water. Then mix the two solutions and heat until boiling. Then immerse the pieces of iron to be colored. The metal takes a rich blue color and is more enduring than the color produced by tempering.

False Sound From Bell.

When a fast passenger train is rushing past a station, it is quite possible to notice an alteration in the tone of bell or whistle, if the bell be rung steadily or the whistle blown continuously. In the case of the bell, we will suppose it gives out a tone such as the middle C on the piano. That is made by 256 vibrations to the second, and if the engine was standing still, at the end of the second the first of these vibrations would be 1,100 ft. in front of the engine, as sound travels 1,100 ft. a second in air at 60 degs. F., and the rest are equally spaced over the intervening distance. If the train is traveling 60 miles an hour, which is 88 ft. a second, the first of these vibrations is now only 1,012 ft. ahead of the engine at the end of the first second.

By this we see that 256 separate sound waves are made to occupy less space than normally. They are bunched together, so to speak, and that is equivalent to the production of a higher note, as it is at the rate of 277 vibrations to the second. The train rushing toward you sounds a higher note than the true tone of the bell. The opposite is the case when the train has gone past. Now the 256 sound waves are dragged apart, so as to cover not 1,100 ft. but the greater space of 1,188 ft., and the tone produced by the stroke of the rapidly receding bell is equivalent to only 237 vibrations a second, and this gives a lower tone than the normal sound of the bell. These changes can be heard in a more marked degree by a passenger on one rapidly moving train passing another fast express in motion.

Moving Picture of a Flying Bullet.

A cinematograph apparatus which takes pictures with intervals of one five-thousandth of a second has been invented by Dr. Cranz of the Military Academy of Berlin. A striking example of the power of the apparatus shows a bullet fired at a bladder of water that is hung on a string.

The eye only sees a little smoke from the pistol and a couple of holes in the bladder, from which the water runs; but when this is cinematographed and the film is shown slowly a very interesting series of operations can be watched.

First the bullet is seen approaching. It is traveling 1,000 feet a second, but it seems to move quite deliberately. In front of it and extending a long way above and below it is a dim line, bent sharply immediately before the bullet. A bullet can no more pass through air than a vessel can through water without making a wave; and this is the air wave. It is made visible on account of its different density, just as the waves in air are seen above a chimney or over hot ground.

Behind the bullet comes scattered grains of the powder that have not been burned, and traveling more slowly still comes the wad. The bullet enters the bladder and disappears inside, a little water spurting out of the hole it makes. Then it reaches the other side, but it no longer cuts through at once, as it did when the bladder was backed up by the water.

Something like a finger seems to push the bladder outward into a long tube, then the tube opens and lets out the bullet, which gradually travels away. The tube does not at once collapse; its form is maintained by the stream of water which follows the projectile.—*Ideal Power.*

Coloring Metal.

A common method of coloring steel tools and other articles of metal is to heat a flat piece of iron of sufficient mass to retain heat for some time. The article to be colored may then either be laid on the heated iron or a piece of sheet iron may be placed on the heated mass to prevent a too rapid heating of the article to be colored. The colors appearing on the article to be colored begin with pale straw, followed by dark straw, brown, purple, blue and green, after which the colors fade into white. When the desired color appears, the article should be dipped into an oil bath. These colors fade rapidly by handling.

A method of coloring taps and reamers is sometimes used with very uniform results. Pieces of pipe are heated, and the article to be colored is held by tongs or otherwise and inserted into the heated pipe. As the colors appear the article may be partially or altogether withdrawn from the heated pipe. This method is frequently used in the smaller kinds of taps, as the threads are apt to be injured in the event of coming in close contact with a heated piece of iron.

Other methods are also in vogue as those that we have alluded to are not always advisable on account of the tendency to affect the temper of the articles. A bath consisting of water 1 quart, copper sulphate 1/8 oz., nitric acid 1/4 oz., mercury bichloride 1/4 oz. muriate tincture of steel 1 oz., and alcohol 1 oz. This bath may be prepared in a wooden box into which a small steam pipe should convey a jet of steam to moisten the air in the box. The vapor arising from this bath forms a deposit on the articles which are allowed to remain in the receptacle for several hours. Very rich coloring is obtained in this way. The color is more vivid than that obtained in the process of tempering steel.

Steam and Electric.

The electric locomotive has some advantages which do not pertain to operation, but which are nevertheless important. (1) Due to the lack of smoke and gases, the maintenance charge on bridges, etc., is decreased. (2) There is a fuel saving as there are no standing charges against an electric locomotive; it only uses power when hauling trains and no fuel is required while coasting or standing as with the steam locomotive; moreover, a cheaper grade of fuel can be burned in the power house and it, therefore, has a higher efficiency. (3) Does away with turntables, for an electric locomotive is operated equally well from either end and in this manner time is saved at terminals and capacity of yard increased due to fewer movements required. (4) No fires to draw, tanks to fill, etc., at end of run, which helps also to increase capacity of station. (5) It contributes to the comfort of the passengers.

It does not follow that because the electric locomotive is such an efficient machine and has its many advantages that the steam locomotive is a thing of the past to be forgotten and that the electric locomotive will in a few years replace the steam locomotives throughout the country. The electrification of trunk lines is expensive and unless the traffic is dense enough, the large first cost is not warranted and would not pay, although the operating cost for the electric locomotive is less than steam. With long hauls and few trains the cost with steam can not be equalled as it is necessary to take into account the interest and depreciation on the investment if electrified. Where the traffic is dense and the capacity of the terminal has been reached with steam, or where a tunnel enters into the question or where the railroads are compelled by the force of public opinion to electrify, or where a substantial saving can be shown, then electrification will take place.

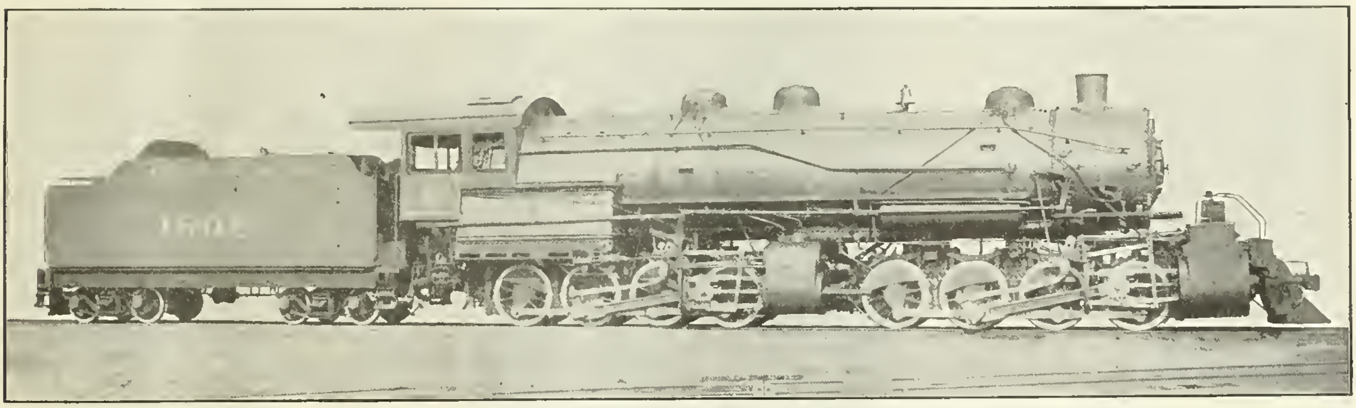
Potential Energy in a Boiler.

Few realize the power lying dormant in a steam boiler. Everyone knows that boilers sometimes blow up causing great destruction to life and property. Mr. George E. Wallis, instructor in mechanical engineering in the University of Michigan, recently said: "A cylindrical boiler, 60 ins. in diameter and 16 ft. long, contains about 6,600 lbs. of water, and 22 lbs. of steam. If the boiler is working at 150 lbs. pressure, there is stored in it over 1,500,000,000 foot-pounds of energy. This, if it is liberated and expended on the boiler, will raise it one mile against the force of gravity." This ought to force every one who is in charge of a steam boiler make safety his unvarying watchword.

Mallet Superheater for the D. & H.

In June of last year the D. & H. received six Mallet locomotives from the American Locomotive Company, which at the time of their construction were the most powerful engines in the world. They were put in pusher service on the 18-mile grade of the Pennsylvania division between Carbondale and Ararat station, where they have been in operation ever since. From the W. C. tower, Carbondale, to Forest City, a distance of 5½ miles, the grade is 1.36 per cent., and from the latter point to Summit, it averages about 8 per cent., with a number of 6 and 7 deg. curves.

Recently the D. & H. have received from the same builders four more articulated locomotives, practically duplicate in design of the first lot except that they are equipped with the Schmidt loop type fire-tube superheater. One of these later engines is shown in our illustration. Apart from the modifications in the construction of the boiler, very little change from the original design was necessitated by the application of the superheater.



MALLET SUPERHEATER LOCOMOTIVE FOR THE D. & H.

American Locomotive Company, Builders. J. H. Manning, Superintendent of Motive Power.

In the non-superheater design the high-pressure steam pipes are connected to the branch pipes in the smoke-box and extend back underneath the running boards to the high-pressure cylinder; consequently, no change in this particular was necessary on account of the application of the superheater. Extended piston rods are applied to all pistons and the rods of the high-pressure valves are also extended in the superheater design.

There is a difference in the valve-setting between the two classes of engines. The valves in both cases have a travel of 6 ins. In the superheater engines the high-pressure valve has a 1-in. steam lap, a 3/16-in. lead and 5/16-in. exhaust clearance. The low pressure valve has the same lap and lead and a 3/8-in. exhaust clearance. In the case of the non-superheater engines the high-pressure valve has a 1 1/16-in. lap, a 3/16-in. lead and a 5/16-in. exhaust clearance, while the low-pressure valve has a 1-in. steam lap, a 5/16-in. lead and a 7/16-in. exhaust clearance. The boiler of the engines here illustrated is fitted with 270 tubes, 2¼ ins. in diameter, 24 ft. long and 42 flues, 5½ ins. in diameter.

Shortly after the first lot of engines went into service, tests were made to determine their fuel and water consumption as compared with the D. & H. class E-5 consolidation locomotives whose place they took in pusher service. These later engines have a total weight of 253,000 lbs., 223,000 lbs. on driving wheels and a tractive power of 49,700 lbs. Observations were taken of several runs made by the same two class E-5 locomotives working together as pushers and also of locomotives Nos. 1600 and 1605 of the articulated type, working separately. In order to obtain the fairest basis for comparison only the results of those runs in which conditions were most nearly alike were tabulated, four in each case. The general averages showed that the articulated locomotive hauled within 2.7 tons as much as two consolidation locomotives together at approximately the same speed, and burned 44 per cent. less coal.

From records of the fuel consumption of the articulated locomotives, covering the time since they have been in service, Mr. J. H. Manning, superintendent of motive power, states that they have maintained the averages shown in the tests made. Similar tests will be made of the superheater locomotives, which will permit of interesting comparisons with the locomotives using saturated steam. We hope to be able to publish results of these tests in a future issue.

An analysis of these figures and a consideration of the causes which produce the economy shown, bring out some very interesting points in regard to the saving effected by the use of a single unit of great power instead of two or more units of less power in handling a given amount of tonnage. For instance, the total weight in working order, of the articulated locomotive and tender is 194,200 lbs., or approximately 97 tons less than the aggregate of the two consolidation locomotives with their tenders. The length of the division is 18.7 miles, which gives in round numbers, 1,800 ton-miles less for the articulated locomotive per trip as compared with the two consolidation engines. The consolidation locomotives burned on the average .68 lbs. coal per ton-mile; consequently, the above saving in ton-miles means a resulting reduction of 1,225 lbs. of coal per trip or 6.4 of the average total amount of coal burned (19,074 lbs.). On the other hand, both classes of locomotives have approximately 100 sq. ft. of grate area; consequently, with the single unit there is 100 sq. ft. less of grate area to consume coal, when the train is standing on a siding. It will be readily appreciated that considerable economy of fuel results from this cause. The tests showed that the consolidation locomotives burned an average of 55.8 lbs. of coal per sq. ft. of grate area per hour. Assuming that standing on a siding the rate of combustion is half of this amount or 28 lbs. and that in the 18 miles there is an average lost time of 20 minutes, which is a very conservative figure, the saving in coal would be 933 lbs. or 4.89 per cent. of the total coal burned.

An excellent system of operating and handling the Mallet locomotive has been adopted by Mr. Manning, which is unique and will be of interest to all mechanical officials who have to do with this type of locomotive. In the matter of roundhouse work, the Mallet engines are segregated from the general equipment. A building was erected at the end of the roundhouse and a number of tools for handling the roundhouse work were installed. Night and day mechanics were selected to work on the Mallet locomotives. Their whole time is not put in on the Mallet engines but the understanding and organization is such that when there is work to do on those engines they are the men who look after it.

When overhauling is necessary, the articulated locomotives are, of course, taken over to the shop which is about 100 yards from the roundhouse. At the shop a drop-table has been installed that permits of dropping four pairs of drivers at one time. With this device all the wheels of the articulated locomotives can be removed in twenty minutes after they are ready to be taken down.

As far as the operation is concerned, a maximum speed limit of fifteen miles an hour, both working under load and coming down the grade light, has been fixed. All the articulated locomotives are equipped with speed recorders and the rule in regard to speed limit is rigidly enforced. The locomotives are run forward up the hill for thirty days and then turned and run backard for an equal length of time, thus equalizing the flange wear on the tires of the front and back systems. There can be no doubt that this careful system of operation contributes largely to the successful service which these locomotives are performing. Some of the principal dimensions are as follows:

Weights.—On driving wheels, 457,000 lbs.; total of engine, 457,000 lbs.; tender, 168,800 lbs.

Wheel Base.—Rigid, 14 ft. 9 ins.; driving, 40 ft. 2 ins.; total of engine, 40 ft. 2 ins.; total of engine and tender, 75 ft. 7¼ ins.

Cylinders.—Diameter, H. P., 26 ins.; L. P., 41 ins.; stroke of piston, 28 ins.

Wheels.—Driving wheels, diameter outside, 51 ins.; tender wheels, diameter, 33 ins.

Journals (diameter and length).—Driving, 10 x 12 ins.; tender, 10 x 12 ins.

Boiler.—Type, conical connection; working pressure per square inch, 220 lbs.; outside diameter at front end, 90 ins.; length of firebox, inside, 126 ins.; width of firebox, inside, 114 ins.; tubes, number, 270—2¼ ins., 42—5½ ins.; diameter, 2¼ ins. and 5½ ins.; length, 24 ft.; evaporative heating surface, tubes, 5,245 sq. ft.; firebox, 353 sq. ft.; total, 5,598 sq. ft.

Superheater Heating Surface.—Grate area, 100 sq. ft.; kind of fuel, bituminous.

Tender.—Type of tank, water bottom; tender frame, steel channels; water capacity, 9,000 gals.; fuel capacity, 14 tons; maximum tractive power (working compound), 105,000 lbs.

The Chemist on the Railroad.*

By H. E. Smith.

Chemist and Engineer of Tests, Lake Shore & Michigan Southern Ry., Collinwood, Ohio.

Among the industries of the country, the railroads are probably the largest, whether they be judged from the standpoint of investment required, territory covered, or men employed. Considered as manufacturing establishments, the railroads use as raw materials, iron and steel of all kinds, brass, bronze and babbitt, wood and timber of all kinds, stone, brick, cement, oils and paints, and a great number of materials of lesser importance. The manufacturing process covers various departments of field engineering, power production, shop work and metallurgy. The finished product is the transportation of passengers and freight.

As in numerous other manufacturing industries, the equipment required is constantly becoming heavier, more elaborate and expensive. The methods of operation are constantly becoming more complicated, more specialized and more costly, yet the piece price of the product, transportation, is constantly diminishing. This condition evidently necessitates increasingly scientific management and operation. The need of the civil, the mechanical and the electrical engineer is obvious. With the increasing development has come the need of the chemist and, beginning nearly thirty years ago, the Massachusetts Institute of Technology has at various times furnished chemists for this service.

As has already been partially indicated, the field for the chemist in railroad service is very wide. Early in the construction of a first class road the chemist is in demand for the testing of cement, to ensure sound and durable concrete bridges and other structures; in the selection of ballast stone of such composition and physical properties that it will withstand the weather and the impact and wear of service. Timber for cross ties now commands such a price that economy necessitates preservative treatment by carefully tested and regulated materials and processes. Rails must be of such composition that they will resist wear to the greatest possible degree, yet be free from brittleness.

The problem of boiler water supply, especially that for locomotives, is of very great importance. An average modern locomotive is a complete power plant of 2,000 horse power, mounted on wheels, and contained within a space only a fraction of that required by a stationary power plant of the same capacity. About one hundred gallons of water are evaporated per mile traveled. In many parts of the country the only water available is of such quality that economy in operation requires its chemical purification. This brings to the chemist the problem of carrying out chemical reactions on a large scale, and in extremely dilute solutions, yet with very close adjustment and at a low cost.

Iron castings are used in such quantities that railroad companies frequently make their own. The various kinds of pig iron and the coke must be tested to ensure proper quality. The mixtures must be adjusted to secure the necessary product. Car wheels must be tough and strong yet very hard on the tread, to resist wear. Machinery castings must be strong yet machine easily. Packing rings must be very resilient. Yet in all mixtures economy must be practised by using up scrap.

The proper selection of steel for efficient and economical service is a constant problem. Special alloy steels either with or without special heat treatment or other manipulation are used in increasing quantities. It is necessary to make very frequent and systematic chemical and physical tests to ensure uniform and satisfactory quality.

Large quantities of brass or bronze, mostly in the form of bearing metal, also babbitt for the same purpose, are required. The prices of the constituent metals vary from five to thirty-five cents a pound, which constitutes a strong temptation to substitute the cheaper for the more expensive, so far as possible. The chemist must be called upon to detect such substitution and to determine whether the constituents have been properly proportioned. Scrap must be utilized and the chemist is needed to test the remelted metal and adjust its composition to standard figures.

Paints are used in large quantities on cars, buildings, bridges, etc. The pigments are frequently adulterated with inferior, inert or injurious minerals, the linseed oil with petroleum and inferior vegetable oils and the turpentine with benzine. The proportions of the specified ingredients must also be checked. Lubricating and burning oils constitute another important class of material for study, to secure the proper selection of grades and maintenance of standards.

The list of articles which come up for occasional attention includes, soaps, greases, roofing materials, fireproofing materials, various chemicals, dyestuffs, ink, grinding and polishing materials, disinfectants, rope, cotton and woolen waste, fuel, etc. etc.

Not only must all these materials be examined after purchase but many of them must be bought on definite specifications in order to secure the desired quality under competitive bids. The writing of the specifications falls chiefly upon the chemist. To this end he must study carefully the needs of the service, the quality of material best adapted to meet those needs, as well as the quality available on the market, and finally the methods of test best adapted to determine the quality. This exhaustive study also may be the means of ultimately developing or improving various industries so that it is beneficial not only to the consumer but to the producer.

It is natural that the chemist should also be required to study various methods and processes of operation in different parts of the railway service, with a view to the economy of material or labor or to increasing the efficiency of the service. In all the work above described the investigator must be more than a chemist. He must be something of a geologist, a physicist, a metallurgist, and electrician or a sanitarian as the case requires, and withal must have the ability to predict the effect from the cause, or to trace back from the effect to the cause. It is for these reasons that the brood and comprehensive training offered by the Institute of Technology is especially adapted to fit men to take up scientific work for the modern railway.

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*Presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

Items of Personal Interest

Mr. Frederic A. Ryer has been appointed purchasing agent of the Boston & Albany Railroad.

Mr. B. Wanless has been appointed shop foreman of the Canadian Pacific, with office at Sutherland, Sask.

Mr. C. W. Van Buren, master car builder, of the Canadian Pacific, Eastern lines, at Montreal, has resigned.

Mr. C. F. Loweth has been appointed consulting engineer of the Chicago, Milwaukee & Puget Sound Railway.

Mr. E. O. Reeder has been appointed chief engineer of the Chicago, Milwaukee & Puget Sound Railway.

Mr. W. F. Duane has been appointed general storekeeper of the Texas & Pacific, with office at Marshall, Tex.

Mr. J. Davey has been appointed locomotive foreman of the Canadian Pacific, with office at Bredenbury, Sask.

Mr. C. Gibbons has been appointed foreman, erecting shops, of the Canadian Pacific, at the Winnipeg shops.

Mr. J. E. Sargent has been appointed purchasing agent of the St. Louis Southwestern, with office at St. Louis, Mo.

Mr. Benjamin S. Hinckley has been appointed purchasing agent of the Boston & Maine, with office at Boston. Mass.

Mr. A. Lupton, gang foreman of the Canadian Pacific, has been appointed general night foreman of the Winnipeg shops.

Mr. T. C. Miller has been appointed gang foreman of the Canadian Pacific, Winnipeg shops, vice Mr. A. Lupton, promoted.

Mr. J. E. Sargeant has been appointed purchasing agent of the Cotton Belt system, with headquarters at St. Louis, Mo.

Mr. C. C. Nuckols has been appointed general manager of the Consolidated Car-Heating Company of Albany, N. Y.

Mr. A. B. Copp has been appointed secretary and treasurer of the Chestnut Ridge Railroad, with office at New York, N. Y.

Mr. Edgar Palmer has been appointed vice-president of the Chestnut Ridge Railroad, with office at New York, N. Y.

Mr. W. R. Owen has been appointed assistant purchasing agent of the Rock Island Lines, with headquarters at Chicago, Ill.

Mr. J. D. Maupin has been appointed superintendent of motive power of the Trinity & Brazos Valley Railway, with office at Houston, Tex., vice Mr. C. H. Seabrook, resigned.

Mr. A. E. Bond has been appointed foreman of the Quebec, Montreal & Southern, with office at Iberville Junction, Que., Canada.

Mr. Cornell S. Hawley has been elected president and treasurer of the Consolidated Car-Heating Company of Albany, N. Y.

Mr. A. B. De Baudles has been appointed president of the Chestnut Ridge Railroad, with office at South Bethlehem, Pa.

Mr. Lucius T. Koons has been appointed general manager of the Chestnut Ridge Railroad, with office at New York, N. Y.

H. T. BENTLEY,
President, M. M. Association.

Mr. T. Cassidy, locomotive foreman of the Canadian Pacific, at Rogers Pass, B. C., has been transferred as a fitter to Revelstoke, B. C.

Mr. W. F. Drysdale has been appointed mechanical engineer of the Northern Railway Company, with office at Limon, Colo.

Mr. Frederic B. Goff has been appointed treasurer of the Hunt-Spiller Manufacturing Corporation, succeeding Mr. W. B. Leach.

Mr. C. V. Sexton has been appointed assistant secretary and treasurer of the Chestnut Ridge Railroad, with office at New York, N. Y.

Mr. R. Quinn has been appointed foreman in tender shop in charge of road equipment of the Canadian Pacific, at the Winnipeg shops.

Mr. H. C. Gerror has been appointed road foreman of engines of the third division of the Atlantic Coast Line, with headquarters at Sanford, Fla.

Mr. C. Ludolph, car accountant of the Texas & Pacific, at Dallas, Tex., has been appointed purchasing agent of that road, with office at Dallas, Tex.

Mr. J. Doig, shop foreman of the Canadian Pacific at Cranbrook, B. C., has been appointed night foreman of the east end shops at Calgary, Alta.

Mr. A. W. Davis has been appointed locomotive foreman of the Grand Trunk Railway, with office at Stratford, Ont., vice Mr. A. J. Roberts, resigned.

Mr. A. J. Roberts has been appointed general foreman of the Temiskaming & Northern Ontario, with offices at North Bay, Ont., vice Mr. G. Battley, resigned.

Mr. J. S. Brown, member of division No. 559 of the B. of L. E., has accepted a position with the Galena Signal Oil Company, with headquarters at Indianapolis, Ind.

Mr. John Barnes, member of division No. 302, of the B. of L. E., has been appointed road foreman of engines of the Wabash Railway, with office at Chicago, Ill.

Mr. J. L. Terry has been appointed assistant to the vice-president and purchasing agent of the Denver, Laramie & Northwestern, with office at Denver, Colo.

Mr. E. J. Pearson, consulting engineer of the Chicago, Milwaukee & Puget Sound, has been appointed first vice-president of the Missouri Pacific-Iron Mountain.

Mr. J. Mullen, shop foreman of the Canadian Pacific at Medicine Hat, Alta., has been appointed shop foreman of the east end shops, with office at Calgary, Alta.

Mr. Arthur W. Byron, assistant master mechanic of the Pennsylvania shops at Olean, has been promoted to be master mechanic at the Buffalo shops of the same road.

Mr. J. W. Painter, member of division No. 500 of the B. of L. E., Cleburne, Tex., has been appointed fuel oil inspector for the Gulf, Colorado & Santa Fe Railway.

Mr. E. H. Bankard, purchasing agent of the Baltimore & Ohio Lines, at Baltimore, Md., has recently had his authority extended over the Cincinnati, Hamilton & Dayton.

Mr. James W. Hill has been appointed master mechanic of the Peoria

& Pekin Union Railway, with headquarters at Peoria, Ill., vice Mr. T. J. McPherson, resigned.

Mr. Howard Curry, of division No. 474 of the B. of L. E., has been appointed mechanical superintendent of the Northern Pacific Railroad, vice Mr. Wm. Moir, resigned.

Mr. H. Bowen, shop engineer, of the Canadian Pacific, has been appointed chief draughtsman, mechanical department, of the Winnipeg shops, vice Mr. A. C. Frith, resigned.

Mr. R. D. Smith, assistant superintendent of motive power of the Boston & Albany, has been appointed superintendent of motive power and rolling stock, with office at Boston, Mass.

Mr. W. K. McLeod, locomotive foreman of the west end shops of the Canadian Pacific, has been appointed locomotive foreman of the east end shops, with office at Calgary, Alta.

Mr. G. R. Steeves, employed as a fitter at Field, B. C., on the Canadian Pacific Railway, has been appointed locomotive foreman at Rogers Pass, B. C., vice Mr. T. Cassidy, transferred.

Mr. W. H. Sample has been appointed master mechanic of the Ottawa division of the Grand Trunk Railway, with office at Ottawa, Ont., vice Mr. R. Cowan, assigned to other duties.

Mr. William Moir has resigned from the office of mechanical superintendent of the Northern Pacific Railroad, and from active service in any capacity, and will live in the city of Tacoma, Wash.

Mr. E. Z. Hermansader, assistant master mechanic of the Chicago, Milwaukee & St. Paul, at Green Bay, Wis., has been appointed master mechanic at Dubuque, Ia., vice Mr. Walter Liddell, resigned.

Mr. Walter B. Leach, formerly general manager and treasurer of the Hunt-Spiller Manufacturing Corporation, has been elected president of that corporation, vice Mr. William Prescott, deceased.

Mr. J. E. Hickey, mechanical superintendent of the Mexico, North Western, at Madera, Chihuahua, Mexico, has been appointed superintendent of motive power and equipment, with office at Madera.

Mr. R. A. Gamble, fuel agent of the Alberta division of the Canadian Pacific, at Calgary, Alta., has been appointed car service and fuel agent of the Saskatchewan division, with office at Moose Jaw, Sask.

Mr. F. D. Reed, assistant to the vice-president of the Rock Island Lines, in addition to his present duties, has been appointed purchasing agent, with headquarters at Chicago, Ill., vice Mr. J. M. McCarthy, resigned.

Mr. R. S. Teague, night locomotive foreman of the Canadian Pacific, has been appointed locomotive foreman of the west end roundhouse of the Canadian Pacific, at Calgary, Alta., vice Mr. W. K. McLeod, transferred.

Mr. D. L. Forsythe, road foreman of equipment of the St. Louis & San Francisco, has been appointed assistant superintendent of locomotive fuel service of the South Eastern division, with headquarters at Birmingham, Ala.

Mr. P. A. Crysler, assistant general foreman, passenger car repairs, Angus shops, of the Canadian Pacific, at Montreal, has been appointed assistant superintendent of district No. 3, Eastern division, vice Mr. J. H. Boyle, transferred.

Mr. John Walters, chargeman for E. F. and G. E., Fauquier, contractors for the National Transcontinental Railway, at Cochrane, Ont., has been appointed locomotive foreman of the Temiskaming & Northern Ontario Railway, with office at Cochrane, Ont., vice Mr. L. G. Fleming, resigned.

A. STEWART.
President, M. C. B. Association.

Mr. George C. Jerome announces that he has purchased all the rights and interest of Mr. A. B. Elliott in the firm of Jerome & Elliott. The said business will hereafter be conducted under the firm name of the Jerome Metallic Packing Company (not inc.), at the same address, 1120 West Monroe street, Chicago, Ill.

The officers elected for the year 1911 and 1912 of the American Railway Master Mechanics' Association were as follows: President, Mr. T. H. Bentley, assistant superintendent of motive power and machinery of the Chicago & Northwestern; first vice-president, Mr. D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines; second vice-president, Mr. T. Rumney, general mechanical superintendent of the Erie; third vice-president, Donald R. MacBain, superintendent of motive power of the Lake Shore & Michigan Southern; treasurer, Dr. Angus Sinclair, editor, RAILWAY AND LOCOMOTIVE ENGINEERING, New York.

The officers elected for the year 1911 and 1912 of the Master Car Builders' Association were as follows: President, Mr. A. Stewart, general superintendent of motive power and equipment of the Southern Railway; first vice-president, Mr. C. E. Fuller, superintendent of motive power and machinery of the Union Pacific; second vice-president, Mr. D. F. Crawford, general superintendent of motive power and machinery of the Pennsylvania Lines; third vice-president, Mr. Morgan K. Barnum, general superintendent of motive power of the Illinois Central; treasurer, Mr. John S. Lentz, M. C. B., of the Lehigh Valley; joint secretary of the M. M. & M. C. B. Associations, Mr. Joseph W. Taylor, 390 Old Colony Building, Chicago, Ill.

Obituary.

Michael Fennell, the oldest engineer on the Grand Trunk Railway system, passed away last month at his home, No. 10 Coleraine street, Point St. Charles, Montreal, at the age of 79 years. Mr. Fennell was a railroad man before the Grand Trunk was built. Coming to this country from Ireland, he secured a position on the old Lacihne road, then the only line in operation on the island of Montreal, and when the latter was merged into the Grand Trunk system, Mr. Fennell was transferred to the new management. The deceased engineer had several distinctions of which he was proud. He helped to haul ballast for the construction of Victoria Bridge, and he had the honor of driving the engine which carried King Edward, then Prince of Wales, into Montreal. In his long service of 50 years on twelve sections of the Grand Trunk, Mr. Fennell never had an accident, though he hauled all kinds of trains from ballast to passenger specials.

Samuel Spencer.

The railway men in the South have done a noble thing in commemorating the life and work of Samuel Spencer, who at the time of his death was at the head of an organization of more than 40,000 railway men in the employ of the Southern Railway Company alone. He was president of six railroads. He was one of the finest types of railway men. He was just and generous and companionable. He was an able writer and an eloquent speaker. In youth he had been a gallant soldier. Athlete and engineer, he worked his way from rodman to president with an energy that was tireless. He seemed fitted to do all there is to be done in railroad work and passed from place to place leaving a glad memory behind him. He was a fine example of the truth that it is good to bear the yoke in one's youth. He never forgot what he had been. He was one of the leading master minds in the upbuilding of the South, and the splendid monument erected by the employees of the Southern Railway Company in Atlanta, Ga., is a fitting tribute to the memory of a great and good man. "Vita enim mortuorum in memoria vivorum posita."

International Railway Fuel Association.

The following list of officers were elected at the third annual meeting of the International Railway Fuel Association, held in Chattanooga May 18, 1911: President, Mr. T. Duff Smith, Grand Trunk Pacific, Winnipeg, Man.; first vice-president, Mr. David Meadows, Michigan Central Railroad, St. Thomas, Ont.; second vice-president, Mr. R. R. Hibben, Missouri, Kansas & Texas, Parsons, Kan.; secretary-treasurer, Mr. D. B. Sebastian, Rock Island Lines, La Salle St. Station, Chicago; executive committee for two years, Messrs. R. Collett, Frisco Lines, Springfield, Mo.; R. Emerson, Trinity Bldg., New York, N. Y.; W. C. Hayes, Erie Railroad, New York, N. Y.; for one year, Messrs. E. McAuliffe, Frisco Lines, Chicago, Ill.; J. McManamy, Pere Marquette, Grand Rapids, Mich.; N. M. Rice, A. T. & S. F. Ry., Topeka, Kan.

Chilled Car Wheels.

In reference to the M. C. B. report on car wheels, a synopsis of which will be found in this issue, we give the appendix to the report, which is a communication from the secretary of the Association of Manufacturers of Chilled Car Wheels, and addressed to Mr. Wm. Garstang, chairman, Standing Committee on Car Wheels, Master Car Builders' Association, and dated at Chicago, February 24, 1911:

Dear Sir.—The most important item which the Association of Manufacturers of Chilled Car Wheels has to present to the Master Car Builders' Standing Committee on Car Wheels is the recognition of brake pressure, or the rapidity with which heat is generated on the surface of the tread of the wheel, as an element to be considered in recommending standards. The rapidity with which heat generates through brake friction on heavy grades produces a stress in the wheel greater than from any other single source. The thermal test was introduced to cover this phase of the subject, and has served a very useful purpose. This test, however, cannot take the place of experience with wheels in service, and no test can make a section of any material as reliable as a thicker section of the same material. There is a limit, or a maximum safe working factor, with respect to temperature stress, for each weight of wheel. It is this limitation which we consider of great importance, and which we wish your committee to consider.

The Master Car Builders' recommendations are for wheels for 60,000-lbs., 80,000-lbs. and 100,000-lbs. capacity cars. Coupled with these recommendations should be a maximum braking power for each capacity car. The recent tendency has been to include (especially on the 60,000-lbs. class) cars constructed for special purposes having a very heavy light-weight and a corresponding heavy braking power. Not only is the braking power increased as the light weight of the car increases, but the percentage of brake pressure to the light weight of the car in many cases is being increased from 70 to 80 or 85 per cent.

The result is that we now have refrigerator cars with braking power as high as 38,000 lbs., which is 25 per cent. greater than that used on the majority of 100,000-lb. capacity cars. The result is that under such conditions the 625-lb. wheel under the special 60,000-lb. capacity cars does not possess the same factor of safety as the 725-lb. wheels under the 100,000-lb. capacity cars. The class of cars to which we refer constitutes a very small percentage of the total cars in the 60,000-lb. class, which is all the more reason that special attention should be given them to see that the wheels are in keeping with the conditions under which they operate.

There are several ways of meeting the situation: First: A rule could be established limiting the braking power of cars of each capacity. The objection to this is that in the railway service there are times when every possible pound of braking power is required. If it is considered impracticable to keep the braking power in proportion to the capacity of the car, then another standard wheel should be made to take care of cars, especially in the 60,000-lb. class, in which the braking power is far in excess of the ordinary 60,000-lb. box car. Such a wheel would be the present M. C. B. 625-lb. design, with 1/4 in. of metal added to the plates, which would produce a wheel weighing 700 lbs. Nothing short of this will fully take care of cars which produce the maximum heat in the wheel when operating in miscellaneous trains on heavy grades.

There will then be two wheels for cars using the 60,000-lb. capacity axle, viz.: 625-lb. wheel for ordinary freight cars; and secondly, a 700-lb. wheel for the heaviest refrigerator, furniture, automobile car, etc. In the 80,000-lb. capacity class it is questionable whether the very heavy automobile cars do not have a braking power greater than that intended for the 625-lb. wheel, especially where the braking power is calculated at 80 or 85 per cent. of the light weight of the car, making the braking pressure approximately 40,000 lbs. per car.

Further, the 80,000-lb. and 100,000-lb. capacity cars used in the coal trade are practically identical. That is, the brake pressures are alike. The only difference is that one car is allowed to carry 20,000 lbs. more than the other. The tendency is growing toward the adoption of one wheel to take care of the 80,000 and 100,000-lb. classes.

During the last thirty years the rapid development of the freight car has required a new design of wheel about once in 8 years; the first 600-lb. wheel being made in 1886; the 650-lb. wheel in 1894; the 700-lb. wheel was brought into general use in 1902. During the last eight years the tendency has been to increase the light weight of cars through use of steel underframes; also to carry greater capacities. Cars are now being constructed with axles of 8-in. fit, which corresponds with a gross load on 8 wheels of about 240,000 lbs. Wheels weighing 825 lbs. are furnished for this service. This is simply mentioned to indicate that the development in freight cars has not yet ceased, and that it is necessary to recognize the growing requirements and keep pace with them in the design of wheels.

A graphical chart is submitted, indicating the relation of brake pressure to wheel requirements. This chart is based on numerous observations indicating the effect of temperature stresses on wheels of all manufacture, and is plotted in strict accordance with data obtained not only by wheel companies but by men in charge of brake tests working for and reporting only to the railroad companies.

In conclusion, we wish your committee to recognize the factor of brake power, or the conditions which generate heat in the tread of wheels, as an important element in your recommendations. We are not so much interested in the manner in which this is accomplished, providing that in your recommendations the conditions under which wheels operate will be relative to their weight or class. We would suggest that a committee be appointed, made up of representatives of air-brake companies, railroad companies and wheel manufacturers, to carefully consider this question and formulate report for your consideration.

Yours truly,
Geo. W. Lyndon,
Secretary.

Don't look for oak trees out of acorns in a day or a year. It takes time to ripen both crop and character.

Questions Answered

BACKING OUT BOLTS.

00. W. T. Armourdale, Kansas, writes: We have had difficulty in backing out bolts on rods when it became necessary to do this work. It is an easy enough matter in the machine shop or engine houses where jacks and sledges are at hand, and there is a firm flooring to operate from, but it is not so easy on the road. Probably you could advise us on the matter.—A. Bolts that are partially sheared are always difficult to back out under any condition. Temporary blocking may be placed under a jack almost anywhere, and if the bolt is particularly stubborn, a hot bar of iron or a shovelful of coal from the fire-box may be held so as to partially heat the rod and strap so that the bolt may be more readily removed. With a jack under the point of the bolt a blow on the strap near the bolt head will not infrequently start the bolt. Kerosene oil applied in the opening under the head of the bolt will facilitate the removal of the bolt.

WOOTZ STEEL.

00. Faithful Reader, Davenport, Ia., writes: In the engineering and mechanical papers which I read, mention is occasionally made of Wootz steel, but I cannot find anything about the steel in text books or in advertisements. Can you tell a faithful reader anything about it?—A. Wootz steel is a product of India and was long famous for excellence. It has been made long before steel making in Europe was begun. It is made from a fine quality of native iron melted in crucibles containing some dried wood or leaves. The weight of the bloom produced is from one to three pounds. The fine ore used is the secret of the high quality. Wootz steel is successfully imitated by several steel makers in Europe.

FLUES GASING.

00. Amboy Div. P. R. R., asks: "Can you give me the cause of flues gassing over? I notice that some grades of coal gas over flues quicker than others." A.—In reply to this question we can only say that you probably mean the discoloration of the flues owing to the composition of the gases, resulting from combustion. Some grades of coal contain a great deal more sulphur than others, and the volatile products of combustion sweeping through the flues no doubt discolor their surfaces, or, as you call it, cause the flues to gas over. We imagine that you do not mean clogging of the flues due to soot or ashes, because clogging of the flues by soot or ashes is entirely a different matter. The discoloration of the flue sheet, or mouth of the flues, is largely due to the quality of the coal, and in many cases, if clogging is noticed with soot, ashes of other matter, it is probably due to the bad draughting of the front end. An engine giving trouble in the way of clogged flues ought to be examined at the front end.

TRACTIVE EFFORT AND H. P.

00. A. M. S., Elkins, W. Va.: "Will you kindly inform me how many pounds of tractive effort is equal to one horsepower." A.—Draw bar pull and horsepower are two very different things. Draw bar pull is tractive effort of an engine minus the internal friction of the machine, and it is practically the strain which could be put on a rope or chain, say forty thousand pounds. Horsepower is the rate at which work is done, and work in the mathematical sense is pressure acting through space. In order to compute horse-power, you must not only know the pressure or strain on the rope, but also the distance moved in a given time. In order to reduce this to a standard, mechanical engineers have said that thirty-three thousand pounds raised one foot higher in one minute, is a horsepower. Do not confuse mere pull with work.

MYSTERIOUS LOCOMOTIVE.

00. Engineer, New Haven, Conn., writes: I am not superstitious, but there are often mysteries connected with the working of locomotives that cannot be explained by ordinary common sense. We frequently find that among locomotives built from the same patterns one will prove itself to be much inferior to the others. It will work so badly that one is compelled to believe that inanimate things are subject to moods and misbehavior. What is the explanation?—A. Two engines of the same class may work quite differently, but there is some cause for the difference which will be identified if properly followed up. Steam of a given pressure will produce the same results when pushing pistons of the same size. The writer once had charge of two engines that were of the same dimensions in every particular, yet No. 28 would not do the same work as 29 because she did not steam as freely. A careful investigation revealed the fact that the exhaust nozzles of 28 were not set plumb. When the defect was remedied both engines worked alike.

BROKEN CYLINDER HEAD.

00 A. G. W., Cheyenne, Wyo., writes: We have had some discussion in regard to the proper action for safety in case of the breaking of a front cylinder head and agreed to ask your opinion.—A. Place the valve on the center closing both steam ports and clamp the valve yoke rod so that the valve will be firmly held in place. Then disconnect the valve rod. If the piston has not been damaged there is no need of disconnecting any of the connecting or main rods. The locomotive can then be run with one engine acting only. Keep the broken head in place if possible to keep out grit. In the case of heavy trains there is a tendency on the part of the locomotive to stop at the dead center, but if sufficient momentum can be acquired this risk is very small and unattended by any danger. If the distance to run is over 20 miles or so some method should be adopted to lubricate the piston on the damaged side. A portion of the broken cylinder cover might be removed or slacked off to admit of oil, but if this is impracticable the piston may be lubricated through the steam ports before clamping the valve in position, and the valve may be loosened and moved to admit of more oil after running some time if necessary. Ordinary black oil will do as the cylinder is not heated, there being no steam admitted to it.

REFITTING WALSCHAERTS ECCENTRIC ROD.

00. C. L., Los Angeles, Cal., asks: In refitting the eccentric rod connection on the return crank of a locomotive equipped with the Walschaerts valve gear how can it be determined that the rod is of the right length?—A. In refitting the bearings it should be carefully noted if there are liners used that they be returned with such additions as may be required after the reduction of the brasses, the new liners being as evenly divided as possible. To prove the correctness of the adjustment the engine should be placed on the forward dead center on the side that is being refitted, the reverse lever should then be moved from end to end of the quadrant and if the valve remains stationary the eccentric rod is of the right length. When the link-block is being raised if the valve moves slightly forward the eccentric rod should be lengthened. If the valve is moved backward the rod should be shortened. Careful experiments at this point will show the exact variation from the correct length, which may be readily rectified by changing the liners.

Same Grade.

One day a distinguished notary while breakfasting with a friend at a café in Paris indulged in some stinging comments on the public acts of Marshal Marmont. Suddenly another gentleman, dining at another table, arose and approached them, his mustache bristling with anger. "Sir," cried he, tragically, "you shall give me satisfaction!" "Are you Marshal Marmont?" quietly asked the notary. "I have not that honor," was the indignant reply, "but I am his chief aide-de-camp." "Give me your card, then, sir," said the notary; "I will send you my head clerk."—*Argonaut.*

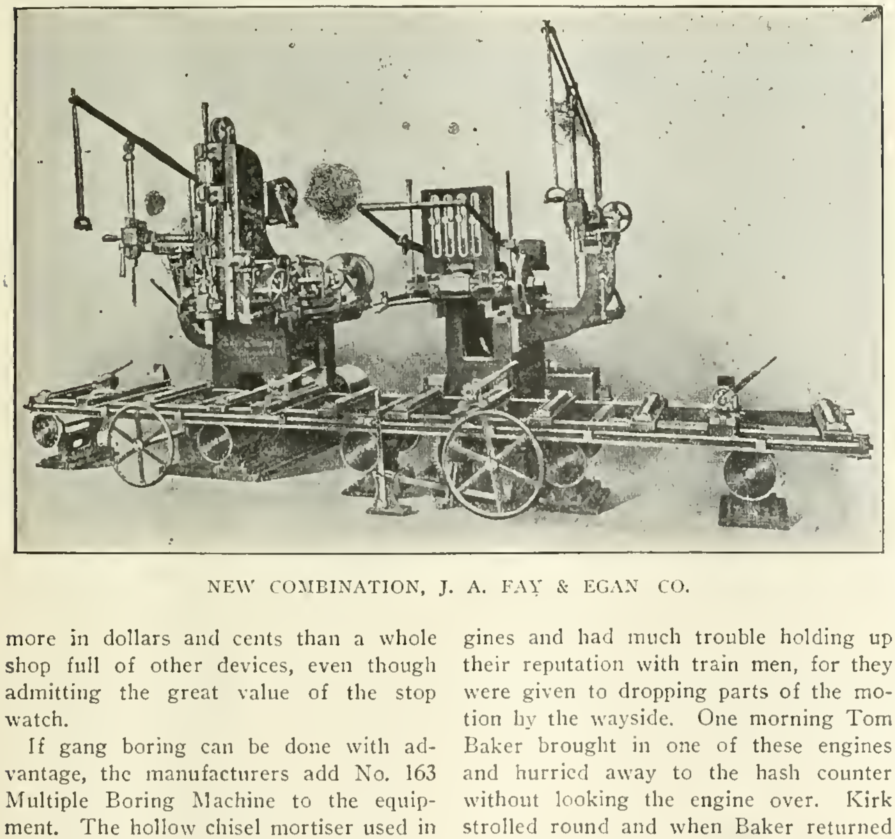
Combination Machine.

When it was seen that certain types of tools had reached their highest development, manufacturers sought to combine one or more separate tools. The pioneers in this kind of work, and the company that is in fact mostly responsible for high development in wood-working tools for use in the car shops is J. A. Fay & Egan Co., of Cincinnati, Ohio. One of the combination productions of this large concern is here illustrated. It is known as the Fay & Egan Combination No. 214 Vertical Hollow Chisel Mortiser and No. 150 Automatic Car Gaining Machine, with boring attachments.

Up-to-date railway mechanics will be quick to appreciate the manifold advantages of being able to place a heavy timber on one carriage and do all of the mortising, gaining and boring that is required without having to carry the work about the shop. This is efficiency and saves more in dollars and cents than a whole shop full of other devices, even though admitting the great value of the stop watch.

If gang boring can be done with advantage, the manufacturers add No. 163 Multiple Boring Machine to the equipment. The hollow chisel mortiser used in this combination is the most powerful machine of its type built. It will mortise from ½ to 3 ins. square and 6 ins. deep. By reversing the timber the mortise can be made 12 ins. deep. For clean, rapid and accurate mortising this machine has for many years been celebrated.

The No. 150 Car Gainer with a 16-in. head will cut a gain 5 ins. deep in timbers up to 20 ins. thick and 24 ins. wide. The cut can be made on either the forward or return movement, or both ways as desired. Space will not permit a full description of the mechanical details of this machine. They are given in full however, in the Fay & Egan catalogue, a copy of which, we understand, is in the possession of every railway purchasing and mechanical official. It is suggested, therefore, that this catalogue be referred to, or if any further information is desired it may be had upon application to J. A. Fay & Egan Co.



NEW COMBINATION, J. A. FAY & EGAN CO.

Saved by the Big Cone.

The revival of the Walschaerts valve gear in this country is bringing out reminiscences of the locomotives that William Mason equipped with that gear for American railways. A group of engines which he built for the South Park Railroad in Colorado had that gear and other peculiarities which made them more notorious than admired. They were small engines, popularly known as Jim Crows, provided with huge smoke stacks with a cone as large as the smoke box door.

Jim Kirk was master mechanic at Leadville. He thought well of the engines and had much trouble holding up their reputation with train men, for they were given to dropping parts of the motion by the wayside. One morning Tom Baker brought in one of these engines and hurried away to the hash counter without looking the engine over. Kirk strolled round and when Baker returned the following conversation is recorded:

"Did you look this engine over when you come in?" says Kirk.

"I allus look over a Crow; they're allus liable to drop somethin'."

"Well, just look at that truck wheel; got six inches broke out of the rim; wonder you didn't go into the Arkansas river."

"That don't hurt nothin'; don't touch."

"Don't hurt? don't touch? What d' y' mean?"

"Well sir, when you're workin' her hard up the hill the exhaust hits that cone so hard it kinder lifts up the front end, so's the wheels don't touch."

Catalogue of Air Products.

The Linde Air Products Company of Buffalo have just issued an elegant catalogue of fifty pages descriptive of the use of the oxy-acetylene blowpipe for welding and cutting metals. The remarkable growth of this new industry is pointed out, and the processes fully explained. The illustrations, which are of the best, present varieties of acetylene generators and complete portable welding plants with details showing the Fouche welding blowpipe with pressure regulator gauges and other attachments. Complete instructions are furnished in regard to the use of the blowpipe, and a number of photographs are reproduced showing repairs that have been made by the use of oxy-acetylene. These are all remarkable as showing that there seems to be no limit to this method of repair work. All who are interested should secure a copy of the catalogue which may be had on application.

Gauge Making.

American machinists are famous the world over for the accuracy of their gauging implements, machines for measuring work, correction gauges, calipers and other accuracy appliances.

The work of making measuring gauges was started in Philadelphia in 1878 by the American Standard Gauge Co. The standards were derived from careful sources in Great Britain and the Coast Survey Bureau in this country on the Whitworth or "touch" system instead of visual inspection.

Flash Point of Oil.

What is known as the flash-point of oil merely refers to the temperature at which an oil gives off inflammable vapor. Petroleum may be dropped on a red-hot plate of metal and it will not ignite. Spontaneous combustion of oil does not exist. The difference between the flashing point when inflammable vapor is given off and the burning point vary with different oils, the average being that the burning point is about 50 degs. higher in temperature than the flashing point.

Drilling Job.

Once in a while a job may arise where tapped screw holes require that the lower part of the holes should be larger so that there will be no thread in that part of the holes. It may be impossible to approach the holes from the bottom. All that is necessary is to drill the required depth the first half of the hole, then take the same drill and grind off one of the cutting sides, throwing the point of the drill out of center. This will increase the size of the lower part of the hole in a ratio to the eccentricity of the drill.

Growth of the Lathe.

From an early treatise by Moxon, published in 1680 in England, it is certain that at that time the lathe was developed to a point where it was possible to turn out high-class ornamental woodwork, including oval shapes, but anything more than this was beyond its power until the slide rest was invented. Devices for clamping the cutting tools in a fixed position were comparatively early, but the first appearance of the slide rest dates from 1772. Complete drawings and details of an excellent slide rest were given in that year in a French encyclopædia. As early as 1741 Hindley, a York clockmaker, produced a screw-cutting lathe with change gears. This of course was a very small machine, and in fact the clockmakers of that day seemed to have a monopoly of mechanical ingenuity. Attempts to produce machinery to replace the work of human hands were made early; thus, for example, in 1732 Wyatt endeavored to make a machine for cutting files, but was not successful.

Grinding Reamers.

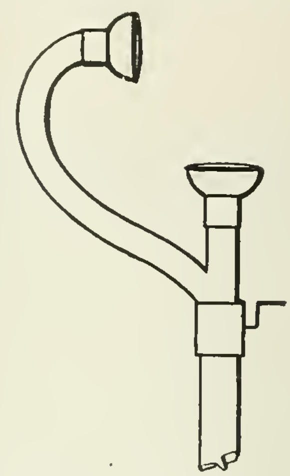
Difficulty is often experienced in grinding reamers owing to the fact that the surface of the emery wheel readily becomes glazed when small areas to be ground are applied to it. The effect of the glazed surface on the teeth of the reamer is of the most pernicious kind, as the teeth of the reamer speedily loose their temper. The glazing may be largely prevented by applying some machine oil to both sides of the emery wheel near the spindle. The oil is speedily absorbed and the centrifugal force, when the wheel is in motion, causes the oil to pass through the wheel and fly off the rim in the form of fine spray, thereby preventing the glazing of the wheel. This remedy, of course, could be applied to the grinding of other articles besides reamers.

Earliest Railway Guides.

The first railway guides were mere children's books compared with present day productions. The first Bradshaw contained six pages only. The date of the origin of Bradshaw is generally given as 1839, and about that time there were other guides in existence which were no less interesting but which eventually died out and passed into the limbo of forgotten things. One of the earliest was entitled "Lacey's Railway Companion and Liverpool and Manchester Guide." It was a very friendly production, describing the scenery through which the railway passed, "and pointing out to the visitor at both places all that was interesting and necessary for business and pleasure." It was published at Liverpool, and was on sale in London as well as in the northern towns at the price of one shilling. Though this old guide does not possess any date, it contains advertisements for the annuals and almanacs for 1835, which provides a clue as to the time of its origin and shows it to be probably the first railway guide ever published. As there were only some twelve trains starting daily, they did not occupy much space, and the guide was expanded to seventy-six pages by a description of the cost and construction of the line.—*London Globe.*

Shop Speaking Tube.

While intercommunicating telephones have largely superseded speaking tubes in office and shop, the conditions existing in some places make the use of the speaking tube much more advisable. In many noisy shops the communication between the tool room and foreman's office for instance, is still carried on by means of speaking tubes and it is need-



MOUTH AND EAR PIECE FOR SPEAKING TUBE.

less to say that this simple method has its advantages.

The accompanying illustration offers a suggestion for a transmitter and receiver on such an outfit and obviates the necessity of shifting the mouthpiece from mouth to ear, and the further annoyance of confusion. The whistle alarm is below both connections and when answered is swung aside in the usual way. We ask our many friends and the general foremen what they think of it. It is not patented. Do you use it?

Find of Manganese Ore.

Modern methods of steel making uses up large quantities of manganese, a metal that is not so bountifully provided in nature's store house as iron and some other ores.

Very extensive deposits of high-grade manganese ore have been discovered near Huttenberg in Carinthia. The quality is said to be equal to that of the finest Swedish manganese, while the ore lies near the surface and can be very easily worked. Viewed industrially Carinthia is one of the poorest provinces of Austria, so that the new find is expected to have an important bearing upon the manufacturing development of the country.

Growth of Trades.

"What I should like to know," said a bright member of an apprentice school, "is when and where the trade of a machinist began. Was it a machinist who cut the first thread of the Archimedes screw made about 250 B. C.?"

The work done by the machinist is almost as ancient as civilization, but the pioneer artisan was not called a machinist. That name did not come into use until last century. The blacksmith is the most ancient artisan and preceded even the carpenter. In the times when industries were developing there existed a class of skilled workmen who rambled about, ready to do any kind of work, from the patching of a chaldron to the making of a millwheel. That class of work was largely performed by gipsys, whose original habitat was Hindostan.

When skillful handicrafts became specialized the common blacksmith developed into the armorer, locksmith and gunsmith. The carpenter extended his handicraft and became a millwright. From the locksmith and the millwright came the machinist and the engineer. The more refined specimens of machine work were done by the locksmith, for besides welding, he had to solder and braze, besides knowing how to produce castings of various kinds that afterwards came to be done by the brass molder.

Nowadays the mechanic who undertakes to do jobs that belong to a variety of trades brings upon himself the reproach "Jack of all trades and master of none." While the mechanical arts were developing, the handy man who could do all kinds of jobs was a most valuable man in a shop or belonging to a community.

P. R. R. Instruction in Nine Languages.

A new book of instructions published in nine languages has just been issued by the Pennsylvania Railroad for the government of employees working on or about the tracks. The English portion of the booklet covers three pages, and following it are translations into German, Greek, Hungarian, Italian, Lithuanian, Polish, Slovak, and Swedish.

The sixteen rules in the booklet are designed chiefly to enforce a proper care in the performance of hazardous duties. Rule sixteen says: "Any employee who, while on duty, is careless about the safety of himself or others, or who disregards warnings, shall be subject to discipline." Another rule makes possession of the book and a knowledge of its contents obligatory for all track workmen.

Railroad men wishing to obtain a copy of this interesting book should apply to Mr. W. W. Atterbury, Broad Street Station, Philadelphia, Pa. Rule sixteen appears to us to very closely define a chance-taker.

The New Bridge at Quebec.

The letting of the contract for the superstructure of the new Quebec Bridge to the St. Lawrence Bridge Company, at $8,650,000, brings the total cost of the bridge, including the substructure, up to $12,000,000. The bridge will be the largest cantilever bridge in the world, the suspension span being the longest single truss span ever designed. The span exceeds that of the celebrated Forth Bridge, Scotland, by 90 ft. It is intended that the bridge shall be ready for traffic by 1915. The awarding of the contract to the St. Lawrence Bridge Company, consisting of a working union of the Dominion Bridge Company and the Canadian Bridge Company, is a matter of great satisfaction to the people of Canada. The bridge when completed will be a monument to the ingenuity, skill and courage of Canadians. It will be one of the greatest engineering works undertaken in this country.

The design adopted will have K.-webb system in the cantilever and anchor arms. The suspended span is of a modified Pratt type. The length of the center span is to be 1,800 ft. The total length of the structure is 3,228 ft., or about three-fifths of a mile. The suspended span is 640 ft. long, 110 ft. deep at the center and 70 ft. at each end. The cantilever arms are 580 ft. long, 70 ft. deep at the end and 310 ft. high over the main post. The anchor arms are 520 ft. long. The width of the bridge between the trusses is 88 ft. The bridge will be 150 ft. above high water. The depth of the water in the center of the river is 200 ft. All members in the anchor arms and those immediately over the main pier, as well as the floor arms, will be built of carbon steel. The cantilever arms and suspended span will be of nickel steel.

The piers are all to be built of cement concrete below water, and granite-faced masonry filled with cement concrete above water. The abutments are to be of granite masonry. The caisson over the main pier on the south side will be 180 ft. by 55 ft. The north side will be built in two sections, each caisson being 65 ft. long by 60 ft. wide. The bridge will accommodate a double track railway and will have a four-foot sidewalk on each side for foot passengers. There are over 100,000 cu. yds. of masonry in the piers and abutments. The weight of steel in the superstructure is estimated at 100,000,000 lbs. The transportation of this immense quantity of steel will require the use of 1,667 freight cars of 60,000 lbs. capacity, or sixty-seven trains of twenty-five cars each.

In the design finally approved there is a main post over the main piers with the top cords meeting in a point at the top of this post.—*Canadian Engineer.*

OUTLINE OF BRIDGE OVER THE ST. LAWRENCE, BETWEEN QUEBEC AND POINT LEVIS, CANADA.

A Key Ring for You.

A very useful little article for personal use is a key ring and chain, and there is one well worth having that is free for the asking. Let us tell you about the make-up of the whole thing. In the first place it has a chain about 18 ins. long made of most ingeniously folded and bent light, but strong brass wire; the links are double, that is the bending makes two links rigid together with a neat little knot between where the ends of the wire are twisted together, so that their ends are out of the way and can't catch in anything. The double link is about half an inch long and quite artistic in appearance.

The upper end of chain fastens over the edge of the trousers or other convenient place. It is thus independent of any button and the hook has a binding snap which secures it where it is placed without possibility of slip so you can't loose your keys and no one can attempt to take them from you without your finding it out at the earliest stage of the game. The clip and hook are something like what goes with some of the best forms of cuff holders, which grip a fold in the shirt sleeve in the morning and the wearer forgets he has it on, so sure and comfortable is he in its possession.

There is also a neat little piece of mechanical engineering in the key ring which beats all the other rings we have seen all hollow. Talking of hollows, you know when you want to get a key on a ring the ends of the two folds or split of the ring are usually made more like a stub switch than anything else, and you have to pry the split apart before the key will go on. It is secure enough when the key is on, but it is often a little troublesome to get it on. Now in the Bridgeport Chain Company's ring, the split is purposely and permanently opened about 1/16 in. close to one end of the joint. This makes a tiny hump just there, but you put the circle-end of the key in the mouth of the little opening and the key slides on the ring fast enough to save you all trouble aud to show its appreciation of what has been done to get rapidly on the ring. The key comes off by the same route with equal facility, but it can't come off without your assistance. This key ring will be sent to you if you drop the Bridgeport Chain Company a post card addressed to them at Bridgeport, Conn., and say you saw the notice in RAILWAY AND LOCOMOTIVE ENGINEERING. That is easy to do and it's worth the trouble.

Couldn't Find Them.

A green salesman for coal approached an engineer of a large company recently, with a view of securing his year's business. The engineer asked him how much sulphur the coal contained. The salesman was ready with his answer and said: "As low as 1 per cent." The engineer next asked him how much ash was in the coal. Again he was ready with his reply and stated that it had 5 or 6 per cent. The engineer next asked him how much fixed carbon was in the coal. That was a new term to the salesman, but he was going to carry his bluff and said: "From 15 to 20 per cent." The engineer next asked him how many B. T. U. were in the coal. The salesman was again ready with his reply and said: "Do you know, we have tried time after time to find those pesky B. T. U., but we have never succeeded in locating one in our coal."—J. M. Leunam in *Power.*

Falls Hollow Staybolt Orders.

We have received word from the president and general manager of the Falls Hollow Staybolt Company, of Cuyahoga Falls, Ohio, that they have just shipped a carload of Falls hollow staybolt iron to the Buenos Ayres Great Southern Railroad, at Buenos Ayres, S. A., and have also recently furnished a large quantity of hollow staybolt iron to the Cordoba Central Railway, at Rosario, S. A.; the Northern Railway, of Limon, C. A.; the American Railroad Co., of Porto Rico; the Guayaquil & Quito Ry. Co., Guayaquil, Ecuador, S. A., and to the Guantanamo & Western Railroad, Guantanamo, Cuba.

The staybolt people now have orders on hand for shipment to the Central Railway, of Peru, S. A.; the Salvador

Railway, La Union, Salvador, and the Ferrocarril de Guatemala Railway, C. A. Furthermore, they are also expecting a carload order for shipment to the Korean Railway, Korea. The prospects for business are very encouraging for the remainder of the year.

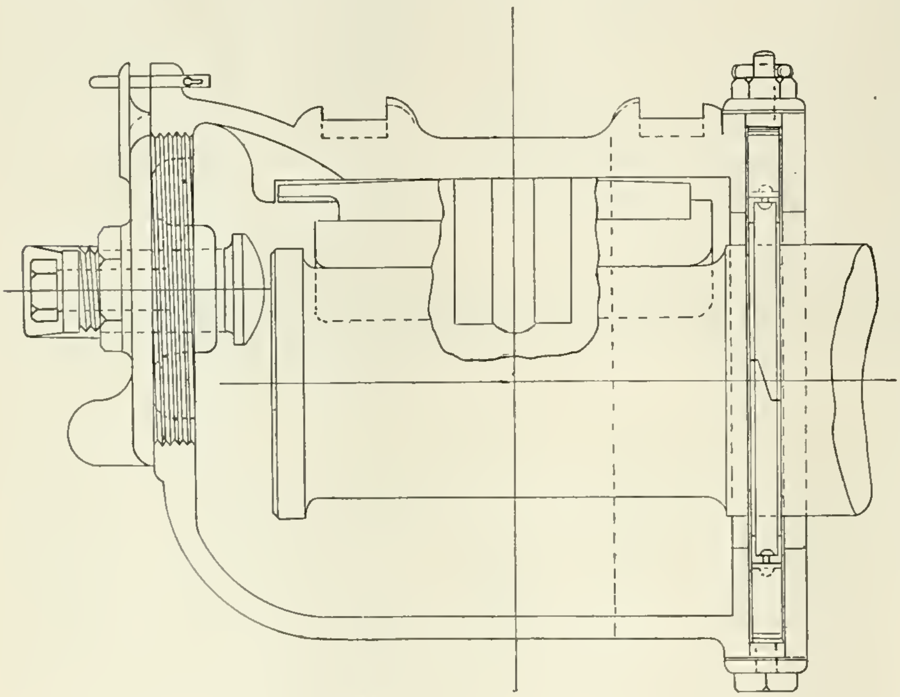
Newest Newcomb Journal Box.

The Newcomb Journal Box Manufacturing Company, of Carthage, N. Y., have brought out a new journal box which embodies features of merit and novelty of construction which will appeal to the mechanic at a glance.

The "shock," or lateral motion, is taken up by means of an adjustable button of phosphor bronze, and the lid closes so tightly as to practically hermetically seal the box.

The box can be sealed in another way as well, by means of an ordinary car seal, and it has a record of four months' service without oiling and five months without re-packing, the bearing being found in perfect condition at the end of this time, with no attention bestowed on it during the test. The company's slogan is "Betterment Means Dividends," and this would seem to be an appropriate maxim in view of the results of tests.

By reference to the illustration it will be seen that the box is round at its outer end with the cover screwed on. The phosphor bronze abutting disc, above referred to, receives the thrust or slide of the car and relieves the lugs on the brasses of that pressure and consequently reduces wear. This abutting disc is eccentric with respect to the journal and therefore constantly distributes the lubricant. It is needless to say that the Newcomb Company have followed M. C. B. standards in construction.



THE NEWCOMB RAILROAD JOURNAL BOX.

Vanadium Facts.

American Vanadium Facts is one of the recent additions to the engineering publications that treat of some particular product, and is a handsome twelve-page periodical finely printed and illustrated. The leading article in No. 3, just issued, is an address by Mr. G. L. Morris, engineer of tests for the Vanadium Company, delivered before the American Foundrymen's Association, on May 24. It presents very fully and clearly the effect of vanadium in cast iron. The article demonstrates beyond a doubt that at an increased cost of little more than half a cent a pound the tensile strength of cast iron may be raised from 24,225 lbs. to 28,728 lbs. This is not all. In the toughening effect obtained together with the uniform fineness of grain it has been shown that in the wear of vanadium cast iron cylinders twice the normal mileage could be obtained than could be done with common cast iron cylinders.

Other articles treat on vanadium steel castings and bearing metals and other products, and the high claims made for the use of vanadium are ably sustained by the publication of testimonials from various parts of the country where its qualities have been fully tried. Copies of the publication may be had from the American Vanadium Company, Pittsburgh, Pa.

Chambers' Throttle Valve.

Among recent orders for new locomotives on which the Chambers' throttle valve has been specified, are the following: Sixty-three for Southern Railway, 30 for Queen & Crescent, 8 for Mobile & Ohio, 25 for Seaboard Air Line, 35 for Atlantic Coast Line, 5 for New Orleans & Northeastern.

The features about the Chambers valve that have met with greatest favor are the ease of making inspections or repairs without removing the standpipe, the impossibility of interior disconnections and engine failures from this source, and the absence of unbalanced thrust upon the throttle stem. The Chambers valve is manufactured by the Watson-Stillman Co., 50 Church street, New York.

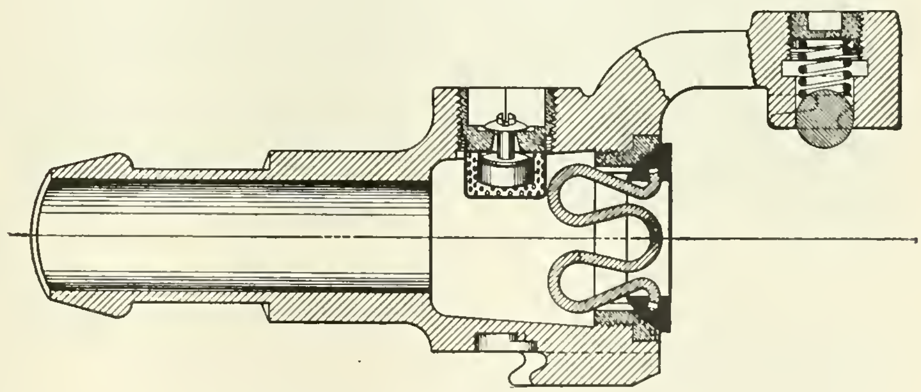
Effectible Efficiency and Economy.

The design of any piece of mechanism used on railways generally involves the consideration of several diverse conditions, and a good example of how this has been most successfully done may be had in the latest type of steam heat coupling designed by Mr. Edward E. Gold, president of the Gold Car Heating & Lighting Company of New York. This type is known as Gold's ball lock coupling No. 701 and differs from the type we described on page 129 of our March 1911 issue, principally in this matter of the lock.

On the side lug of the coupling there is a projection having a deep groove. This engages with a similar projection and groove in the other coupling. This is usual practice, but now comes the ball lock to hold the couplings together so that they do not tend to spring up and so uncouple, and at the same time the ball lock puts pressure on the faces of the gaskets so that they are drawn tightly together all the time and so do not leak, and the wear of the faces is automatically taken up. That is the business of the lock, now note how effectively it does it.

On the outer end of the lug where the projection and groove are, a hole is drilled for the insertion of a plug, and the plug has an internal square like a wash out plug in a boiler where a projection cannot be used. The plug supports a steel spring and the spring presses a steel ball into an open socket which is just large enough to allow the ball to come through the projection of the lug, say about as much as the world would, if pushed into an open socket with a little more than the arctic circle showing. When the couplers are brought together the lugs engage and the balls are pushed back slightly against their own springs as they enter a guide groove, ride over a short flat area on the coupler head, and drop into a hole in the head. The spring pushes on the ball from behind and there it rests in the shallow little hole securing the couplings locked.

While the ball is holding the couplings locked, it is pulling the face of the gaskets together to prevent leakage, and it is capable of taking up wear. This is done by simply stepping the hole into which the ball locks. The hole is about ¾ in. in diameter and ¼ in. deep. Another hole, slightly eccentric is drilled down about ⅛ in. and you have a depression something like a circular sink with a circular draining shelf attached, or like what some people would call a sitz bath, only very much smaller of course. Now when the ball drops into this depression the eccentricity of the shallow half of the depression is such that the center of the ball goes past the edge of the step and the result is a steady effort of the ball backed by its spring to get down into the deep hole and this results in a constant pull on the coupler heads which brings the gaskets tightly together all the time. This is also arranged as a positive lock. These gaskets are made of vulcabeston, and they seat in a bushing of brass in the coupling head. They are easily removed and easily replaced, and they do not break, because they can be hammered out of shape and then hammered back and still be serviceable.



GOLD'S BALL LOCK STEAM HEAT COUPLING.

This coupling has the latest form of gravity trap. This is a circular brass plug with a sunken square for screwing it into the main portion of the head and it reaches into the steam passage. This steam passage, we may say is 1½ ins. in diameter and that means full, free flow of steam. This plug has a perforated brass strainer on the inside end. The center of the plug is pierced by a small hole and in this, very loosely lies a cup head outside and a heavy valve on the inside. The valve is held tight against its seat on the inner face of the plug when steam is on, but falls away when steam is off, and so lets the water which has accumulated, run out. This water passes out through the hole with the loose-fitting stem. The point about the gravity trap which puts it in the front rank is that a workman can ascertain if steam is on before he disconnects the coupler. If steam is on and he wishes to prove it he can do so by pushing the head in, with a bit of stick or anything handy, unseat the valve and tell by the steam flow how matters are. If steam is off the valve will be unseated and water will be dripping out or will have dripped out, and he is safe. The gravity trap prevents freezing, and it is a non-scalder for car men. Two good points, for they make it a safety appliance.

The Wrong Road.

An employee of a Northern railroad, on starting away on his vacation, was granted a pass over the company's lines. During his vacation the young man was married, and as he was returning to the city with his bride, he by mistake handed the conductor on the train his marriage certificate instead of his pass. The conductor, a Scot, looked long at the certificate and then handed it back. "Eh, maan, you've got a ticket for a lang journey, but no on the Caledonian line."

New Tools.

The Springfield Manufacturing Company, of Bridgeport, Conn., have recently perfected a motor-driven self-contained car wheel driver which is apparently an improvement in this line of tools which merits the attention of railroad people. Another tool which this concern is bringing out is their variety grinder which is also motor-driven, having a bed-plate operated on the principle of a planer, and which is calculated to facilitate the facing of guide bars, etc. Those interested would do well to write the Springfield Manufacturing Company for detailed information.

Sprague and General Electric.

One June 1, 1911, the Sprague Electric Company was merged with the General Electric Company, of Schenectady, N. Y. The business of the Sprague Company will be connected under the name Sprague Electric Works of General Electric Company. The manufacture and sale of the lines of apparatus and supplies heretofore exploited by the Sprague Electric Company will be continued by the Sprague Electric Works of the General Electric Company under the same organization, with Mr. D. C. Durland in responsible charge as general manager, and with the assurance that the characteristic high quality of product and efficiency of service to their customers will be maintained as heretofore. All correspondence should be sent to the Sprague Electric Works at the same address as in the past. Bills and statements will be rendered from the Sprague Electric Works, No. 527 West Thirty-fourth street, New York, N. Y., to whom all remittances should be made. The offices of the Sprague Electric Works will be continued, the main offices at 527-531 West Thirty-fourth street, New York, N. Y., and branch offices in the principal cities.

New Vestibule Trap.

The O. M. Edwards Company, of Syracuse, N. Y., are selling a very ingenious platform trap, devised to meet modern needs in connection with the "car-floor-level" station platforms.

The trap is actuated by a lever in the vestibule and slides out to meet the landing platform, thereby closing the usual and dangerous opening between it and the car.

The vestibule door cannot be closed until the trap is drawn in, and it cannot, therefore, be forgotten. The trap can be operated in the usual way also, and is thus available at way stations or random stops. A dual trap with a single purpose—safety.

Another trap manufactured by this company provides for its use as a gate on open-platform passenger cars, and complies with the law in some States requiring a gate on such cars.

Drop Forged Lathe Dogs.

The Armstrong drop forged steel lathe dogs and clamps have already earned an enviable reputation, but the enterprising firm are constantly adding something new to their fine products. Their latest booklet, No. 5, just issued, contains clever variations in lathe dogs and clamps. Some of the devices are especially adapted for use on finished work and can be quickly applied without removing work from centers. A bolt driver of special merit suitable for square, flat or hexagon is described and illustrated, and as a time-saver is sure to meet with approval. There are ten illustrations in the booklet and all are of interest to machine shop men. Copies of the publication may be had on application to the Armstrong Bros. Tool Company, 339 N. Francisco avenue, Chicago.

Northern Pacific Yellowstone Folder.

The Northern Pacific passenger department has just issued their 1911 folder, entitled "Seeing Yellowstone Park Through Gardiner Gateway." This is a publication describing a complete park tour and gives every piece of information which the sightseer naturally wants. It is profusely illustrated, containing a topographical map of the park with a convenient table of the geysers and other phenomena, a table of distances and altitudes, a schedule of the stage service, description of the hotels and points of interest, with full information as to cost. Copies may be had by addressing the general passenger agent at St. Paul, Minn.

McKeen Motor Cars.

Our illustration shows one of the latest types of the McKeen motor cars as built for the Ann Arbor, of which we made note last month. Since that time the McKeen Motor Car Company, of Omaha, Neb., have received an order for a 70-ft. motor car for the People's Electric Railway, at Muskogee, Okla., an an order from the Sand Springs Interurban Railway, at Tulsa, Okla., for a second 70-ft. car. Not long ago they received an order for one of their standard 70-ft. motor cars for the Oregon-Washington Railroad & Navigation Company, at Attalia, Wash. These cars appear to fill a long felt want and are doing good work in their own particular field.

McKEEN MOTOR CAR ON THE ANN ARBOR.

A Test of Patience.

Fra Elbertus says that he has ridden on railway trains for twenty-five years without having lost a hat, grip, umbrella or his temper. The writer has been riding on trains pretty regularly for fifty-five years and had the same experience as Fra Elbertus, with one exception. That was when a car he was riding in broke an axle in a South Carolina swamp and was left all night at the mercy of the most bloodthirsty mosquitoes that ever rendered a bill. After fighting the mosquitoes till he was worn out he lost patience that night.

Safety Car Step.

The American Mason Safety Tread Co., of Boston and New York, are as usual in the vanguard with safety devices. The latest achievement by this company is a tread for car steps which is entirely new in appearance and construction. The device consists of a one inch hard wood step made to the dimensions of various standards, and having a series of holes or pockets drilled in the face to a depth of one-half inch. These holes are filled with a special carborundum cement and struck flush. The front edge of the steps is faced with a metal strip, which in turn is backed by a strip of carborundum, presenting three-quarters of an inch face.

One cannot place the foot upon this step in any manner that will permit of a slip, whether in wet weather or dry, and the step is therefore in very truth a safety device which is safe.

Improved Car Rack.

The Elm City Gas Stove Company, of New Haven, Conn., have secured from the inventor an improved device known as the Yale Passenger Car Rack.

It possesses many features of merit, being so constructed that it permits indefinite extension, or installation in series or individually, as desired.

The rack can be readily removed for polishing or repairs without disturbing the wood screws or the attaching bolts, it merely being necessary to loosen a clamping bolt to do this. None of the clamps, etc., can be lost by reason of their construction, and the whole, when in place, presents an even surface on the top, so that a suit case when once placed is sure to remain in the intended position.

Boston Elevated Buys G. E. Equipment.

The Boston Elevated Railway Company have ordered the following apparatus from the General Electric Company, of Schenectady, for the equipment of their new power station at South Boston: Two 15,000 kw. 6,600-volt 25-cycle turbo-alternators, six 2,500 KVA compensators, and two motor-operated rheostats. The turbines will generate power at 6,600 volts and this will be stepped up to 13,200 by the compensators which are designed with a high reactance to reduce the current and thus prevent the turbines from receiving a heavy shock on a short circuit. The station will supply power to seven rotary converter railway substations, four of which will contain 2,000 kw. units, and the other three 1,000 kw. units. The present installation of rotary converter equipments consists of eight 2,000 kw. and four 1,000 kw. units complete with transformers and switchboards.

Automatic Loose Pulley Oiler.

Our illustrations show the manner in which an application of centrifugal force may be used to automatically oil loose pulleys. The cup will run from one to three weeks after filling, according to the number of starts and stops that are made and the speed at which this pulley is run. All the oil that is put into the cup gets to the bearing. The nuisance resulting from having oil spattered over floor, workmen, machines and belts is entirely done away with and a saving in oil and time is thereby effected.

Fig. 1 shows the cup ready to screw into the hub of the pulley. Fig. 2 is a

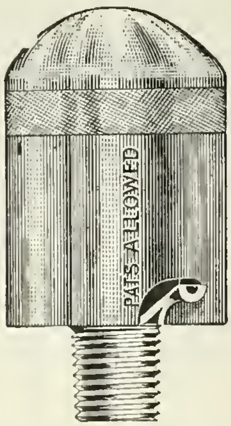


FIG. 1.

view of the inside showing the feeding tube. Fig. 3 shows the cup detached from the nipple for filling. This can be done easily with the hand, no wrenches being required. The cup can be removed, filled and replaced with the pulley in any position, thus doing away with the necessity of shifting belts or turning the shafting to bring the oil hole on top. When the pulley is brought into operation the centrifugal force throws the oil to the top of the cup and fills the feeding tube. When the pulley starts next time a portion of the oil in the tube is fed to the bearing and the tube again fills itself. When the pulley is so placed that the cup is head down oil flows into the feeding tube, and when the cup comes right side up, the oil goes down the feeding tube like water down a bird's throat when it raises its head in the act of drinking after filling its bill with water. This oil cup is sure to deliver oil no matter at what speed the pulley revolves.

The 20th century automatic loose pulley oil cup is made of thin pressed steel and is so light that counterbalancing is not necessary. It is, however, amply strong as there are no moving or wearing parts. It is manufactured and sold by the American Specialty Company of Chicago.

Courtesy on the Erie.

A sweet-faced old lady from Boston was going West on No. 3 and expressed herself keenly interested in the beautiful

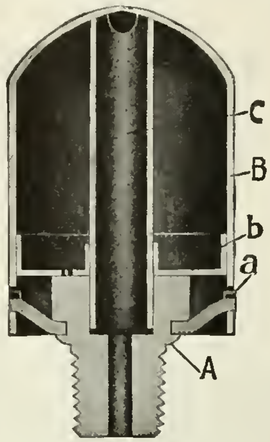


FIG. 2.

scenery traversed by the Erie Railroad. Shortly after the train passed Port Jervis some one told her that the fine river they had just crossed was the Delaware. "The Delaware," she exclaimed, "that is the river General Washington crossed with his army. Conductor, I wish that you would point out to me the exact spot where General Washington crossed this noble river."

"All right, ma'am," was the reply.

Trenton, where the actual crossing of the Delaware took place, was some hundred miles nearer the sea, but the conductor was a humane man who hated to deprive the old lady of the pleasure of

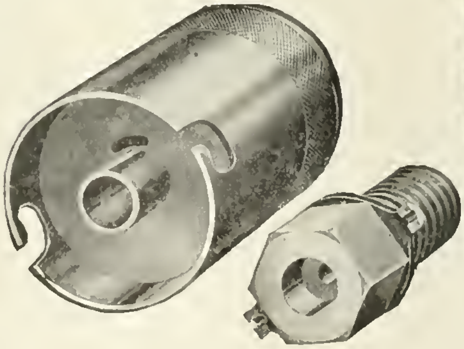
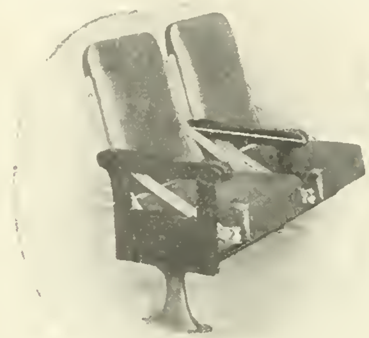


FIG. 3.

gazing upon the historic spot where the father of his country performed the heroic deed of crossing the ice-swollen stream. When near Callicoon, at a spot where the river rushes clear between wooded banks, the conductor went to his passenger and said: "There, madam, that is the spot where the crossing was made." "Wonderful," exclaimed the lady. "How heroic to climb over all those rocks. Conductor, if you ever come to Boston, call on me and I shall send my son to show you Bunker Hill."

Car Seat Inovation.

The Scarritt-Comstock Furniture Co., of St. Louis, are offering a new car seat, unique, simple and attractive. The seat recommends itself to railroads of all classes, being both compact, but roomy. In appearance it somewhat resembles a



BOTH SEATS SAME WAY.

reclining chair, but is such in appearance only. In brief it is a sociable or twin seat, on the plan of a conversation chair; the occupants facing both forward or vis-a-vis at will. The French would call this a téte-a-téte chair.

Should passengers wish to converse they can face each other; should the light not be satisfactory for the reader of a magazine or paper, the half seat can be

SEATS ARRANGED TETE-A-TETE.

instantly reversed without disturbing the other half.

A peculiar feature of merit which identifies all seats made by this company is that the seat proper will not slide out of place or "jump up," it being secured by a contrivance which prevents displacement unless the seat is purposely removed. Another strong feature is the ample unobstructed room underneath for suit case or bag.

New Short Line.

Mr. Julius Kruttschnitt, vice-president of the Union and Southern Pacific railroads, has recently completed a tour of these lines in the Northwest. He said that the lines, as a whole, had come through the winter in much better condition than ever before. Work is being rushed on the road connecting Spokane with the Oregon-Washington main line at Ayre, which will give the Harriman companies a line between Spokane and Portland 100 miles shorter than any other route.

Catalogue and Reference Book.

A Study of the Blast Furnaces, by Harbison-Walker Refractories Co., Pittsburgh, Pa. This enterprising company has spared no points in presenting a fine book of real value to all who are interested in Blast Furnaces. The work is divided into six chapters, giving complete details of the interesting operations, with illustrations of the various forms of crucibles and methods used. The entire subject is discussed with a thoroughness that would be difficult to surpass. Special emphasis is laid upon the lack of attention that has been given to the importance that should be attached to the quality in stove brick. Copies of this valuable book, which is elegantly illustrated and finely bound, may be had on application.

Handled Vacuum Expertly.

Two men on a train were in an argument as to the action of the vacuum brake.

"I tell you that it is the inflation of the tube that stops the train!" exclaimed one.

"Nothing of the sort!" was the reply. "It's the output of the exhaustion."

At the next stop it was decided to submit the matter to the decision of the engineer. Leaning out of the window of his cab, he listened condescendingly to the arguments of both men. Finally he said:

"As a matter of fact, you're both wrong. When we want to stop the train we just turn this tap, which fills the pipe with vacuum."—*Lippincotts.*

U. S. Electric Catalogue.

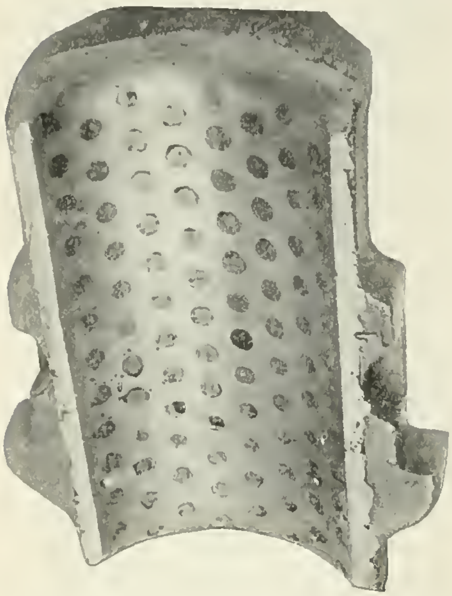
The United States Electric Company, of New York and Chicago, have issued as Bulletin 702, under the title "Absolute Safety by Selective Signaling," a description of the selective dispatcher-controlled train-order semaphore system. RAILWAY AND LOCOMOTIVE ENGINEERING, which means to keep abreast of all improvements, was the first of the railway press to describe this system which was illustrated in the June issue. The Bulletin is prepared in the same general style of imparting information which has characterized the literature of this concern. It is well printed and clearly illustrated. The publishers will furnish copies on request.

New Application of Graphite.

The Strong, Carlisle & Hammond Co., of Cleveland, O., have appeared in the market with a bearing device for lessening friction and saving money for the user, two very important factors in this day of close figuring.

A bronze wire screen made in standard size of 12 x 12 ins., is dotted with graphite cones set at regular intervals all over the surface, and in application a suitable size is sheared from the sheet and placed against the shaft or other bearing. Then the bearing is babbitted in the usual way and when finished the screen forms a bond and the graphite cones present their ends to the shaft.

For use in journal bearings the M. C. B. standard has been considered, and the graphite cones are of standard height so as to simplify the application.



BRASS WITH GRAPHITE CONES.

The claim that the saving on wear is considerable is amplified by the further statement that the babbitt displaced by the graphite represents an equivalent in cost of the cones and screen; in other words, it costs no more to babbitt a box in this way than it does by the old method, and the box will wear longer.

On a certain railroad where it was formerly necessary to set up the journals on the tenders after each long haul (and return) this device was put in service and the labor cost of replacing has been cut in half.

Oxy-Acetylene Welding.

There is a general impression prevalent among laymen that mud-burn troubles are confined principally to engines in the West, more particularly in the alkaline districts.

It is a fact, however, that mud-burn is quite common all over the country and all master mechanics have for years been troubled more or less to keep out of the grip of that malignant old goblin.

Oxy-acetylene has found favor with the railroads in many ways, but perhaps in none so important as the quick and sure application of a patch. Some of our friends who have a great deal of patching to do, have discovered that a patch applied by the welding process is liable to creep and buckle, and that the cutting of the patch a trifle short will overcome this difficulty, and the aperture will close smoothly as the patch is welded into place.

Spontaneous Combustion.

"The Spontaneous Combustion of Coal with Special Reference to Bituminous Coals of the Illinois Type," by S. W. Parr and F. W. Kressmann, has just been issued as Bulletin No. 46 of the Engineering Experiment Station of the University of Illinois. The Bulletin describes a series of experiments directed toward the determination of the fundamental causes underlying the spontaneous combustion of coal. These causes may be summarized as follows. (1) external sources of heat, such as contact with steam pipes, hot walls, and the impact of large masses in the process of unloading, height of the piles, etc.; (2) fineness of division; (3) moisture; (4) activity of oxidizable compounds, such as iron pyrites. An historical review of the literature upon the spontaneous combustion of coal is given in the Appendix. Copies of this bulletin may be obtained gratis upon application to Dr. W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

The Stove Burned Lovely.

It would be jolly to have a real country servant! She would be simple and young and unsophisticated. So refreshing, after the way in which their London domestic had lorded the entire family.

Her name was Elsie, and she turned out to be very simple and very young and very unsophisticated. She had never seen a carpet-sweeper or heard an alarm clock, and she stared in open-mouthed astonishment when her mistress lit the gas stove for her in the kitchen.

But she declared stoutly that she would soon grow accustomed to her new surroundings and her mistress left her to work them out by herself.

"How do you find the kitchen range?" asked the mistress at the end of a week.

"'Deed, mum, it's lovely!" replied Elsie enthusiastically. "I never seed a stove with less trouble to it! Why, the fire you kindled for me when I came is burning brightly and evenly ever since, and I never put a hand to it, nohow."

The B. T. U. in Coal.

A coal agent suggested to me a happy rule for determining this. It is such a valuable rule that all readers of *Power* should be informed of it. It involves no intricate analytics, trigonometry or calculus, but simply the multiplication and division of numbers. The rule is as follows:

Divide the pounds of coal in a car by the railroad number of the car, and multiply the quotient by the price per ton. The final result is the British thermal units, or the B. T. U. per pound.—J. M. Leunam in *Power*.

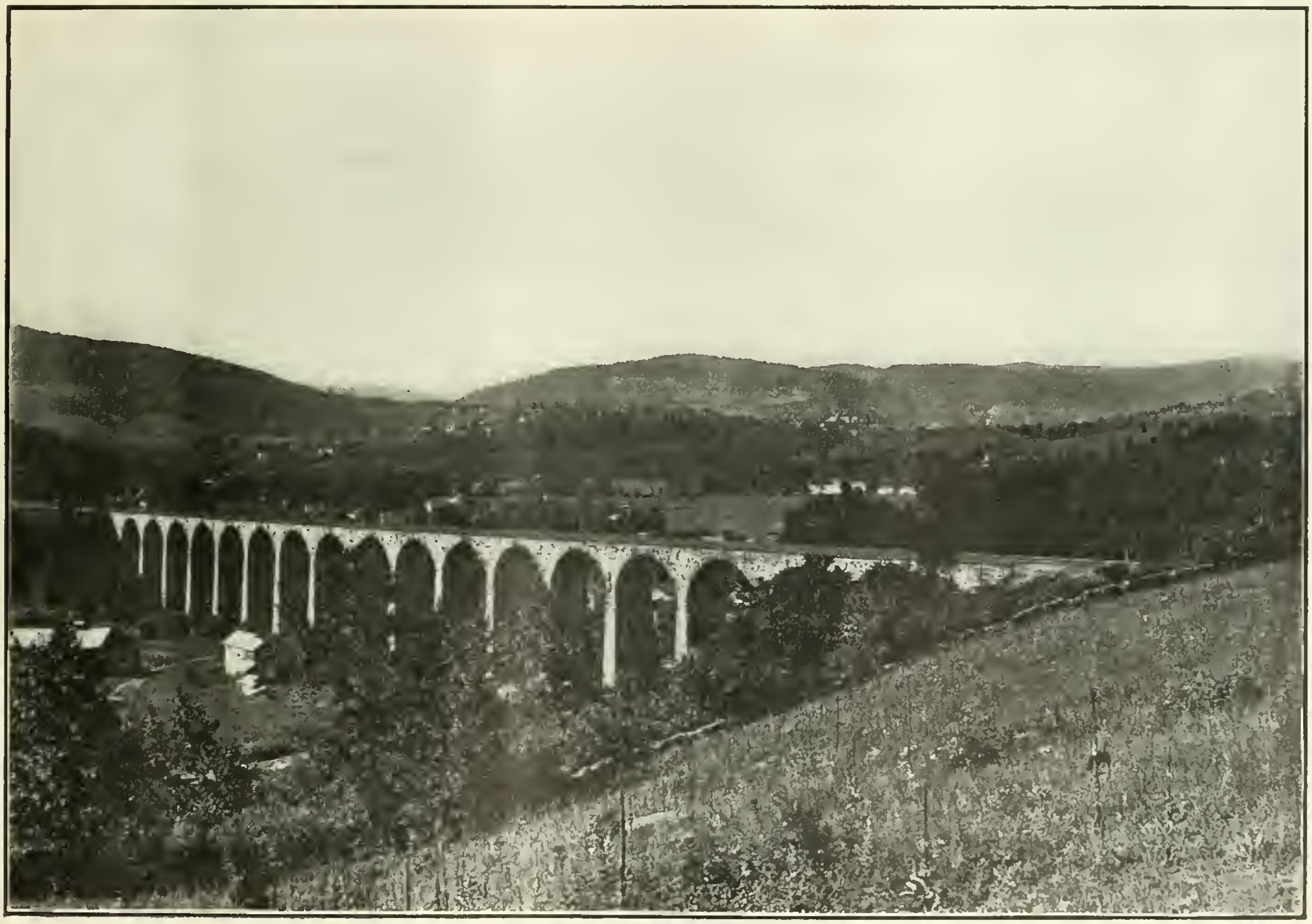
Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, August, 1911. No. 8

Improvements on the Erie Railroad.

The early engineers who mapped out the course of the railroad tracks acted wisely as long as they kept by the banks of rivers, or streams, or babbling brooks. Nature is the great leveler and whoever follows her courses will not wander far astray. The constructing engineers of the Erie had this truth in their minds when they laid out the main line of the Erie Railroad along the Ramapo Valley, but in striking across the mountains from Newburgh Junction to Port Jervis they had no waterways to guide them and hence the portions of the road there are difficult of ascent, and the Mallet compounds find an opportunity to exert themselves to their utmost in hauling the ever-increasing loads of freight that pass over the great railway. Under the present management extensive plans were made to obviate the difficulty encountered on the steep grades referred to, and an extensive addition was planned whereby a much nearer approach to a level roadbed could be constructed and thereby facilitate the freight traffic and improve the hauling capacity of the locomotives.



MOODNA VIADUCT ON THE ERIE RAILROAD.

The report of the completion of the work is just issued, and shows that the entire length of the new addition is 42.3 miles. There are extensive viaducts and tunnels in the new section. Our frontispiece shows an illustration of the largest of the viaducts known as the Moodna Creek viaduct. This structure crosses a beautiful and romantic valley, and from an architectural point of view is a strikingly prominent feature of the rich landscape.

The Otisville tunnel is another extensive work in connection with the new addition to the road, and is 5,314 feet long. The tunnel is 30 feet between the side walls and 25 feet above the top of the rails at the crown of the circular arch, and is lined throughout, with the exception of 926 feet near the westerly end of the tunnel.

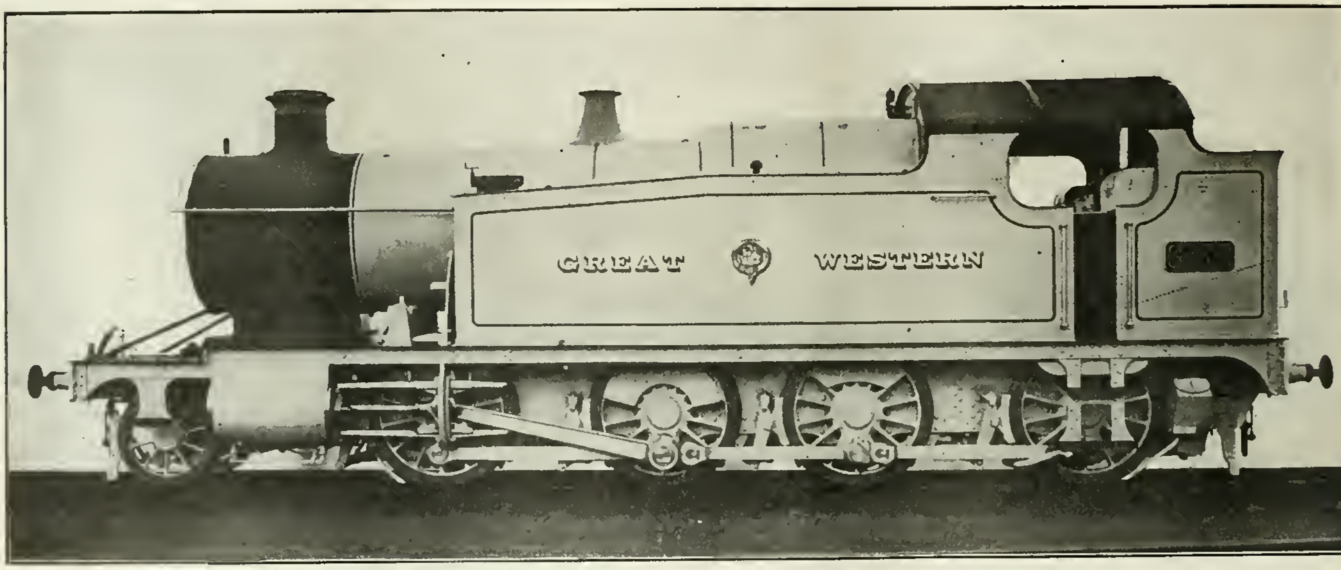
The Walkill viaduct, 390 feet in length, with 60-ft. arches, and two four 40-ft. arches, is also another great work, and, like the viaduct that we have illustrated, it forms a striking feature of the richly wooded valley which it spans. There are, as may be readily imagined, a number of extensive cuts and fillings in the course of the work, the largest cut being just north of Middletown, which necessitated the removal of nearly half a million cubic yards of rock. The filling over the Otterkill Creek, near Washingtonville, involved an almost equal quantity of filling.

In bridge construction it was found necessary to build 19 overhead highway bridges, 20 undercrossings, besides 5 other road crossings under viaducts and over tunnels, making a total of 44 road crossings. This does not include the railroad crossings, of which there are seven, only one of which, the Montgomery branch of the Erie Railroad, crossing at grade near Campbell Hall.

As we stated at the outset, the early engineers of the Erie Railroad had many physical difficulties to overcome, and the fact that some of the work is being improved upon should not be placed to their discredit. In the original survey of 1834, the Shawangunk mountain range was the great obstacle to be overcome between the Hudson and the Delaware, and no feasible pass was discovered through the range except along its western face, beginning a little distance beyond Otisville. The mountain range we have referred to might have been avoided altogether if the railroad had been carried over into the State of New Jersey for several miles, and so reached the valley of the Delaware at Carpenter's Point. The company's charter expressly stipulated that the railroad from Suffern to Port Jervis must be confined to New York State territory, so that the tortuous path and steep grades between Goshen and Port Jervis was the only available one at that time which could include in its route the towns of Middletown and Otisville.

In the early days of railroading it was largely a question of expediency that entered into the engineers' consideration. The towns had been already planted, and the shortest accessible route to them was the object. Now that the towns have blossomed into cities the railroad problem has become one of keen competition between rival companies whose aim is economy in power and rapidity in transportation. Of the millions expended by the Erie Railroad Company in the important improvements that we have referred to, there is an added facility in transportation that will rapidly redound to the enterprising management that is transforming this railroad into one of the best constructed and most thoroughly equipped railroads of our time.

From Highland Mills to Graham Station, all that is brightest and best in American scenery is there. Pleasant farms glow in luxuriance in the rich valleys. There is comfort and quiet about the happy homes. The cottages are flower-clad, and the vitalizing effect of the activities of a great railroad cannot do other than add to the wealth of the beautiful country.



NEW ENGLISH TANK ENGINE, 2-8-0, FOR THE GREAT WESTERN.

2-8-0 Tank, G. W. R. of England.

A new type of mineral tank engine has recently been constructed at the Swindon Works of the Great Western Railway, which is shown in the accompanying photograph. It is intended for working heavy coal traffic in the South Wales district.

The coupled wheelbase is 20 ft., eased by the trailing wheels being provided with sliding axleboxes, which allow plenty of side-play when going around sharp curves. The coupling rods are fitted with spherical joints for the same purpose. The cylinders are 18½ ins. in diameter, with a stroke of 20 ins., and the driving wheels are 4 ft. 7½ ins. in diameter. The heating surface of the firebox is 122.92 sq. ft. and of the tubes, including superheater, 1,443.82 sq. ft., giving a total heating surface of 1,566.74 sq. ft. The grate area is 20.56 sq. ft. The superheater is of the Swindon type and has tubes 1 in. in diameter. The working pressure of the boiler is 200 lbs. per sq. in. The tanks carry 1,800 imperial gallons of water and the bunker 3 long tons of coal.

The total weight is 78 tons, of which 70 tons rest on the driving wheels. The tractive effort is 33,399 lbs. Most of the details are interchangeable with the 2-6-2 tank engine working in the same district.

Old Time Railroad Reminiscences.

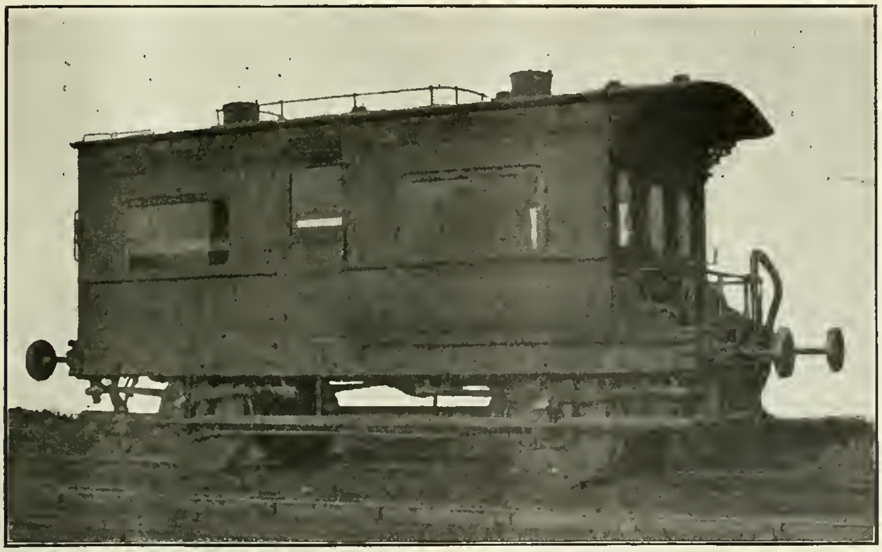
By S. J. Kidder.

It is my belief that I have been a pretty good follower of the other fellow when he has pointed out or accomplished something in the line of progress, but after reading an article in the January number of Railway and Locomotive Engineering, entitled "Railroad Train Dispatching by Telephone," I fell into a retrospective mood and wondered if I could for once lay claim to doing something before the other fellow. I will relate the incident and if any of your numerous readers antedate me in train dispatching by telephone, I will gracefully retire from the head of the class to the position so long occupied further down the line.

Away back in the early 80's, I was running a passenger engine between Burlington and Keokuk, and what was then known as the Keokuk branch of the Chicago, Burlington & Quincy Railroad. We had arrived in Keokuk one morning about two o'clock and after the usual preliminaries of taking coal and water and putting the 245 in the house, I looked her over, washed up and along towards noon left the roundhouse and sauntered off in the direction of the hotel for dinner.

With the wants of the inner man appeased, I was about to return to the roundhouse when up rushed a call boy from the master mechanics' office, who wanted to know if I would go down the St. Louis, Keokuk & North Western Ry., known for short as the "K. Line," several miles with a number of flat cars loaded with lumber which were to be unloaded at Des Moines River bridge. It might be stated that the K. Line was not at the time a part of the Burlington system, but as my engine happened to be the only one available at the time and not due to leave on my run until 4.30 p. m., it had been borrowed for the occasion. I assented to the arrangement, went to the roundhouse, got out my engine, coupled to the cars and with an order to work wild, pulled out and not long after reached the bridge. Near the point where the cars were to be unloaded was a short side track, but of sufficient length to permit of our clearing the main line when two freight trains, one from either direction, and which would be due after a time, came along. We proceeded with our work of unloading without molestation. The freight trains, both of which were due while we were yet discharging our cargo, had not shown up and as a result, when ready to return to Keokuk, we were effectually blocked. The regular leaving time of my train was only some forty-five minutes off and no other engine at this end of the line could be substituted, and matters began to assume a serious aspect and to an extent that something must be promptly done.

While discussing the matter with the conductor, I happened to observe what appeared to be a telephone wire which extended across a field, the poles, perhaps eighty rods away, leading out of view behind a bluff, and the thought occurred that possibly we could get out of our predicament if a telephone happened to be in the immediate vicinity. I at once started on the trail of that suspended wire and behind the hill discovered that it extended to a dwelling. Reaching the house, I quickly made my presence manifest by a vigorous rapping on the door and to the lady who responded, explained my errand and in turn received permission to use the 'phone. Billy Cunningham, the train dispatcher, was called up, who promptly notified me that both trains of that date were abandoned. "Well," said I, "give us an order with which we can get back to town." "All right," said he, "take it down." Pulling an old envelope from my pocket, I wrote his dictation something as follows: "Conductor and engineer, work train, Des Moines River bridge: Run to Keokuk regardless of all trains. 12 (the twelve meaning, do you understand). I replied 13 (I understand), and repeated the message as he had given it to me. He then gave me the O. K., which signified that the order was all right and the initials of the superintendent making the running order complete.



OLD INSPECTION CAR ON THE FURNESS RAILWAY, ENGLAND.

An Old Inspection Car.

We reproduce a photograph of an old-time inspection car, built at Birmingham, England, about 1865, for the use of Sir James Ramsden, late managing director of the Furness Railway of England. The vehicle measured 19 ft. in length over the underframe, and was 8 ft. wide over body. Four wheels were provided, the wheelbase being 11 ft. The carriage was divided into two compartments, one 9 ft. 6 ins., and the other 7 ft. 6 ins. long. Each compartment was upholstered in light-colored leather, the windows were draped with curtains, and the interior was well lighted. Luggage, etc., was provided for on the roof. A hand-brake was operated on an end platform, but the vacuum brake was fitted to the vehicle in 1884. Sir James constantly used the carriage up to the time of his retirement, but since 1894 it has been standing in the company's shops at Barrow.

Economy in Coal Consumption.

During a series of tests conducted for the purpose of determining the comparative amount of coal consumed in operating the 11-in. and the 8½-in. cross compound air pumps, the economical features of the 8½ in. pump were clearly demonstrated.

One hundred and eighty-five lbs. steam pressure was employed and the pumps were operated against 110 lbs. air pressure, and the speed was controlled by the 1¼ in. governor set at 110 lbs.

The amount of coal required was computed on the usual basis of 7 lbs. of water evaporated per lb. of coal, during 1,000 hours' continuous service. Each pump compressing air at the rate of 30 cu. ft. of free air per minute, the 11-in. pump, during the 1,000 hours consumes 85 tons of coal, while the 8½-in. pump compressing the 30 cu. ft. of free air per minute consumes but 36 tons of coal during the 1,000 hours and shows a saving of about 58 per cent.

At 50 cu. ft. of free air compressed per minute the 11-in. pump uses 129 tons of coal during the 1,000 hours, and to do this the 8½-in. pump requires but 52 tons of coal, or 77 tons less than the 11-in. pump, showing a saving of 60 per cent.

At 60 cu. ft. of free air per minute, which is the capacity of the 11-in. pump, the 8½-in. pump under the same conditions mentioned shows a saving of 65 per cent. in coal consumption.

This may not appeal very forcibly to the railroad, but it does appeal to the manager of fugitive or industrial enterprise as an opportunity to save money.

In railroad service, however, it is often considered advisable to have the compressed air produced by means of two smaller pumps rather than one large compressor, even if it is more expensive; then, in the event of an air pump failure, the second pump will be relied upon to prevent an engine failure.

Which Received the Smack?

A distinguished novelist recently found himself traveling in a train with two very talkative women. Having recognized him from his published portraits, they opened fire upon him in regard to his novels, praising them in a manner which was unendurable to the sensitive author.

Presently the train entered a tunnel, and in the darkness the novelist raised the back of his hand to his lips and kissed it soundly. When light returned he found the two women regarding one another in icy silence.

Addressing them with great suavity, he said: "Ah, ladies, the one regret of my life will be that I shall never know which of you it was that kissed me!"

From latest accounts the ladies had not yet spoken to each other.

Harrington Automatic Stop

The Harrington automatic train-stopping device has been in active use on the Northern Railway of New Jersey for four years, and it has been actuated more than 1,500 times by experimental tests with speeds to 70 miles an hour to prove its physical endurance, and for the purpose of demonstrating its effectiveness. The invention consists of the application of the air brake and in the use of an air whistle, operated by a cross arm placed on top of the engine cab coming in contact with a flexible, free swinging weight, hung from a pole alongside the track and located 1,000 ft. in advance of the semaphore, and mechanically controlled and operated by the same. The suspended portion of the apparatus consists of a weight, formed of

SIGNAL STOP, SWINGING CONTACT DOWN.

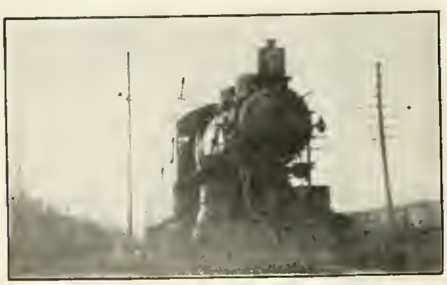
a short rubber-covered pipe, hanging from a chain in such a manner that it will strike against a horizontal transverse arm attached to the roof of the cab of the locomotive, moving the arm and causing a service application of the air brakes throughout the train, besides sounding a whistle to warn the engineer and inform him that he is within the danger zone. When the signal is set at clear, the suspended weight is lifted high enough to clear the arm on the locomotive, and the engine passes on without interference. The suspension is of such size and weight as to cause the movement of the cross arm on the locomotive cab by its inertia. When semaphore is set at danger, the suspension hangs 4 ft. to one side of the track centre and 14 ft. 9 in. above, and when the signal is clear it is raised 20 ft. above the rail and moved 6 ft. to one side of the track centre. If the engineer fails to stop his train when the semaphore is set against him the train is automatically stopped without shock by service application of the air brake and the air whistle warns.

HARRINGTON STOP IN WINTER.

On electric roads with cars equipped with air the current is cut off, the air brakes applied and a whistle alarm given, where hand brakes are used, the current is cut off and a gong used in place of the whistle.

To fully test the apparatus, sixteen locomotives and seven signal stations have been in constant daily use for four years, under most severe weather conditions, having been tested 1,500 times with 98 per cent. efficiency with speeds ranging from 5 to 70 miles an hour, have been witnessed from the locomotive by men of the highest standing, the train in every case was stopped unaided by engineer with throttle open. The Interstate Commerce Commission, Block Signal & Train Control Board's third annual report, on page 22 states concerning the S. H. Harrington Stop: "The system with reasonable inspection and maintenance, would be safe and reliable and its use would tend materially to promote safety of operation on a railroad using it."

By attaching the apparatus to the distant signal, or to a pole 1,000 ft. in advance of the home signal, the train can be stopped at the home when it is set at danger, even in time of fog or storm, or when weather conditions prevent the engineer from seeing distinctly. With such a device it is practically impossible for an engineer to run past the signal, the matter being taken out of his hands and placed in control of inanimate and automatic mechanism. The invention is that of Mr. S. H. Harrington, of New York, a consulting mechanical engineer of several years' experience in railroad work.



SWINGING CONTACT JUST STRUCK.

New Alpine Tunnel.

It is now reported that the final obstruction of the Loetschberg tunnel through the Bernese Oberland, Switzerland, has been removed after five and a half years' continuous work and the expenditure of about $20,000,000.

With the completion of this fine piece of engineering work there will be a direct through route from Milan to Berne and thence to Calais and Bontagne. This

SIGNAL CLEAR AND SWINGING CONTACT UP.

tunnel was planned to give the Simplon Tunnel Railway line a direct connection with the railways which traverse Switzerland from north to south.

The distance from Milan to Calais by this route will be about 675 miles, or nearly 80 miles less than existing lines. The tunnel is to be double tracked. The Loetschberg tunnel at its highest point is 4,640 ft. above the sea. It is not quite as long as the St. Gothard, which is 9¼ miles long, or the Simplon, which is 12½ miles in length. The Loetschberg has a grade of only 7 metres per 1,000 metres, and is 27 ft. wide and 19½ ft. high.

It was first planned as a single track line. The gauge is standard 1.45 m., or 4 ft. 8½ ins. The line from Spiez on Lake Thun to Brigue will be operated electrically.

General Correspondence

Superheater Engines Pull More Cars.

Editor:

As to this subject: It seems to me that it may be a question of mechanics, and entirely aside from heat units, B. T. U., etc. If the pressure on the piston remains more uniform throughout the entire stroke with the superheated steam; in other words, if there are less jerks tending to start the wheels slipping and a more continuous pull all the time, the results would be better, or at least, it is reasonable to expect them to be better. The indicator cards ought to show whether this is true or not, and, if not, it would be a saving of time not to look for it elsewhere.

JOHN E. SWEET.

Californian Pioneer.

Editor:

I enclose a picture taken from a daguerreotype photograph, of an old wood-burner, which is one of the original locomotives brought around Cape Horn to California, and operated on the old Sacramento Valley Railroad, which ran from Sacramento City to Folsom.

I am sending picture through the courtesy of *Sunset* magazine, from which cut was taken from.

In gathering data concerning the old locomotive I could get no information as to the dimensions or builders of the machine, only, that it was an outside-connected wood-burner, and was named the "L. L. Robinson," and operated on the old S. V. R. R. The photograph was taken at Folsom in 1855.

The construction of the Sacramento Valley Railroad, the first in the state of California, was commenced in the early part of 1852 and completed in 1856, some years before the old Central Pacific Railroad was organized. Among the most prominent of the promoters and builders of the Sacramento Valley Railroad were the Messrs. Judah and Pioche, the first-named gentleman having come to the coast from old New York State in the early '50s, to supervise and push the road through.

A few years afterwards, during the '60s, the Central Pacific Railroad Company was organized and built in the central part of California, and toward the East by way of Truckee, and on to Ogden, Utah. About this time the Union Pacific Railroad was being pushed westward from Omaha, Neb., and old-timers well remember that eventful day of May 10, 1869, when both trains of the rival companies met at Promontory Point; one from the East and the other from the West, the last spike was driven, connecting the Pacific coast with the East. Among the chief promoters of the Central Pacific Company were the late Collis P. Huntington, Leland Stanford, Sr., Hopkins and Crocker.

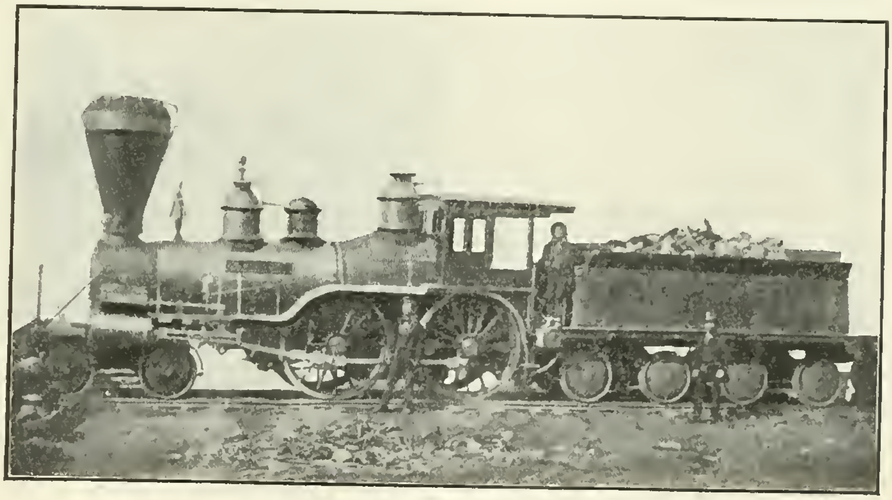
Shortly after the Central Pacific was organized and construction commenced, it absorbed the old Sacramento Valley road, this road becoming the Sacramento division of the Central Pacific.

From out of the old Central Pacific Company grew the present Southern Pacific Railroad Company, one of the largest railroad systems in this country.

Hoping that the picture may be of use to you, and if some of the old-timers can let me know as to who were the builders and what were the dimensions of the old machine, through your excellent paper, I remain,

L. H. DE LUDE.

Los Angeles, Cal.



CALIFORNIAN PIONEER.

Superheated or Saturated Steam.

Editor:

After reading the letter in your June issue from H. G. S., of Washington Heights, with very much interest, I will take advantage of the invitation extended by you to give my opinion.

He says the superheater engine, by reason of the lower steam pressure and longer cut-off, probably gives a more even turning movement to the crank pin. Now, I don't see any reason for the longer cut-off in the superheater engine. If the diameter of the cylinder is increased enough to compensate for reduction of steam pressure and if the invisible slip, as he terms it, was entirely eliminated, I do not think it would make the great difference in power he speaks of.

Now, in the saturated steam engine, with the temperature of the cylinder parts always below the temperature of the steam at boiler pressure, it follows that every particle of steam coming in contact with the cylinder parts will give up some heat and for every heat unit that leaves the steam condensation takes place and some of it is returned to water or is carried by the steam in the form of mist or suspended moisture. Now, to take the place of it more steam must be admitted to the cylinder and as the cylinder is losing heat always then condensation must be taking place all the time.

With this moisture in the steam I do not see how it could expand as quick and with such force as it would if it did not contain it and after the admission of steam is cut off by the valve and steam in the cylinder is allowed to expand to the point of release it must lose some more power by this process.

If the temperature of saturated steam at 200 lbs. pressure is 387 degs. F. and this steam is passed through superheater tubes and acquires an additional amount of heat sufficient to raise its temperature to 500 degs. F., then no condensation can occur until the temperature of this steam has fallen below 387 degs. F., and to do this it must lose the 113 degs. of superheat.

When this steam is passed to the cylinder it will soon heat the parts of the cylinder to a temperature far above the temperature of saturated steam at this pressure and as this steam enters the cylinder and comes in contact with the parts no condensation will take place and no extra supply of steam from the boiler will be necessary on this account and the steam will contain no mist or suspended moisture, but will be in the form of a perfect gas, each particle repelling the other and carrying no extra weight whatever.

Then after cut-off, by reason of its excessive heat the steam will expand to point of release without any condensation at all and be exhausted at a temperature far above that of saturated steam for the same pressure.

Now, by reason of all this it appears to me that at equal cut-off the superheater engine would have a greater M. E. P. in the cylinder at all times than the saturated steam engine, except possibly the initial pressure when engine is working very slow, as the saturated steam would then have time to replace very near all loss by condensation in the cylinder, but after cut-off the loss of power would commence.

If this is the case then the superheater engine should develop the greater tractive effort by reason of the fact that the average M. E. P. in the cylinder is greater, and comparing engines of the same dimensions and using the same boiler pressure the superheater engine should do a small amount of work more than the saturated engine and also make better time on the road.

The superheater engine, not being called on to replace condensation losses, will do the work on a smaller amount of fuel and water.

At Purdue University the superheater has been tested under varied conditions and a total of about 5,000 miles made and all records of the tests have been published in a fine book by Prof. W. F. M. Goss, entitled, "Superheated Steam in Locomotive Service."

This, however, is a laboratory test, but should and does not determine the merit of the superheater.

However, I am with H. G. S. on the actual road tests and I think the railroads should make the tests fair and impartial and furnish the data. We cannot question Dr. Schmidt's conclusions on the superheater and superheated steam, and the fact that about 6,000 superheaters of his design are in use on about 135 different railroads in Europe (where the cost of fuel is quite an item) should be sufficient recommendation to the American railroads and the sooner they take to this money-and-time-saving appliance for locomotives the quicker the fuel department will save a little more money. I am working for a railroad that uses a great deal of oil for fuel and I think the oil-burning engine is the ideal place for the superheater, as there are no spark-arresting devices in the front end, just the petticoat pipe, no diaphragm or cinders to contend with. The temperature of the front-end gases in an oil burner are undoubtedly greater than those of a coal burner.

So I think that an oil-burning engine equipped with a fire-tube superheater and a front-end feed water heater would be the real thing and I haven't been smoking any hop either, although I know that is almost a dream.

C. C. Shaw,
Engineer I. & G. N. Ry.
Palestine, Tex.

Art of Good Wheel Boring.

By Mr. H. H. Markland,
P. R. R. General Shop Inspector, Altoona.

A few words about first-class wheel boring may not be out of place. Without a doubt, wheels should be bored having a true hole free from all ridges or roughness. Ridges in wheels are very objectionable on account of uneven strain on wheel when mounting, making a leverage that may start a crack. On account of the eccentricity of rough bore of steel wheels and core of cast iron wheels there will always be some motion of boring bar when boring, even with the most rigid construction. That is, the bar will follow the hole, also when the roughing cutters start to go out at the bottom of the hole the bar will vibrate less than when cutting higher up in hole which is apt to leave a ridge in bore. If finishing cutters are cutting at same time, they will make a ridge when roughing cutters are through hole. The safe way to bore a wheel is to take a light finish cut independent of roughing cutters. This is a point well understood in machine work, but strange to say, for wheel work the scheme of rought and finish boring all at one time is advocated principally on account of greater output of machines, and while it is true that many wheels are bored very satisfactorily by this plan, the method as a whole is undesirable on account of stray wheels going into service having ridges in the bore. Actual trials on cast iron wheels showed that after rough boring it was necessary to enlarge bore .04 of an inch to insure truing the bore of all wheels. This with bar and mills in very good state of repairs.

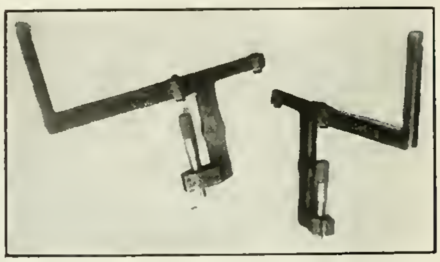


FIG. 1. WHEEL BORE CALIPERS.

To bore wheels to close sizes it is desirable to allow a predetermined amount of work for finish cut. This is to insure an equal amount of work for cutters and also uniform pressure on the various parts that will naturally have more or less give or lost motion. For cast iron wheels the finish cut can with safety be set at .04 of an inch. Steel wheels about .02 of an inch. A practice followed with most excellent results with bar, has been to set roughing cutters to smallest size bore required in ordinary limits, say when boring wheels 6⅞ ins. to 7 ins. they would be set 6⅞ ins. As each wheel has rough bores the finishing cutters were set .04 ins. less than the size required. The wheel was then bored with both sets of cutters cutting at one time. After this cut was completed the bar being raised and finishing cutters set out to required size and second cut taken when the finishing cutters only were cutting. As an illustration of accuracy that may be attained, wheels were called for, bored to following diameters: 6.982, 6.842, 6.928, 6.922, 6.940, 6.848, 6.809, 6.810, 6.822, 6.796 ins. All the wheels were bored in the order called for within a limit of .001 of an inch. No caliper readings were taken except to prove sizes after wheels were removed from the mill. All changes in sizes being accomplished by turning index wheel to size called for. The boring was done as fast as cutting tools would permit. With a satisfactory boring bar having an accurate micrometer adjustment for finishing cutters, wheels can be bored to any size required to accuracy of .001 of an inch and as many wheels can be turned out as by any method. On account of the accurate wheel boring, which is an accomplished fact, it certainly is advisable to bore wheels to suit the axles on account of less cost for labor and only turning the smallest possible amount from axles.

A satisfactory manner of setting finishing cutters is as follows: A trial cut to be taken and calipered with micrometer calipers, the index can then be set to size shown by micrometer readings. Fig. 1 illustrates a special micrometer caliper that was designed by the writer for wheel bore. The principal novelty is in the extra anvil to insure the caliper being set square with center line of wheel. Fig. 2 shows an application of tubular inside micrometer caliper for the same purpose. By either of these, caliper readings may readily be made and size chalked on wheel in 30 seconds.

With these calipers a very satisfactory test for wheel bore is that the bore shall not be over .001 of an inch taper or out of round. This can be lived up to with fairly good tools. Also the bore should be smooth and finishing cut taken with feed of tool at least 4 per inch.

The question of mating wheels to axles to obtain proper mounting pressure has always been and will continue to be a problem. Many theories were investigated where they appeared to have bearing on the subject. One of the old theories being that the hardness of the wheel had everything to do with mounting pressure. There may have been some truth in this but the writer was unable to find it. Wheels made from same run of metal will generally mount at about the same pressure when having same draw, providing other conditions are similar.

There are a number of conditions that will affect mounting pressure even if apparent draw be similar. One is the kind of lubricant employed. A test with cast iron wheels showed that the mounting pressure would average about five tons higher using plain oil as compared with white lead and oil. Also the turning and calipering of axle has some bearing. If a tool is used that throws up a slight bur or fin, the calipers will read the top of this and not the true solid metal which is liable to cause mounting at low pressure. The trouble of wheel or axle galling cannot in all cases be guarded against and may cause considerable variation in pressure, especially on steel wheels.

For accurate mounting of wheels to uniform pressure, no method of measurements and inspection has been devised to equal the micrometer method, and, with the calipers where the readings can be made quickly with but few possibilities of error, there should be no reason to continue the use of machinist's calipers. One result will generally follow where micrometers are used and careful inspection is insisted on. The wheel seat will be turned fairly true. With these conditions and draw or mounting pressure carefully checked the wheel will have ample bearing on the axle and will not work loose.

A large number of measurements were taken at our shop to determine proper draw or amount axle should be larger than wheel. No general rule can be given for amount of draw on account of wheel from various mills and foundries differing. However, by measuring draw with micrometer and noting mounting pressure on a few wheels, the proper draw for any batch of wheels can be arrived at that will be a fairly true indication of mounting pressure. A plan for mounting wheels on axles that has worked very satisfactorily is as follows:

Each axle when turned is calipered and size of wheel seat chalked on axle near wheel seat. From these sizes a list is made for boring mill operator deducting the necessary amount to be allowed for draw. The wheels are then bored and size chalked on wheel after being proved by micrometers. The wheels and axles are then mounted, the sizes chalked giving necessary information as to which should go together. This plan avoids hunting among a lot of wheels and axles to find mated pairs and also the minimum amount of calipering.

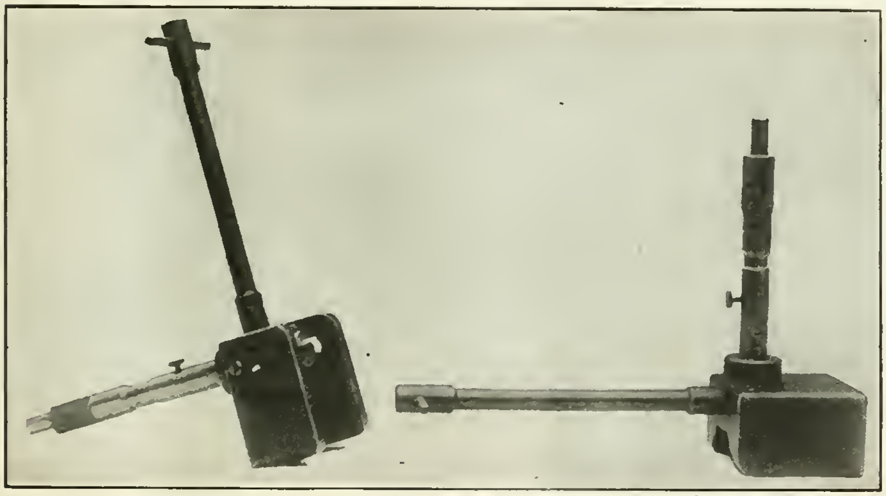


FIG. 2. TUBULAR INSIDE MICROMETERS.

The micrometers referred to have Brown & Sharpe micrometer heads, the frame having been made special on the railway on which they are used, and to best of the writer's knowledge has never been patented. The tubular inside micrometer caliper, Fig. 2 was made by Brown & Sharpe. Recording gauges on mounting presses cannot be too strongly recommended, they being a check by which the superintendent can easily detect any bad or careless work. However, a recording gauge is not always a true indication of mounting pressure on account of the throw of the needle at each impulse of pump on press. This is the more noticeable with pumps having only one ram or piston. For accurate work or determined limits the average of throw of the needle should be mostly considered.

The question of grinding in place of turning repaired axles is worthy of careful consideration. Its advantages are that a wheel seat once ground will not be injured enough in mounting and dismounting wheel to require regrinding each time unless the wheel galls or scores the axle. That is, when compared to turning, the surface will be smoother and not have many tool marks that generally push off when mounting wheel. From experience with journals used in machinery, we have every reason to believe that car journals would be ground better than the average of lathe turning and burnishing or filing. The sides of collars and fillets being the most difficult part. The makers of grinding machinery, however, say this is not a hard problem. By grinding, the probabilities are that less metal will be cut away than by any turning method on repaired axles. This should prolong their life. That is, when re-turning there is always a possibility of the workmen cutting deeper than is absolutely necessary, in order to get below the glazed surface and insure removal of all low spots. With grinding, there will be no incentive to cut deeper than absolutely necessary. Actual tests appear to indicate that by grinding only one-half as much metal will be removed as compared to turning, that is, where an axle may be reduced some .3 of an inch by turning, a similar axle will only be reduced some .015 of an inch by grinding, and, as explained above, each .001 of an inch in diameter costs four cents, at which rate the value of the axle would be reduced some 60 cents more by re-turning when compared with grinding.

The Unexpected.

A barrister of considerable reputation on a northern circuit found it necessary, if he were to gain a verdict, to discredit a certain witness.

The cross-examination, therefore, suggested that the youth was a wrong 'un, and that his relations in general, and his father in particular, were all worthless. The youth demurred.

"Don't you know," thundered the counsel, "that your father would be in gaol if the police knew where to find him?"

"I don't think so," said the youth. "But you'd better ask him yourself. There he sits in the back row of the jury."

Pacific Type for the Soo Line

An order of ten pacific type locomotives has recently been delivered to the Minneapolis, St. Paul & Sault Ste. Marie Railway by the American Locomotive Company, one of which is shown in our illustration. These engines are representative of the latest development of the modern high duty passenger locomotive. The design which was prepared by the builders represents their most approved practice for engines of this class, embodying as it does in one engine, practically all the new features which have been successfully applied by them during the past two years to other engines of a similar class.

They constitute the latest of an interesting series of designs of pacific type locomotives, each one heavier and more powerful than the preceding. The story of this development on the "Soo Line" is told by the following table, and is typical of what other roads have had to do in their effort to meet increased requirements or to improve service.

TABLE SHOWING DEVELOPMENT OF PACIFIC TYPE LOCOMOTIVE ON THE SOO LINE.

Year.	1904-1909	1910	1911
Weight on driving wheels, lbs.	131,000	147,500	158,000
Total weight, lbs...	206,000	221,000	258,000
Cylinders, diameter and stroke, ins..	20 x 26	24½ x 26	25 x 26
Driving wheels, diameter, ins.	69	69	75
Boiler pressure, lbs. per sq. in.......	200	160	180
Totat heating surface, sq. ft......	2,877.3	2,876	3,522
Superheater heating surface, sq. ft.	.....	515	805
Grate area, sq. ft...	42.9	47	52.8
Tractive power, lbs.	25,600	30,800	33,200

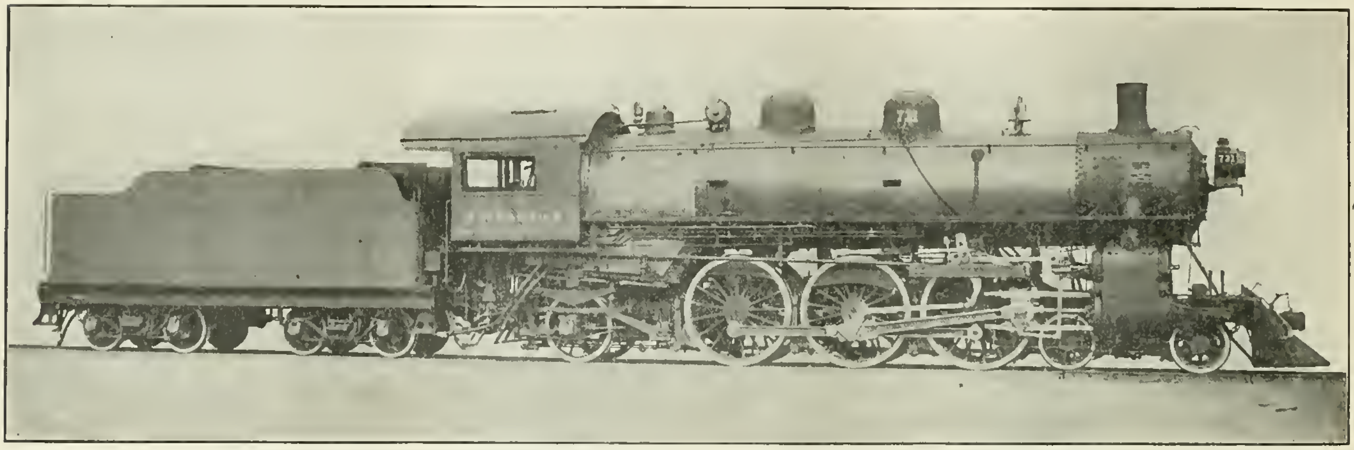
During seven years from 1904 to 1911 there has been an increase in weight of 52,000 lbs. and 7,600 lbs. in tractive power. Also, the design which a year ago was considered adequate to meet the requirements has been superseded by one 37,000 lbs. heavier and having 2,400 lbs. more tractive power. Part of this present order will be used on the Chicago division between Chicago and Minneapolis, and the remainder on the "Soo" division. The former division is over very rolling country. In the 460 miles between Chicago and Trout Brook Jct. there is only about 85 miles of level track.

In going north from Chicago there are 191 miles of ascending grades of which about 24 miles are at least one per cent., the maximum being 1.21 per cent. The longest ascent going in this direction is between Gillis Landing and Custer, a distance of 31.6 miles, in which there is a rise of 414 ft. Traveling south there are 184 miles of ascending grade of which about 16 miles are at least .8 per cent., the maximum being 1.2 per cent.

Their fast trains have a schedule from Chicago to Minneapolis of 14 hours and 25 minutes (including stops) or an average speed of 33 miles per hour, while in the other direction the schedule time is 14 hours and 35 minutes or 10 minutes slower, giving an average speed of 32.6 miles an hour.

Present traffic conditions necessitate running more cars on their through limited trains and in ordering these heavier engines it is the purpose of the "Soo Line" management to increase these trains to 12 cars and to operate them on the same schedule as is now in force for the lighter trains. Definite limits are set for the maximum speed on the descending grades so that in order to maintain the schedule these new engines will have to handle 12 cars on the up-grades at the same speed as the present type handles the lighter trains.

Like the class which they supersede, the engines here illustrated are equipped with fire tube superheaters of the side header type. Their weight of 258,000 lbs. and tractive power of 33,200 lbs. places them among the most powerful engines of their class. Among the new features embodied in this design will be noticed the steam pipe arrangement having an outside connection with the cylinders. A similar arrangement was applied by these builders to a recent order of Pacific type locomotives built for the New York Central, and in a number of other instances. This arrangement provides more free area in the smoke box under the table plate for the waste gases than the ordinary arrangement. It also greatly simplifies and strengthens the coring of the cylinder casting and, taken as a whole, provides for the simplest and most direct passage of steam from the superheater header to the steam chest, and one open to inspection for its entire length. Another example of the builders' latest practice is the design of the Walschaerts valve gear, crosshead and guide. The guide is an integral part of the valve chamber head and is centered by the bore of the valve chamber, thus insuring absolute alignment of the crosshead and valve stem. The guides are of the four-bar type. Each of the upper guides is formed of a separate piece bolted to its corresponding lower guide and between the two pieces is a liner plate which makes it possible to easily adjust the guides for any wear.



PACIFIC OR 4-6-2 FOR THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE RAILWAY.

T. A. Foque, General Mechanical Superintendent. American Locomotive Company, Builders.

The trailing truck is the builders' improved design of outside bearing radial truck with floating spring seat yoke which has been successfully applied to a large number of recent pacific type locomotives built by them. This type of truck is of a very much simpler construction than their older design and saves a considerable amount of weight. Compared with their former truck of the same class there is a difference of from 2,500 to 3,000 lbs. in favor of the design here applied. Extended rods are used for both pistons and valves following the latest practice with superheated steam.

Throughout the whole design there is evidence of special attention in working out the details to keeping the weight of the parts of the engine and running gear as low as possible, consistent with strength in order to provide the maximum boiler capacity within the given total weight of the engine.

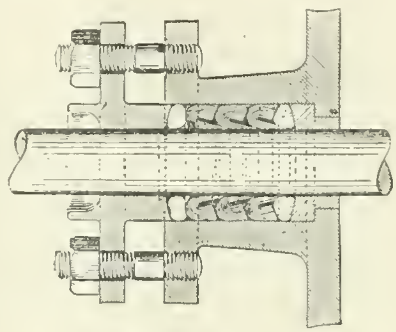
The following table gives the principal dimensions:

Cylinder.—Type, simple; diameter, 25 ins.; stroke, 26 ins.
Tractive power. 33,200 lbs.
Wheel Base.—Driving, 13 ft. 6 ins.; total, 34 ft. 7 ins.; total, engine and tender, 66 ft. 2¼ ins.
Weight.—In working order, 258,000 lbs.; on drivers, 158,000 lbs.; engine and tender, 401,200 lbs.
Heating Surface.—Tubes, 3,315 sq. ft.; firebox, 207 sq. ft.; superheater, 805 sq. ft.; total, 3,522 sq. ft.
Grate area, 52.8 sq. ft.
Axles.—Driving journals, main, 10½ x 12 ins.; others, 10 x 12 ins.; engine truck journals, diameter, 6 ins.; length, 12 ins.; trailing truck journals, diameter, 8 ins.; length, 14 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.
Boiler.—Type, extended wagon top; O. D. first ring, 72 ins.; working pressure, 180 lbs.; fuel, bituminous coal.
Firebox.—Type, wide; length, 108⅛ ins.; width, 70¼ ins.: thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, sides and back, 4½ ins.
Crown staying, radial.
Tubes.—Number, 217; diameter, 2 ins.; length, 21 ft. 0 in.
Superheater.—Double loop side header type applied; tubes, 1½ in.; O. D., No. 9 B. W. G. thick.
Air Pump.—8½-in. cross comp.; reservoirs, two 28½ x 52 ins.
Engine Truck.—Four-wheel swing center bearing.
Trailing Truck.—A. L. Co.'s latest radial with outside journals.
Smokestack.—Diameter, 18 ins.; top above rail, 15 ft. 6 ins.
Tank.—Capacity, 7,500 gals.; fuel, 12 tons.
Valves.—Type, 14-in. piston; travel, 6½ ins.; steam lap, 1⅛ ins.; ex. clearance, ⅛ in.
Setting.—1/16 in. lead in forward motion; 7/16 in. lead in back.
Wheels.—Driving, diameter outside tire, 75 ins.

Automatic Piston Packing

Little or nothing has been attempted to obviate the waste of power resulting from the packing of a gland or stuffing-box, and practically no change has taken place in the form or style of gland and stuffing-box since they were introduced. The amount of power consumed and the energy expended by means of placing so-called soft packings in the stuffing-box to prevent leakage, whether of steam or liquid, is in some cases so great, more especially in the smaller machines, that there is a larger percentage of the total energy necessary to drive the engine consumed in overcoming friction at that point. This is an item of considerable importance, even in the case of the most powerful machines, as every ounce of steam entering a cylinder means coal consumed which should produce a corresponding amount of effective work.

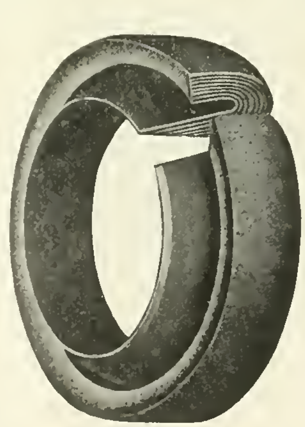
In the case of a packing which is not self-setting, the pressure or friction on the rod is created by the swelling of the packing or by the screwing up of the gland, or both, and this is the constant pressure present at all times upon the rod on both strokes, when in motion and at rest. It is necessary to screw up the gland sufficiently tight to prevent leakage of steam against the highest pressure at which the engine is worked. Now on the forward stroke of an engine the steam pressure on the gland amounts to practically nothing, hence there is really no necessity to have the packing as tight then as at the commencement of the return stroke; but this was not possible to avoid before the advent of an automatic packing which would, of itself, reduce the pressure of its contact as the pressure of the steam dropped. This fact alone is responsible for a waste of power which can be mathematically demonstrated. By reason again of the



SECTION OF PACKING.

fact that this new automatic packing operates only on part of the one stroke it must naturally last much longer than when always held by fixed pressure in direct contact with the rod.

J. M. Sea Rings are moulded of a laminated material (asbestos, flax or duck) in the form of wedge, with its thin end turned inwards. There is a hollow space in every ring, between the lip and the heel of the ring, into which the



THE PACKING RING.

steam follows, so that the steam itself, not the gland pressure, makes the packing pressure tight. With these rings these two pressures are separated entirely, the fluid pressure getting behind the long taper tongues and pushing them onto the rod; the outer wall or periphery, taking the whole screw pressure or physical pressure and the long taper tongues acting exactly as the points on a railway line, shunting the fluid pressure back and afterwards onto the rod.

These two mechanical principles are developed and work in every J. M. Sea Ring that is made, and that without complicated wedges, glands, springs, or any other artificial aids and means. They stand perfectly 600 degs. Fahr. superheat; moreover, they are much better than metallic packings, because, even should the temperature exceed this by an unforeseen cause, they contain no white metal to melt out and cause disaster. J. M. Sea Rings work just as well on horizontal rods as on vertical rods; they are just as satisfactory for steam-hammers, air compressors or for any other purpose, but for pumps of all kinds they stand pre-eminent. The H. W. Johns-Manville Co., through their various branches in all the large American cities are now actively engaged in introducing this packing to steam engineers and others who are interested in this product.

The Sugar Coated Boss.

We all know him and speak of him by this name, yet it is now doubtful if the word rightly belongs to the English language. Philologists, the people who interest themselves particularly in the origin of words, are divided about the origin of the word boss. Those with Celtic leaning trace the word to the Gaelic word bos, the hand. That theory is far-fetched, for no one ever heard Celtic Highland navvies, the railway builders of last century, use the word boss in its modern sense.

The word is doubtless the Dutch word baas, meaning master. We have frequently heard it used by Dutch sailors in the same way it is used by American workmen. The pronunciation is almost unchanged. Master in all the early Dutch settlements was baas, and boss it became with the English speaking races, who hated and repudiated the expression master, but were willing to endure it under a foreign name.

There are many kinds of bitter pills that have their obnoxious taste entirely obliterated by a thin coating of sugar. There are many people who respect bosses and repudiate the idea of working for a master.

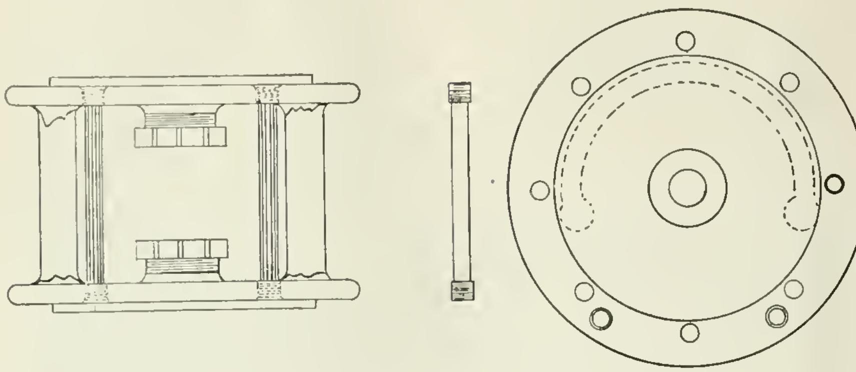
On the plains of Delhi, in India, there stands a massive iron pillar, nearly sixty feet in length and weighing about nineteen tons. This ancient column, according to *The Engineering Magazine*, is literally a monument to the "antiquated" process and metallurgists that produced it, for it has resisted the attack of the elements during a period of about 2,900 years, in which fully a million times its bulk of iron or steel has crumbled into useless dust.

People fond of fruit jellies had better adhere to the home made article. A trade item tells us that in 1910 Germany imported more than 3,000 tons of decayed and waste fruit, mostly in the shape of apple and pear peelings and cores to be converted into jellies.

Saving Pump Center Piece.

By Charles Markel,
Shop Foreman, C. & N. W. Ry., Clinton, Ia.

The blue print I am sending you shows our method of preventing the center piece of old style 9½-in. air pumps from breaking and causing the total loss of the piece. By simply applying two ¾-in. 12-thread stay bolts, which will hold the center piece together if it is cracked and will prevent it from cracking if applied when casting is new. We used to have a great many pump failures before this method was adopted. The sketch plainly shows what is required, and does not require any lengthy description.



SAVING BROKEN CENTER PIECE IN AIR PUMP.

Useful Boiler Makers' Tool.

Editor:

Relative to the new federal law requiring inspection of boilers, effective July 1, probably many of your readers will be glad to know that one of the most useful and necessary boiler shop tools offered to the trade is the Helwig Pneumatic Staybolt Clipper, made by the Helwig Mfg. Co., St. Paul, Minn., which is highly commended by users generally for its exceptionally satisfactory, rapid and economical manner in which it cuts off staybolts.

It cuts off bolts of any length—crown stays as well—the desired length just right for riveting, without injury to the thread or sheet, as it cuts off the bolt with a smooth, soft, straight cut, and leaves the bolt just as tight in the sheet as when first put in.

This is a compact machine, made in two sizes, the larger weighing but 210 lbs., and cutting off staybolts up to 1½ ins.; the smaller weighing 170 lbs. and cutting off 1¼-in. staybolts, and less. Convenient to handle, easy to operate; cheap to maintain.

I have had considerable experience with tools used in boiler shops in the West and Southwest, and I am now writing from my personal knowledge of the merits of the tool and am not concerned in its manufacture or sale.

St. Paul, June 24, 1911. S. H.

Invention of the Barometer.

We have frequently been asked the question, What is the Torricellian tube? or what is the Torricellian vacuum? These relate to the invention of a very useful instrument.

The ancient belief was that water rose in a pump because nature abhorred a vacuum. About the year 1640 a deep well was sunk in Florence, Italy, and it was found that the pump would not raise the water from a depth greater than thirty-two feet. The investigation of the mystery was taken up by Evangelista Torricelli, a pupil of Galileo's who experimented with a long glass tube using different fluids. In this way he discovered that the height of the column depended upon the specific gravity of the fluid. He closed the tube at one end and filled it with mercury. Then he placed his finger on the open end and dipped it into a basin of mercury and holding it vertically permitted the contents of the tube to settle. It was then found that a column of mercury 27½ inches stood in the tube.

On comparing this column of mercury with the height of a column of water raised by the pump, it was found that the heights agreed in an inverse ratio of the specific gravities of water and mercury. It was then natural to reason that both columns were balanced by the pressure of the atmosphere.

Afterwards Torricelli made a barometer of a glass tube charged with mercury. The modern barometer differs very little from Torricelli's invention.

A High Priced Hotel.

At the last convention three supply men and one master mechanic went to the room of one of the group to have quiet communion. A bell boy answered the call and brought up certain refreshing drinks. The host then asked "how much?"

"I don't know how much the drinks will be," said the honest lad, "but you may depend on them being twice what they would be in any other hotel."

The lad had the makings of an honest man.

Monogram Bolt Fastening.

The Grip Nut Company, of Chicago, are showing a new bolt fastening for freight cars and other uses that supplies a need, especially emphasized in the case of felt-lined refrigerator cars. A hole is cut clear through the woodwork and an escutcheon of metal fitted into both sides.

The hole through the escutcheon somewhat resembles a keyhole of large dimensions, and the bolt is inserted through the large or round end and drops into the slot with the bolt head firmly held against the inner side. A washer plate is then slipped over the outer end of the bolt and this washer covers the entire aperture and has lugs on the back which engage the hole and prevent displacement. The nut and lock nut are both then applied in the usual way.

It is apparent that should a bolt break, say at the head, the head will fall out of the way and a new bolt can be put in place without even opening the car, and the constant troubles with the grab irons and side ladders made compulsory by the new law will be largely obviated by the simplicity with which repairs can be made. This is undoubtedly one of the most meritorious inventions that has been devised and introduced into the railroad field in many a day.

Care of the Human Engine.

Dr. Osler, now Sir William Osler, the regius professor of medicine at Oxford, and famous for his alleged dictum that most people ought to be killed off after forty, lectured at the Working Men's College in Crowndale road, St. Pancras, on "The Care of the Body." He compared the human body to a steam engine, and pursued the analogy in all sorts of appropriate directions. Above all, he exhorted his hearers not to put too much fuel on the furnace, lest it should get clogged. Though not a vegetarian fanatic, he would have them to be careful not to eat too much meat, and assured them that they must not be above drinking plenty of milk, as it was the human engine's "ideal fuel." With curious significance, in view of his supposed utterances, Dr. Osler admitted that the human engine was sometimes well enough made to last out fully three-score years and ten in regular working order. So far as alcohol was concerned, he abjured it in every form as being totally unnecessary, and considered it would be a good thing if every keg of alcoholic liquor in the world were pitched into the sea. He confessed to a personal weakness for an occasional pipe, but admitted he—and everybody else—would be better without.

Steel Passenger Cars Built for the Pennsylvania

In order to complete the equipment of steel cars for passenger trains, the Pennsylvania Railroad Company have arranged with the Pullman Company to design and build some all-steel parlor and sleeping car equipment, of which 638 are now in service.

In both exterior and interior appearance they closely resemble the standard wooden Pullman car, except in the interior finish, where steel replaces the highly-polished natural wood.

STEEL PASSENGER CAR FOR THE PENNSYLVANIA.

Steel is used for inside finish backed by asbestos, to act as a non-conductor of sound and heat, except in cases such as back wall of upper berth, berth partitions and possibly a few other cases where non-inflammable composition material is used, due to the steel being too cold to the touch.

Trucks are of standard Pullman type, supplied with cast steel frames in place of the usual wooden members.

The principal dimensions of the cars are:

	Ft.	Ins.
Length over end sills...	72	6
Length over platforms, coupled	80	6
Width over side sills..	9	9¼
Width over eaves	10	0
Height over all	14	7

THE SIX-WHEEL TRUCK.

An entirely new form of truck was required for the steel cars, owing to the fact that the deep center sill of the underframe lowered the center plate until it just cleared the middle axle of a six-wheel truck. Advantage was taken of the opportunity offered for redesign, and a truck based upon a new principle was evolved, which is applicable either to four-wheel trucks for motor cars, or four and six-wheel trucks for those drawn by locomotives. The new truck utilizes, to the best advantage, the valuable properties of steel as a structural material, and is designed to carry a load equivalent to the maximum capacity of the 5 x 9-in. axle, weighs 21,000 lbs., which is the same weight of the old wooden trucks, but is considerably stronger. Transoms, spring plank and equalizers, though important parts in former truck designs, are not required, as their functions are covered by other elements in the new principle of design.

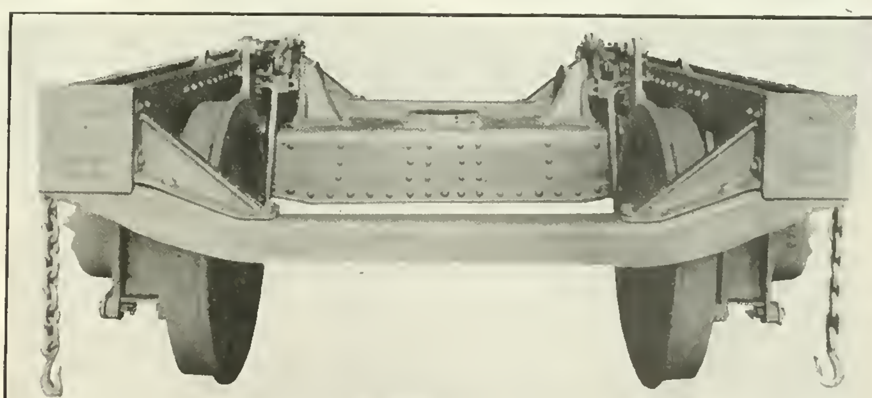
The illustrations show the exterior appearance as well as the construction of the truck. Two elements are embodied; the rectangular frame carrying the wheels and the bolster which transmits the load delivered at the center plate to the axle through the spring rigging.

The axles run in boxes of the usual type, which slide vertically in pedestals, secured to the wheel pieces and connected at their bottom ends by pairs of tie bars (sufficient space being allowed between tie bars to permit the use of a jack in removing bearings). Each wheel piece is composed of two 10-in. channels (with their flanges turned toward each other) separated to permit certain of the working parts to go between them and secured to one another at intervals.

Two-wheel pieces are held together by four pressed steel cross members of channel section, one at each end of the wheel pieces and one at either side of the middle wheels. They are depressed below the bottom of the wheel pieces in order to clear the center sill of the underframe.

The bolster is composed of four girders running crosswise of the truck, to the top of which are secured two girders running lengthwise of the truck. The center plate rests upon the two short transverse girders of pressed steel. The lower flange of these girders is turned up at the ends and the plate riveted to the lower flange is brought up and riveted to the longitudinal girders. Between the girders is riveted a reinforcing casting to transmit the load delivered by the center plate. A horizontal rectangular plate forms the lower flange of both girders and acts as a diaphragm to square the bolster. Spring beams are riveted to the under side of girders and to the rectangular plate which forms their lower flanges. They extend on both sides beneath the wheel pieces and are confined between guides, which allow only vertical and transverse motion of the bolster with reference to the truck frame. Spring beams are of sufficient width to admit between their downwardly-projecting legs four elliptical springs.

It may be added that the Pennsylvania Railroad has in servie 764 all-steel cars of various types, and 358 cars now under construction. The company has gone further in the direction of the use of steel cars than most other roads, and in the arbitrary elimination of wood or other combustible materials in their construction. The Pennsylvania's policy, in this respect, was the result of a long period of inquiry and experiment in which the late President Cassatt took an active part. After several cars had been built, the president appointed a committee of motive power officials to make a thorough report on the designs to be adopted, and the cars are now being built in accordance with the recommendations of that committee, and are rapidly being placed in service.



TRUCK FOR STEEL PASSENGER CAR.

The Lift Lock at Peterborough, Ont.

The Canadian Pacific is well named the road of many wonders, and its numerous interesting features are frequently mentioned by those who travel on its lines. Not the least interesting of these and one which sometimes only receives passing notice is the celebrated lift lock at Peterborough, Ontario.

This hydraulic mastadon is situated just east of the city, in plain view from the north side of the train, and is the largest lock of the kind in the world. The height of lift is 65 ft., there being two chambers or tanks built of steel plates, each 140 ft. long by 33 ft. wide, and having a depth of 9 ft. 10 ins.

A ship can be locked through in twelve minutes, the actual vertical motion requiring only 1½ minutes, the lock proper being automatic and reminding one of the "Old Oaken Bucket" of rhyme and song.

The following data is of interest and may, in a measure, enable one to judge of the magnitude of this great machine that works with the smoothness of a toy:

External diameter of press cylinders, 8 ft. 3½ ins.; diameter of ram, 7 ft. 6 ins.; working stroke, 65 ft.; pressure to operate, 600 lbs. per sq. in.; approximate water in each chamber, 1,300 tons; depth of water in each chamber, 8 ft.; height of guide towers, 100 ft. from foundations; base of tower, 26 ft. 6 ins. by 40 ft. 8 ins.; breast wall of lock, 40 ft. thick, 80 ft. high, 126 ft. long.

There were 120,000 cu. yds. of earth removed in excavation, and 26,000 barrels of cement used in the concrete construction.

The substructure of the lock constitutes the largest monolothic mass of concrete in the world, containing over 26,000 cu. yds.

The cost of the lock, completed, was half a million dollars, and in its summer setting of green, backed by a sky of blended color, this truly wonderful work is also "a thing of beauty and a joy forever."

VIEW OF THE LIFT LOCK AT PETERBOROUGH, ONT., AS SEEN FROM C. P. R. TRAINS.

Locomotive Flange Lubrication.

Among the new subjects of discussion recently introduced, that of flange lubrication has begun to attract attention, and an able committee, of which Mr. M. H. Haig was chairman, presented a lengthy report to the Master Mechanics' Association, giving in detail such data as was obtainable. The questions submitted by the committee have not called forth as many answers as might have been expected. The report embraced replies from five railroads having flange lubrication in use, eight railroads having no flange lubrication and two railroads reporting very little flange wear. From the replies the fact is gathered that the Pacific type of locomotive in passenger service and the consolidation type in freight service, have the greatest flange wear. In general, other conditions being equal, the longer the rigid wheel base the greater the amount of flange wear. Interesting data from the Santa Fe Railroad shows from records of twenty locomotives, over a period of eight months, that before flange lubricators were used an average of 18,600 miles were run between tire turnings, and since their adoption 60,400 miles is the average. The total reduction in radial thickness between the turnings was 15/32 ins.

Of the methods of lubrication fourteen devices are now in use or have been tried. The lubricants used embrace crude oil, engine and car oil, solid lubricant, water and exhaust steam. The general application of the lubricant seems to favor the method of attaching nozzles or other feeding apparatus on the front and back driving wheels about 25 degs. above the center line of the axle. Some are furnished with rubber attachments that press against the flange of the wheel. Nearly all are equipped with steam pipe connections to keep the lubricant in solution in cold weather. While the use of grease is said to be more economical than oil, it is more readily affected by climatic conditions, and its use in some sections has been abandoned.

The effect of flange lubrication on wear of rails is particularly marked. In cases where sharp curves occur and rails would have to be replaced in eight or ten months before flange oilers were used, the committee's figures place the life of the rail since the adoption of flange lubrication at about three years.

Construction has been begun on Red Oak & Northwestern, a connecting link and feeder for Wabash. The first part to be built extends from Imogene, Ia., where it touches Wabash, to Red Oak, thirteen miles. Later the line will be extended northeast to a new terminus.

Feed-Water Heating in Egypt

Some very important work in the matter of feed-water heating in locomotive practice has been done on the Egyptian State Railways by Mr. F. H. Trevithick, the chief mechanical engineer of the Egyptian roads. The results of his extensive experiments and tests have been published in a series of articles in London *Engineering*, from which we make a few extracts. Our illustrations are made from photographs received from the same source. We may here say that the eminent worker in this field is a grandson of the famous Richard Trevithick who, in 1803, built the first locomotive to run on rails.

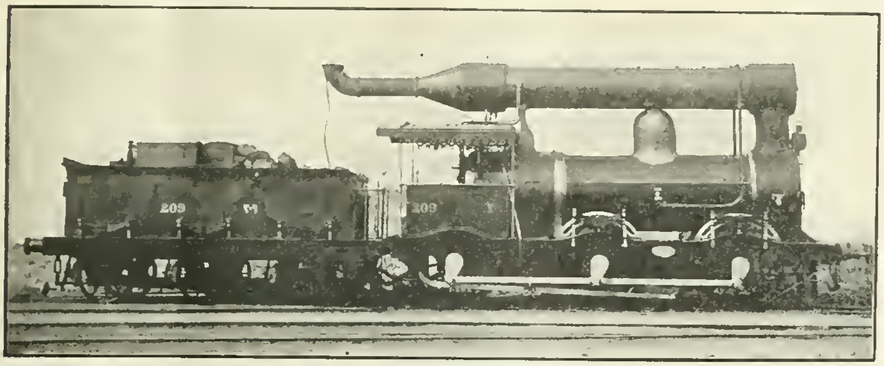


FIG. 1. EGYPTIAN STATE RAILWAYS ENGINE NO. 209.

Dealing with the matter of feed-water heating, we are told: "That feed-water heating has been brought within the range of practical application is proved by the fact that workable systems, all offering more or less economy, have been devised both here and abroad. Though a smaller economy is only possible with some than with others, several systems have passed well into the practical stage. On the Egyptian State Railways experimental work, extending over some ten years, has enabled Mr. F. H. Trevithick, M. Inst. C.E., the chief mechanical engineer, to produce an efficient feed-water heating system, and, carrying the work a stage further, to evolve a combination system of feed-heating and moderate superheating or steam-drying.

"The injector is itself virtually a feed-water heater of the class using live steam. Whether this class of feed-heater results in direct economy, or only in indirect benefit, is a point without the scope of this article; but it may be pointed out that even the indirect advantages, usually obtained with the use of live-steam feed-heaters, are practically nullified in the case of the injector, owing to the limited range of temperatures possible, the water not reaching a temperature high enough to result in precipitation of most of the salts until after it has entered the boiler, and the formation of scale there is thus in no way reduced.

"The exhaust-steam injector carries matters a stage further than the ordinary injector. The feed-water is heated to about 180 deg. Fahr., by exhaust or waste steam, in its passage through the exhaust-steam injector; and if it could be delivered into the boiler by the exhaust steam alone, the system would be a distinctly economical one. Unfortunately, the exhaust-steam injector has to be supplemented by a live-steam injector, and, while further raising the temperature of the delivery, this auxiliary injector uses a considerable amount of steam. It is claimed that the delivery from this combined apparatus reaches a temperature of 280 deg. Fahr.

"In a third class of feed-water heating appliances only waste products, such as exhaust steam and flue gases, are utilized for raising the temperature of the water, and this system carries with it a clear gain, provided the method adopted of subsequently getting the water into the boiler does not more than off-set the advantage. The maximum benefit possible from heating the feed by waste products cannot be secured with any tender-tank heating arrangement, nor can the full advantage of feed-heating with exhaust steam be realized with tank-heating combined with the injector for delivery, and it therefore becomes necessary either to abandon the idea of heating the water in the tank, or to find a substitute for the injector. Both these ways out of the difficulty have been tried. If the injector is to be retained, the heater must be arranged between it and the check, and not on the supply side.

"The first engine was fitted up with as little expense as possible, and was an old six-coupled goods engine, No. 209, built in 1865, at the Atlas Works, Manchester, and at the time about to be scrapped. The apparatus fitted to this engine consisted of a long horizontal combined exhaust-steam and flue-gas heater. It was placed above the boiler and dome, as shown in Fig. 1, and carried, at the smoke-box end by a vertical length of cylindical 18-in. flue, and, near the cab, by a saddle fixed to the boiler shell. The parallel portion of the heater was 14 ft. long and 2 ft. 3 in. in diameter. This contained a central flue 9 in. in diameter, and ninety-one 1⅞-in. boiler tubes. The place of the ordinary blast-pipe was taken by a 9-in. pipe, which connected the 9-in. central flue. The action of the blast being thus preserved. The feed-water was delivered to the heater at the back end by injectors, and it passed out to the boiler at the front end.

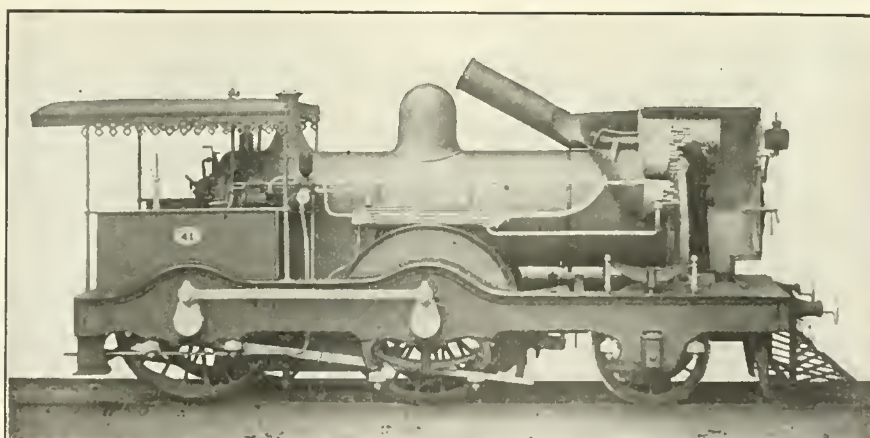


FIG. 2. EGYPTIAN STATE RAILWAYS ENGINE NO. 41.

"Figs. 2 and 3 show the next important development. At this stage the exhaust steam was dealt with in the small heater placed above the driving-wheel splasher of the four-coupled passenger engine No. 41, which was the next to be used for the experimental work. The exhaust-steam heater consisted of a cylinder, 5 ft. long by 7⅝ in.

in diameter, containing thirty-seven ¾-in. tubes. A heating surface of 36 square feet was thus provided. The heater was connected by a pipe from the front end to the blast-pipe near the nozzle. At its other end it was provided with a drip-pipe. The feed entered at the back end, and passed out to the smoke-box heater at the front, flowing in a direction contrary to the steam. The flue-gas heater was also radically altered and arranged within a specially-designed smoke-box. This heater now consisted of six cylinders

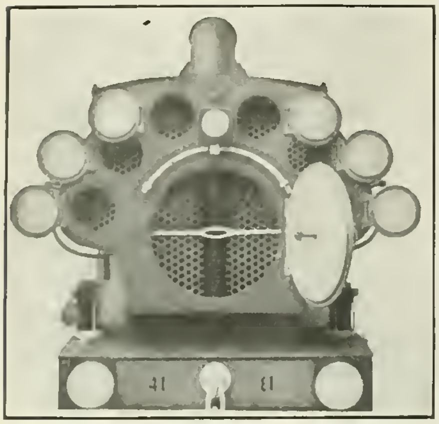


FIG. 3. FRONT OF ENGINE NO. 41.

in series, each 3 ft. long by 13½ ins. in diameter, and each containing thirty-one 1⅞-in. tubes. The total heating surface provided by the 186 tubes was 273 sq. ft., in addition to which useful surface, amounting to some 63 sq. ft., was provided by the exterior of the drums. The aggregate flue area was 372 sq. ins. From the illustration it will be seen that the smoke-box heater cylinders were fixed horizontally to a vertical diaphragm plate. The blast-pipe was carried through this partition-plate, into what was, virtually, the uptake beyond, where the exhaust was directed up an inclined chimney. The only passage for the flue gases on their way from the smoke-box proper to the chimney was by way of the heater tubes. The feed passed through all the heater drums in succession. Feed temperatures of 230 deg. Fahr. were obtained with this arrangement of exhaust and smoke-box heaters.

"Engine 620, shown in Fig. 4, was the next to be fitted up, these illustrations also being of a model. The exhaust steam heater on this engine was considerably enlarged, and consisted of a long barrel made up of three 8-ft. lengths of 6½-ins. piping joined together by means of flange castings. Each section or length of the heater contained thirty-one ¾-in. tubes. A 3-in. pipe was carried from the front end to the exhaust space in the cylinder casting, the back end being blocked by a plate, in which there was a ¾-in. hole, to allow of the escape of the water of condensation. The exhaust from the pump was also turned into this heater. The feed-water was pumped in at the back end, and flowing forward, left at the front end, and was carried up to the smoke-box heater. The exhaust-heater afforded heating surface amounting to 146 sq. ft., or about four times the amount provided on engine No. 41. This heater was, of course, covered with lagging.

"In the smoke-box heater an altogether fresh departure was made. This heater consisted of two cylindrical hollow shells placed one within the other, all the flue gases being passed between the two on their passage to the chimney. Each shell consisted of two plates rivited together, with a ¾-in. annular space between them. The outside diameter of the smaller shell was 5½ in. less than the inside diameter of the larger, so that, when arranged concentrically, there was a 2¾-ins. annular flue space between the two. The innermost shell plate, of 4 ft. internal diameter, was prolonged back and fixed up against the smoke-box tube-plate, so that it enclosed the whole of the tube area. The blast-pipe was extended and carried through the inner shell, as shown in the illustration, the blast thus having the effect of drawing the flue gases forward through the central flue towards the smoke-box door, and then back through the 2¾-in. annular flue into the outer chamber and to the chimney. The front end of the central flue was blocked, when the door was closed, by wire netting, which prevented sparks, etc., from passing into the return flue and out by way of the chimney. In this smoke-box heater there were some 159 sq. ft. of surface exposed to the hot gases, while the area of the annular return-flue amounted to 464 sq. ins., or rather more than the aggregate flue area of the boiler-tubes. The feed-water from the exhaust-steam heater entered the outer shell of the smoke-box heater at the bottom and passed up to the top. Here connection was made with the inner shell, where, by means of a partition piece, it was made to flow round the whole chamber before being carried off to the check."

In a subsequent issue we hope to be able to give some of the results obtained in these experiments. At present our limited space only enables us to show the various interesting forms of construction which have been the steps in this very interesting evolution toward economy by means of feed-water heating.

Two Millions to Spend.

The Canadian Locomotive Company, of Kingston, Ontario, are planning to spend immediately two million dollars upon their plant and equipment. In the latter part of 1910 this company completed a large contract for the Grand Trunk, and also built some engines for the Grand Trunk Pacific.

At present there are under construction some ten-wheel and consolidation engines for the Canadian Pacific, switchers for the Canadian Northern, pacific type, and switchers for the Intercolonial, and some ten-wheel and consolidation engines for the Algoma Central.

The engines recently built for the Temiskaming & Northern Ontario, embody all that is beautiful and symmetrical in locomotive design. This power was practically "special" in all features and is probably the costliest, finest and most attractive of any ever built in Canada for passenger service.

Mr. H. Tandy, the superintendent of the works, is one of the old guard. He was with this company some years ago, when he left to go with the old Brooks Works at Dunkirk. Just prior to the time when the American Locomotive Company, took over the Dunkirk plant Mr. Tandy was again induced to take charge of the Canadian Locomotive Works. Part of Mr. Tandy's good record is that he never built a freak engine.

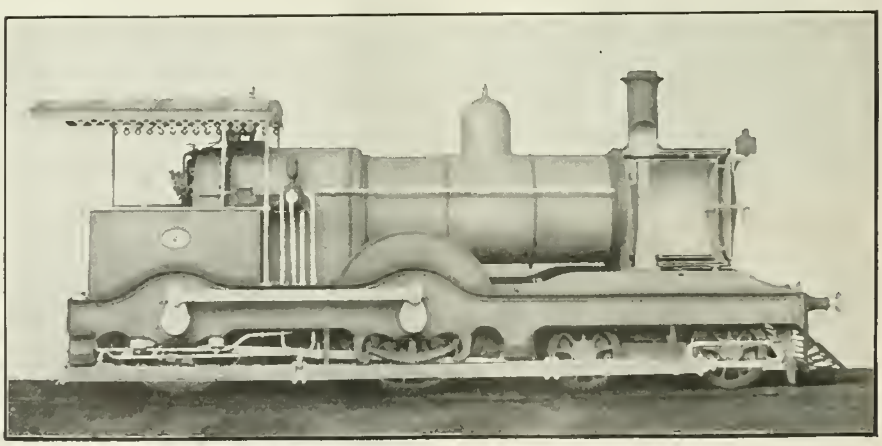


FIG. 4. EGYPTIAN STATE RAILWAYS ENGINE NO. 620.

35-Ton Electric Locomotive for Woodward Iron Works

The Woodward Iron Works have ordered a 35-ton locomotive from the General Electric Company. This locomotive will be used for hauling coke to the blast furnaces.

The locomotive is a unit designed along the lines of the General Electric Company's standard practice with all-steel framing and cab and with arch bar truck. It is arranged for slow speed service and is equipped with 4 GE-57 motors wound for 220 volts and with type M-single unit control.

The great rigidity and strength required in locomotive construction combined with the utmost simplicity in design are features characteristic of all General Electric locomotives and are emphasized in the design of this. To illustrate, the platform framing consists of six pieces of channel and two large plates all riveted securely together. Of these two 8-inch side channels 18¾ lbs. per foot and two 7-inch center channels 17¾ lbs. per foot run the whole length of the platform. A heavy box casting forming the drawhead is riveted between the center channels and to an 8-inch cross channel that forms the end framing. The outer longitudinal channels are also riveted to the same cross channel through forged knees. All this channel framework is connected and squared by two heavy plates, each of which covers half the length of the platform and runs the entire width, forming the floor of the locomotive.

The draft gear is a Climax No. 3 freight coupler with 5 x 5 in. shank fitted with yoke springs and follower plates. M. C. B. standards have been followed in the design and support of this coupler and as a consequence repair parts can be obtained or replacals made with a minimum of delay and expense. The coupler is carried in an extension of the drawhead casting, which is riveted to the center sills and end frame. Thus, hauling and buffing stresses are transmitted directly to the principal members of the locomotive frame.

The same characteristic of making every ounce of material available for strength is to be observed in the location of the ballast. This consists of a number of 2-in. rolled bars lying between the sills, running the whole length of the platform, notched over the bolster plates, and bolted to the sills, thus adding strength and stiffness to the platform framing instead of serving merely as dead weight.

ELECTRIC LOCOMOTIVE FOR WOODWARD IRON WORKS.

The members of the truck side frame are forged bars 4 inches wide and of weights proportioned to meet the requirements of the service. Journal boxes are steel castings carried between the top bar and tie bar by 1¼-in. pedestal bolts and fitted with 4¼ x 8 in M. C. B. bronze bearings and wedges. Heavy malleable iron bolster guides are bolted in between top bar and arch bar with 1½in. bolts and a spring plank, consisting of a 12-in. steel channel is riveted to these bolster guides. The bolster itself is a steel casting of a box girder design, approximately 8 x 10 ins. deep, with the lower center pin formed in the upper surface of the casting. Cast iron side bearings are bolted to the outer ends of the bolster. Th weight of the bolster and center pin load is carried on full elliptic springs built up of ⅜-in. plates, 6 ins. wide, and designed for a normal load of 12,365 lbs. each.

The brake rigging is inside hung, the brake hangers being carried on the bolster guides, while cast steel brake heads and cast iron shoes are furnished. Brake levers are proportioned to develop a braking pressure of 85 per cent. of the weight on drivers with 50 lbs. pressure in the brake cylinder.

A 12 x 12 in. brake cylinder is located midway between the trucks and attached to the center platform sills. The brake piston is attached to the truck levers through a system of floating levers arranged symmetrically on the two sides of the locomotive.

Turning now to the cab and the apparatus located on the platform, it will be noted that the cab is made up in three sections which are independently attached to the platform. The central cab contains the apparatus directly manipulated in the control of the locomotive while the auxiliary end cabs contain the auxiliary apparatus.

The cabs themselves are built of strong, heavy, soft, sheet steel plates. Doors and windows are framed in small angles and channels riveted to the inside of the cab sheet and serving the double purpose of framing the doors and windows and of stiffening the cab sheets. Access to the main cab is obtained through a door in each side opening from the cab to the running board. Access from one cab to the other may be obtained from the interior for the purpose of inspection, cleaning or ordinary repairs, while for construction, or replacals, the end cabs can be removed and the apparatus contained in them exposed without disturbance.

The Terre Haute, Indianapolis & Eastern Traction Company has placed on order with the General Electric Company for two 300 k. w. rotary converters, fifteen 100 k. w. transformers and a switchboard. The rotary converters and six of the transformers will be installed in the Maywood substation. Six of the transformers will be installed in the Mooresville substation and three in the Martinsville substation. The transformers are oil-cooled, 25 cycle units, 33,000 volts primary and 390 volts secondary, and are provided with 50 per cent. starting taps on the secondary.

The switchboard will be installed in the Maywood substation and will control the 33,000 volt incoming lines, the bank of step-down transformers, and the rotary converter. It will consist of an A. C. rotary converter panel, two D. C. rotary converter panels, rotary converter starting panel, and a blank A. C. rotary converter panel. The ammeter for the incoming line is connected directly in the primary circuit, being insulated with post type insulators for this service. A triple pole, automatic K-10 oil break switch protects the transformers.

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The Heated Season.

The more than usual heated atmospheric spasms that marked the torrid days and sultry nights of last month called forth a wild wail of anguish from public and press, especially from the press. Like Fame, the press has a tendency to magnify everything coming within the scope of its mental vision. Statistics were juggled with as usual to show that the death rate in the larger cities was magnified by heat. As a matter of fact, the sudden deaths of strong, healthy people by sunstroke were extremely few, but it is easy to ascribe to the heated atmosphere the death of the feeble and the diseased, to whose death it may be justly said that the heat may be an accelerating cause.

There is one comfort in these heated periods that they are soon forgotten. As the Indian summer approaches the memories of the dog days vanish. It is the present moment that possesses us, and the present condition that affects us, and our personal discomfort that disturbs us. Who is there among the gifted army of newspaper writers who describe the rising of the mercury in the thermometer with such startling effects that ever gives a passing thought to the tens of thousands of locomotive engineers and firemen who pass their days and nights in an atmosphere compared to which the hottest July days are as steam compared to superheated steam? Not to speak of the smoke and sulphur and dust and ashes among which they live and move and have their strenuous being. One might imagine that these men had not the same feelings as are the common lot of humanity, but they are the same, the difference being that they are more uncomplaining. They have no blatant press to cry aloud about their sufferings. They know that the conditions are inevitable, and conscious or unconscious they give a shining illustration of the truth that it is noble to suffer and be strong.

The railway men engaged in locomotive service also know that they are not alone in their trying atmospheric conditions. What shall we say of the countless army of men who go down to the sea in ships? A July day in an American city would be a Spring picnic to men accustomed to feeding the furnaces of steamships, and yet little is heard about them, because they have the common sense to realize that whatever discomforts there may be about their work and its environment are largely unavoidable, and are being improved as rapidly as human ingenuity can accomplish.

To Prevent Frames from Breaking.

In the discussion on Breakage of Locomotive Frames that was heard at the Master Mechanics' Convention an air of mystery developed as to why locomotive frames break? Considering the terrific stresses and shocks to which locomotive frames are constantly subjected, the real surprise ought to be, not that they break occasionally, but that they hold together as well as they do.

The locomotive frame has been gradually developed to meet the requirements of the service which has been growing more arduous year after year. When the boilers were set low, putting an even load upon the frames with no twisting action, breakage of frames was very rare, for most of the stresses imparted were in a vertical direction on the line of the greatest resistance of the frame. The real time of trouble from frames breaking came on as boilers were raised to provide for wide fire boxes, the stresses due to the long leverage being greater than the strength of construction has yet been able to meet. Engines equipped with the Walschaerts valve motion, which permits of strong bracing between the frames, have shown excellent results in freedom of frame breakage, but the possibility of strengthening the frames of link motion engines has not been used to the best advantage. If it was properly carried out cross bracing would help materially to strengthen frames, but many of these cross braces are put up as if their object was ornament rather than utility.

In this regard Mr. George W. Rink made some sagacious remarks in the discussion on frames when he said: "I believe the bracing is an important part of the locomotive. I have an idea that sufficient metal is not applied vertically to the bolt holes in the braces. Where you find a bolt with anywhere from three-quarters of an inch to one inch of metal through the bracing, the same should have at least an inch or an inch and a half of metal, and the frame bracing should extend from the top rail to the lower rail, so as to brace crosswise, in other words, use a brace in the shape of the letter X. I believe that would be far preferable to using a large flat brace lying on the top rail. We have found occasion to apply to engines originally built with such a brace an additional brace to the lower rail and extending a sheet from the top frame casting to the lower additional bracing. What I have just described applies principally to the front furnace supports.

"I believe the use of a sheet connecting the mud ring into the supporting casting is a good idea. As far as the thickness of the sheet is concerned, I believe the thinner the sheet is the better, as far as flexibility is concerned. My attention was called the other day to an eight-wheel engine that had the front jaws broken on both sides. This engine had a frame of about 4 x 7. It had no underhung springs. The wedge required lining up and it was neglected, and I can attribute the cause of that breakage to the fact that the wedges were not properly lined up."

Cylinder Castings.

The custom of analyzing cast iron used in cylinders is now very generally in practice, and it is well that it is so, for the quality of the metal is of the greatest consequence, and test pieces of the metal should be invariably called for in order to ascertain if the metal is the best adapted for the purpose. The ratio of parts have been carefully estimated by expert mechanical engineers, and the following is in their opinion the ratios of parts best adapted for locomotive cylinders: Graphite carbon, from 2.75 to 3.25 per cent.; silicon, 1.25 to 1.30; phosphorus, .50 to .80; combined carbon, .50 to .70; manganese, .30 to .60; sulphur, .06 to .10. It may be stated that the presence of sulphur in an excessive degree is one of the chief evils to be particularly guarded against in the selection of cast iron, while the proper mixture of silicon is also of the utmost importance.

The cylinders for use in locomotives should possess the elements of hardness and strength in a very marked degree. They should at the same time be free from brittleness in order to be readily and evenly machined. There is great need of more care in cooling the castings after molding the cylinders. Those who have been occupied in reboring cylinders have observed that there are nearly always two large spaces on the inner face of the cylinder where the metal is worn slightly deeper than in the rest of the cylinder. After the first cut through the cylinder in reboring, it will be seen that these spaces appear in two oblongs corresponding to the two thickened walls between the exhaust and inlet parts, and the fact that these spaces are worn deeper are proof that the metal is softer in those parts on account of the fact that being thicker those parts were longer in cooling. There is a readiness in some foundries to remove the castings from their places before being completely cooled, with the result that the thinner portions of the metal are liable to be more brittle than the thicker parts.

A bushing in the cylinder almost always wears more equally than the original cylinder. Care must be taken to make due allowance for shrinkage as an excessive pressure of the cylinder upon the bushing tends to induce brittleness. Cast steel cylinders with cast iron bushings are generally very reliable with an evenness of wear that is rarely to be found in the solid casting. This is not to be wondered at, because in casting bushings there is an equality in thickness.

Redeeming What Used to Be Waste.

Many industries now thrive and grow rich on materials that used to be consigned to the scrap pile and waste heap. One of our greatest wastes in olden times was that of cotton seed. The southern planter found his bins choked with this product at the end of the ginning season, and after he had set aside enough to feed his cows the rest was hauled away by wagon and dumped on waste lands in an effort to get rid of it. The oil in the seed made it objectionable for fertilizing land, and for cow feed when good butter was wanted. Fifty years ago it was only bulky and useless garbage.

In 1870 experiments showed that when the oil was pressed out the residue made a good fertilizer. In 1880 some investigating cows ate the hulls and meal and proved their great value as a cattle food, and in ten years more the oil had become a staple food for humanity. The oil is now a substitute for olive and cod-liver oil, is used for illuminating, is excellent for packing sardines, and forms a large percentage of packed lard. In the past year crushers paid $80,000,000 for the cotton seed delivered at their plants, and the products marketed at a price far beyond that.

Coal Consumption in Heat Units.

A heat unit is the measure that scientists employ to express the quantity of heat dealth with in all scientific and engineering processes. The amount of heat represented ought to be as intelligible to ordinary persons as the weight represented by one pound or the volume of one gallon, but somehow few people understand the details of heat measurement.

One heat unit is the amount of heat required to raise the temperature of one pound of water one degree Fahr. at its greatest density, which is 39 degs. Fahr. In ordinary practice the evaporating of one pound of water at any temperature is called a heat unit. To the ordinary reader that statement does not convey much intelligible information. A heat unit represents the amount of energy needed to perform 778.3 foot pounds of work. As one horsepower represents the energy expended in raising 33,000 pounds one foot high per minute about 42 heat units represent one-horse power.

Careful experiments have demonstrated that the combustion of one pound of good quality of coal contains about 14,500 heat units, each equivalent to 778.3 foot pounds. If then the heat of combustion of one pound of coal could be employed in raising a weight of one pound it would raise it $14{,}500 \times 778.3 = 112{,}853{,}500$ feet, or more than 2,100 miles. The proportion of this heat energy, converted into useful work is very small, less than 10 per cent., when used in the very best steam engines. Locomotives very seldom utilize more than 4 per cent. of the heat energy of coal.

When one gets converting the number of tons of coal used daily or weekly into heat unit figures, the sums become so formidable that we regard them with amazement. For instance, the Erie Railroad uses in its locomotives about 50,000 tons of bituminous coal every week. Any of our readers who enjoy long numbers might work out the sum $112{,}853{,}500 \times 50{,}000 \times 2{,}000 =$ and see how it looks.

Fuel Inspectors.

That the Lehigh Valley made no mistake when it appointed a fuel inspector, has been effectively shown in its records of coal consumption. This inspector has carried on a campaign of education which has resulted in engineers and firemen learning how to get out of coal more heat than they did previously, with less consumption of fuel and a corresponding saving to the company.

It requires 150 carloads of coal daily —the equivalent of three trains of 50 cars each—to keep the engines of the Lehigh Valley supplied with fuel. This represents an expense of $10,000, from which it will be readily understood that if a saving of 10 per cent. can be effected, and which experts say is possible by correct firing of an engine, it will figure up a large sum for the company annually.

Fuel constitutes one of the biggest items of expense that railroad companies have to meet, and economy in its consumption has been for some time closely studied by the motive power departments. Waste of bygone days is no longer permitted, and the requirements have become most exacting, while at the same time tests and experiments and the development of saving devices has constant thought and attention.

Accurate records kept by the Lehigh make it possible to know just what each engine crew is doing, whether they are making improvement and to what extent. Every fireman has an incentive to make his run with a minimum of waste. His chances for promotion to the right-hand side of the cab is largely dependent upon the work he does at the left-hand side.

Why Prosperity Eludes Us.

A remarkably able article notable for its sensible views of business prospects has recently appeared in *Collier's Weekly,* written by C. E. Simmons, a successful business man. We submit extracts from the article:

To restore prosperity a radical change in public sentiment is necessary. The present state of the popular mind is decidedly unhealthy. A feeling of antagonism—of hatred, I might say—toward large corporations is prevalent. It is unreasoning, undiscriminating, virulent. It is exercised toward all corporations—and especially toward railroads. The masses of the people seem to think that most corporations are corruptly governed and managed. In point of fact, I firmly believe that 90 per cent. of all corporations in this country are controlled and directed upon principles of common honesty and truth, as much so as are private business interests; and I also believe that the standard of individual honor was never higher than it is now.

There exists in the minds of many the mistaken impression that the rich man has acquired his wealth by graft and dishonorable methods. This impression has gained headway rapidly within the past five years. Numbers of people think that it is impossible to become wealthy by upright, honorable ways. They have been led to such conclusions by the character of attacks upon corporations. These attacks have not been conducted quietly and with dignity through the proper channel—which is the court procedure—but rather after the manner of a crusade. Looking backward a few years, we can easily see how the present unhealthy state of the public mind toward the most potent factors in the prosperity of the American people has been brought about.

We are suffering in the eyes of the

world by reason of this wave of prosecution and persecution of corporations. To other nations our war upon corporate interests seems so short-sighted as to partake of the ridiculous. It suggests to them the policy that "kills the goose that lays the golden egg." With our evolution of business from individual and firm management to corporate organization, some evils crept in. No one denies that some corporations have been unfair, and even brutal in their methods to meet and to destroy competition. These abuses have been so flagrant as to cast serious doubts on the integrity of the administration of certain great business combinations. *That such wrongs should be righted—that the evils should be corrected—that the offenders should be punished, we do agree, but all of this can be done in the orderly judicial manner much more effectively and with more lasting results than by the noisy, vengeful tactics which have been introduced.*

The public has been confused. There is lack of discrimination between the corporation which is honestly managed with fair methods of doing business, and the corporation which resorts to unprincipled, vicious ways. The chief sufferers from this sweeping condemnation of corporations have been the railroads. We face a crisis today. By reason of the hostility of the public towards the railroads, capital—with which the country was never better supplied—hesitates to respond to the needs of railroad extension and betterment. If this unjust prejudice shall continue, capital will seek industrial and other investments—ignoring the needs of the railroads. We shall awake in a very short time to find our transportation facilities utterly inadequate—our growth checked—our business suffering a partial paralysis.

Keep Cast Steel Frame Specifications in the Official Family.

Leading members of the Railway Master Mechanics' Association have shown themselves dissatisfied with the recommendations made by the American Society for Testing Materials. When a proposal was made to request that society to frame specifications for cast steel locomotive frames it was opposed on the ground that the American Society for Testing Materials generally co-operated with the manufacturers and ignored the interests of the users. For that reason it was decided to engage the services of railway mechanical engineers to work out details of specifications for cast steel locomotive frames.

It is well for a man to respect his own vocation, whatever it is; and to think himself bound to uphold it, and to claim for it the respect it deserves.—*Little Dorrit.*

Railway General Foremen's Convention.

When this paper reaches our readers the seventh annual convention of the International Railway General Foremen's Association will have been a thing of the past, but we shall have published nothing about it for the simple reason that the August number of RAILWAY AND LOCOMOTIVE ENGINEERING was on the press before the convention was finished. We adhere rigidly to our publishing date, which puts us at a disadvantage with the papers that come out merely when their publishers get ready.

We know of no railway organization that has advanced into usefulness and popularity as the Railway General Foremen's Association, a source of pride due principally to the wise selection of its officers, who have always been men of commanding ability and natural leaders in their line of business. In spite of the loose criticisms made by amateur industrial reformers against railway management in general, and railway shop management in particular, the production of railway repair shops compares favorably with any mechanical industry on this continent, and the credit for this desirable condition of affairs is due in a great measure to the men who perform the duties of general foremen. These general foremen form the finest example of what natural selection will do in bringing the best men to the front with which we are acquainted. In most other lines of industry the men looking for advancement strive to obtain the good offices of some influential person to help them begin moving up the ladder of promotion. That will not work with the man who has to carry on the important duties of general foreman. He must display ability to carry on work and to manage men, and these ultimately constitute the force that pushes a workman into the influential position of general foreman.

The work arranged for the seventh annual convention of the International Railway General Foremen's Association was not of an elaborate character, but we have no doubt that it was found sufficient to make profitable sessions for the three days that this convention now lasts. The subjects relate mostly to questions relating to a general foreman's duties, themes that always bring out profitable discussions. They are:

How can a shop foreman best promote efficiency? Introduced by a committee of which F. C. Pickard is chairman. If all the members present could be induced to express their views on this important subject it would take the whole time of the convention and would present a picture of railroad shop work that would interest every man concerned with railroad prosperity.

Why is it necessary to have wheel fit, engine truck and driving wheels larger than diameter of journal? That is the second subject under investigation by a committee of which Stephen A. Motta is chairman. Next subject is Shop Kinks, in charge of H. D. Kelley. Describing and discussing shop kinks, which means labor-saving appliances, has been the most valuable work done by the Master Mechanics' Association, and we have no doubt that increased kinks will be submitted by Mr. Kelley, who is good authority on the subject. As subject No. 4, D. E. Barton will report on Methods of Shop Organization, a subject by no means threadbare, one that will stand much ventilation with benefit to all railway interests concerned in the repairing of railway machinery.

Bar Against Plate Frame.

The bar frame for locomotives was originally an English invention, the Bury locomotives, a popular pioneer type, having had that form of construction. The early American railway master mechanics in their preference for simplicity were nearly unanimous in preferring the bar to the plate form, yet, singularly, enough British locomotive makers displayed decided preference for the plate. Owing to British locomotive builders having supplied many foreign railways with motive power in the early days, the British locomotive with its inside cylinders, plate frames and other peculiarities, became the standard of many countries, including most of the British colonies.

The persistence of a fashion is illustrated by the fact that at this late day the railway officials in such countries as Italy are still considering the relative merits of plate and bar frames for locomotives. An engineer writing on this subject expresses his belief that what he calls the American frame has some advantage over the plate frame, a conclusion reached by American locomotive users fifty years ago.

New Alloy.

A new alloy, called alherium, has been discovered which will have important uses in the arts if its characteristics as described in the *Electrician* are correct. This is a new white metal alloy, lighter than aluminum, its specific gravity is 2.4 to 2.57. A test piece 0.628 inches in diameter gave an elastic limit of 33,712 pounds per square inch, an ultimate strength of 41,798 pounds per square inch, an extension of 17.5 per cent. on 2 inches, and a reduction of area of 39.1 per cent. This alloy gives sound castings, rolls and turns well, and can be soldered, forged and welded. It is claimed that it does not tarnish nor corrode, and withstands the action of sea water.

It is a strange thought how many would speak the truth at the cost of a fortune or life, for one who would hold to it at the cost of a little daily trouble.—*Ruskin.*

The Annual Conventions.

The annual conventions of the various railway association and societies have brought prominently into notice the growing importance of occasional interchanges of opinions among men engaged in the same occupation. This is in keeping with the progressive and enlightened spirit of the age in which we live, and differs from the older spirit, which is happily disappearing, when every man engaged in scientific or mechanical research kept his own secrets, or admitted others only as necessity demanded, the desire and aim not being to proclaim discoveries or improvements, but to use them only for personal ends.

As is well known in the expanding realm of railway traffic, there still remains a mighty field in which mechanical ingenuity and scientific knowledge can exercise their skill. Not only in the special domain of mechanical appliances, but in all the multiform details that facilitate the work of the transportation department, there is a constantly widening sphere calling for a quickening of action and a newness of methods.

The railway conventions and meetings give opportunities for the expression of thought on these and kindred questions, and while it is true that periodical literature is rapidly taking the place of text books, that soon become antiquated, and maintains a constant stream of information on every conceivable question, which can be readily reached by the humblest artisan, there is a peculiarly vitalizing influence to be felt in the opportunities of getting into touch with the results of experience directly from the lips of those who are actively engaged in the physical and intellectual activity incident to railway work. The advantages to the individual members may be briefly summarized as aiding, by mental exercise, in strengthening the faculties of the mind, in learning how seeming difficulties may be overcome, how troubles may be promptly met, how the elemental and unceasing forces of nature may be better harnessed and utilized; while social intercourse with active, intelligent, thoughtful men polishes the mind and engenders a kindlier courtesy in the complex relations of man to man.

These benefits have their corresponding reflex on the communities of which the members of these societies are a part. The lasting good that is to be gathered from the intercourse to which we have referred tends to improve the conditions of life and work wherever the example or authority of the members extends. The latest improvements in mechanism and in methods are brought into the path of wider development. As iron sharpeneth iron, so the public mind is better educated in the growing benefits that come from a broader vision of the marvelous world of science, and thus the thoughts that are gathered at the conventions of railway men, like seeds sown in the furrowed earth, spring into full blossomed beauty that ripens into the rich harvest of practical utility.

Cool Covering.

Railroad people who are exposed to the heat of summer nearly all incline to dress themselves in light-colored garments, under the belief that white is necessarily cooler than dark colors, a mistake that has recently been dwelt upon at some length by the New York *Times*, which says:

"Among animals white coverings of fur or feathers are the almost invariable wear not in the tropics, but in the arctic regions. They are rare in the temperate zones, and practically unknown in lands where the sun is fierce. This cannot be accidental, and there must be in it a lesson worth heeding. Probably our association of coolness with whiteness is due to the fact that white cloth is usually thin cloth, and the thinness counts for more than the color. There is, however, no reason why cloth cannot be both thin and dark, and of such cloth the coolest garments could unquestionably be made, though it would be many a year before they would look coolest, or enable suggestion to work its mighty spell and give the illusion of comparative comfort.

"The army has discovered by actual thermometer tests that blue or yellow tents show a difference of interior temperature amounting sometimes to full 10 degrees when standing beside white ones in the full blaze of the southern sun. Down in Panama all the 'administration' houses, barracks, and shops, are painted almost black, and the occupants have already lost the feeling that this color is lugubrious because they have learned that black houses are cool, or at least cooler, than those of any other color, and that white houses are the hottest of all.

"It must be noted, too, that white reflects or transmits the short length, or actinic, light rays, while the darker tints do it either not at all or to a less extent. Those are the rays, we know, that cause the dermatitis known as 'sunburn,' and there are excellent reasons for believing that from them, rather than from the heat rays, come most of our summer sufferings. As regards the 'lesson' of the animals there is some force in the suggestion that their colors are largely to conceal the wearers from other animals, their prey or their enemies, but polar bears wouldn't wear white if it didn't keep them warm, or lions and tigers yellow if it didn't facilitate the radiation of their own heat."

In the same degree in which a man's mind is nearer to freedom from all passion, in the same degree also is it nearer to strength.—*Marcus Antoninus.*

Book Reviews.

PRACTICAL APPLIED ELECTRICITY. By David Penn Moreton. Published by the Reilly & Bretton Co., Chicago. 480 pages. Numerous illustrations, flexible leather. Price, $2.

Professor Moreton, of the Armour Institute of Technology, has done a notable service to the better education in electricity, and his lectures on the subject to the classes in the institute of which he is a worthy member of the faculty, well deserve to be perpetuated in book form. As a text book for the beginner the work presents in a clear and interesting style not only the elements of practical applied electricity, but the subject is carried on by easy stages to the most advanced appliances of our time. It is very gratifying to see a work of such labor and learning so free from the involved mathematical labyrinths that are so repellant to the young mind, and of so little value even to the aged and experienced. Professor Moreton's book, apart from its great educational value, is a triumph of good English. The learned professor never sees anything that he cannot describe in plain English. He does not lead a student into a wilderness of hieroglyphs and then leave him in utter darkness. The book educates and illumines. It is sure to meet with popular favor.

Only Blocked for 100 Minutes.

A press dispatch from Boston a short time ago gave particulars of an engineering feat of some magnitude which was the new bridge for the Boston & Albany Railroad over the Westfield River at Huntington, Vt., This bridge was rolled into place in just 49 seconds from the time the word was given. The mass of steel, comprising the new and old bridges, weighed more than 1,000 tons, was 394 ft. long, and consisted of three spans. After being riveted together, the ties and other timbers were placed in permanent position, the new rails with the exception of the end connections at the abutments being spiked in place. The new structure and the lattice trusses composing the old bridges were all mounted on rollers and rails.

When permission to cut the track was obtained from headquarters, the entire mass of steel work, new and old, was moved sideways until the new bridge lined perfectly with the tracks on the roadbed. The connecting rail lengths over the abutments were then put in place, the ends of the bridge were supported on temporary blocking until the masonry work was completed. The new bridge was actually ready for service in exactly 100 minutes from the time that the rails were removed.

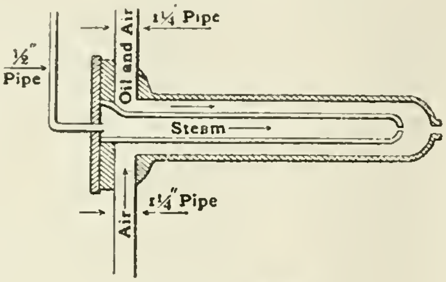
Locomotive Running Repairs

XVII.—Oil Burners.

The rapidity with which the burning of oil in locomotives has come into favor, particularly in the West and Southwest, and the apparently inexhaustible supply of the oil has engaged the attention of the leading railway men, and, as may be expected, a variety of devices, or rather a number of variations of the same general method of providing appliances for the burning of the oil, have come into use, and a brief description of these with the addition of some of the latest changes and improvements that are being made, cannot fail to be of interest to railway men.

In the matter of the repairing of these appliances it may be briefly stated at the outset that the repairing that may properly be classified under the heading of running repairs consists chiefly in maintaining the brick arch work which is an essential feature of the appliances in oil burning locomotives. The best kind of fire-brick in use rapidly deteriorates in the great heat to which it is submitted, the wasting of the brick being more rapid than in the fire-brick arches that are in use in coal burning locomotives, and the danger to the lower parts of the fire-box from exposure, in the event of portions of the brick work falling away, is consequently great—the average period of service of parts of the brick work not exceeding three weeks in the case of locomotives that are in constant service.

Fortunately the fire-boxes of coal burning locomotives lend themselves readily to oil fuel consumption. On some railways the changes necessary have been made with a degree of rapidity that seems surprising, and in districts where oil fuel is plentiful and consequently cheap, and where coal is high priced on account of having to be conveyed considerable distances, the saving in almost every instance has been considerable. In this regard it may be stated that a general comparison between the prices of oil fuel may be obtained by estimating the price of oil at two-and-one-tenths of a cent per gallon, and taking the comparison between oil and coal on the generally accepted basis that 200 gallons of oil is equal in calorific quality to one ton of coal. It will thus be seen that coal costing $4.20 a ton would be equal to the price of that amount of oil required to produce the same quantity of heat. The work necessary in handling the material is much less in the case of oil, and if the price of coal is higher than the figure quoted, it can be seen that there is an economical advantage to be gained by the use of oil as fuel. In regard to the steaming qualities of the locomotives all authorities agree that the oil fuel, properly managed, produces better results than the best coal. This is not to be wondered at, as the almost complete absence of matter

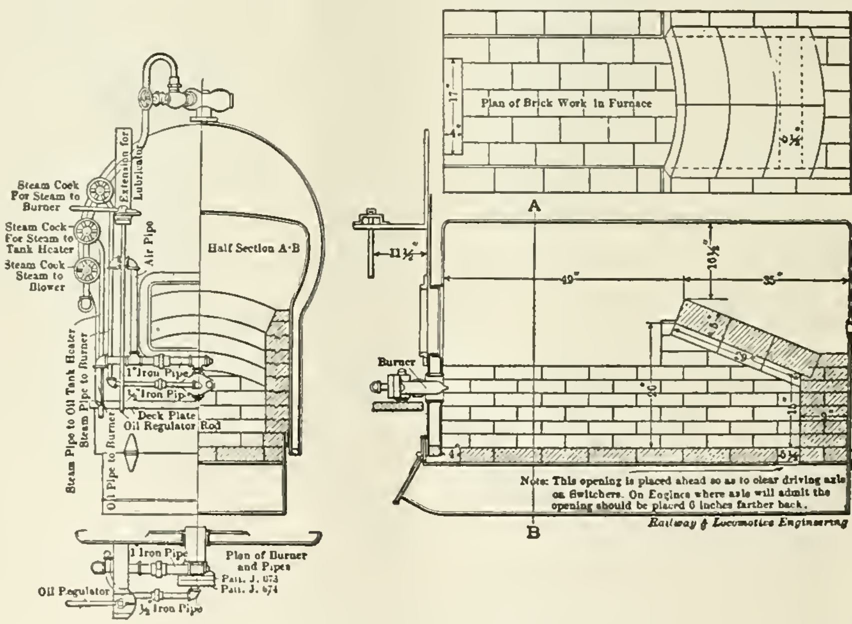


THE OIL ATOMIZER.

that may be said to be non-combustible, and which is always present in greater or lesser quantities in coal is almost entirely absent in even the lower grades of crude oil.

In making the necessary changes from a coal burning to an oil burning locomotive the grates and side bearings on which the grates rest are removed and a cast-iron plate is put in 5 or 6 ins. below the mud ring and extends over the entire space covered by the fire-box. There is generally three openings in this plate measuring 9 x 15 ins., one opening being near the front end of the fire-box the next in the centre and the third opening near the back of the fire-box under the fire-box door. The ash pan and dampers may be left as they were. The cast-iron plate is entirely covered by fire-bricks in order to protect it from the intense heat of the burning oil. On this brick foundation a wall of fire-brick is built reaching as high as the level of the bottom flues in front, and nearly as high as that of the fire-box door along the sides and back fire-box sheet. The thickness of the fire-bricks is usually 5 ins. The three openings are not covered by fire-bricks, their purpose being to admit the amount of air necessary for combustion. It may be added that the cast-iron plate forming the bottom of the fire-box has sides attached to it securely filling the space between the bottom of the fire box and the mud ring.

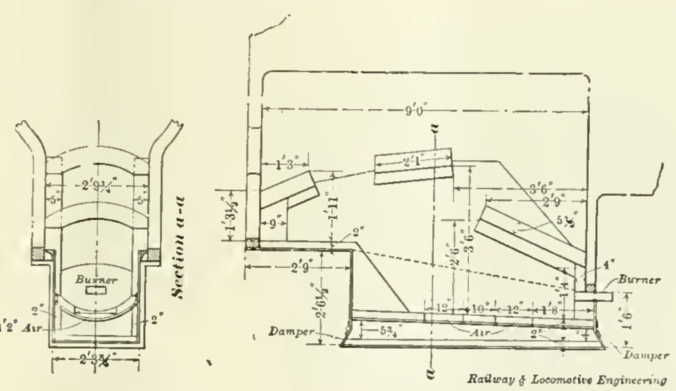
A brick arch resting securely upon the side walls of brick, and extending across the fire box from side to side and beginning at the front end of the fire box and reaching backwards about 4 ft., the part of the arch nearest the firebox door being about 18 ins. higher than the front part near the flues. This brick arch is perhaps the most variable appliance used in the apparatus, sometimes taking the form of two or three separate arches—a short arch in front measuring 3 ft. in length, another arch under the fire box door one-and-a-half feet in length, and an overhanging arch centrally located, 2 ft. in length, and occupying a central position a few inches higher than the other two arches. The dimensions and location of



FIREBOX WITH OIL ATOMIZER AT BACK END.

these separate arches have been a matter of much experiment among railway men, the aim being to obtain the most perfect combustion by causing the oil fuel to deflect against several masses of heated fire-brick thereby insuring the combustion of the inflammable oil before passing to the flues.

The oil tanks are located in the pit of the water tank and the oil, before being injected into the fire-box is heated usually by a coiled pipe passing through the oil tank. This pipe may have its connection with the dome or steam chamber on the boiler head, and in some cases the steam passing through the pipe is conveyed back to the boiler through adjustable valves and nozzles as in the case of the action of the injector. In others an escape valve is opened sufficiently to allow a small jet of steam to pass into the air. The proper degree of temperature to which the oil should be heated to produce the best results has been carefully determined and the variations are incident to the degree of thickness of the oil, the thickest kinds of oil should be heated to a temperature of between 150 and 170 degs. F. The thinner oils from 100 to 120 degs. F. The temperature should be carefully observed and a measuring rod may be readily suspended in the forward tank nearest to the fire-box. The general method of heating the oil is to open wide the steam valve and heat the oil rapidly and when the proper degree of heat has been reached the valve may be shut, and another application made when necessary. Climatic conditions readily suggest the applications necessary. The openings on the top of the oil tanks should be allowed to remain open except when the tanks are entirely full when there may be a danger of splashing. It is hardly necessary to add that lighted torches should be kept away from these openings.



FIREBOX WITH OIL ATOMIZER AT FRONT END.

The apparatus for injecting the heated oil into the fire-box is located under the mud ring on a line with the centre of the fire-box. The atomizer is a simple injector having a pipe connecting with the oil tank, the pipe being attached a short distance above the bottom of the tank in order to avoid conveying water with the oil, the oil generally being lighter than water, the water finds its way to the bottom of the tank where there are means applied to drain it off. In addition to the oil pipe there is also an air pipe, the oil pipe and air pipe being 1¼ ins. in diameter. A steam pipe ½ in. in diameter connected to the boiler, leads into a hollow cylinder surrounded by another cylinder, the apparatus being of sufficient length to extend from the outer wall of the boiler to which it may be conveniently attached inward beyond the mud ring and brick work into the fire-box. The inner cylinder has a small opening and the outer cylinder has a larger opening parallel to each other, and so adjusted at an angle carefully calculated so that when the valves with which the pipes are fitted are opened the jet of steam will project the spray of oil against the inner centre of the slanting arch to which we have already alluded.

In starting the fire in locomotives equipped with oil burners it is necessary that steam or compressed air pressure should be applied. These can usually be supplied at the starting points on railroads, and when greasy waste or other inflammable material is placed in the fire-box and lighted the valves should be slowly opened and the oil will readily ignite. As there is almost always some water in crude oil there is a danger of the fire going out and the oil may, if permitted, continue to run into the fire-box before the brick work has been sufficiently heated to ignite the oil, the fact should be carefully noted, as a considerable flow of oil into the pan might cause a serious explosion while relighting. The quenching of the fire by the mixture of water may readily be detected by the appearance of white smoke coming out of the smoke stack. The odor arising from the oil on the partially heated brick work is also a ready means of detection.

The firing up of oil-burning locomotives where there is no available pressure must be done in the usual way with sufficient wood to raise a pressure of steam, in which case care should be taken not to damage the brick work by throwing wood carelessly into the fire-box. The front end appliances are the same as in coal burning locomotives, with the exception that there is no need of netting or other spark-arresting devices. The omission of the netting calls for extra care at the time when a fire of wood has sufficiently heated the water so that a pressure of steam may be applied to the oil-burning device. A shower of sparks may then be expected and it is well to observe that there is no valuable material in the vicinity. General speaking the oil-burning locomotives are entirely free from the evil of starting fires in their vicinity.

A peculiarity in the burning of oil fuel is the tendency of the flues to collect a gummy substance on the ends that project into the fire-box, and even with the most careful management of the fuel and no appearance of smoke, soot will accumulate in the flues. In coal burning engines the cinders and particles of coal which are drawn with considerable force through the flues tend to prevent the accumulation of soot. In oil-burning engines there is no such cleansing quality in the fuel but the defect is easily remedied by an occasional application of sand. This is usually admitted into the fire-box through an elbow-shaped funnel inserted through an opening in the fire-box door. When a quantity of sand is admitted in this way, it is well that the engine should be running with a long stroke of the valves, and the throttle should be opened wide. The strong exhaust will draw the sand through the flues with such velocity that the gum and soot will be cleaned with a few blasts. Much of the success that has attended the introduction of oil fuel in locomotives has been the intelligent harmony that has existed between the engineers and firemen in working together. The handle of the oil-supply valve is as important a factor in the management of the fire as the throttle or reverse lever is in the control of the engine, and when both are worked skilfully together the result leaves little to be desired.

As was stated at the outset the devices are numerous and their applications are various. In some locomotives the oil-injecting apparatus, or atomizer as it is called, is placed in the front end of the fire box and the spray is injected backward under a system of fire-brick work suited to that direction. It is claimed that the oil fuel thus being driven in a direction away from the flues the opportunities for complete combustion of the fuel before the unburned particles of the spray can reach the flues is greater than when the oil is projected towards the flues. The advantages, however, appear to be more imaginary than real, as the change of position of the appliances has not changed the consumption of oil to any marked degree.

Questions Answered

WOOD BURNER.

60. F. W. R., Marianna, Fla., writes: We have a wood burning engine that gives considerable trouble blowing fire out of the door when steam is shut off drifting. If you will kindly tell us what will remedy the defect it will be greatly appreciated. A.—A full description of the locomotive would be useful in answering a question of this kind, but presuming it belongs to the last century it would be advisable, especially if the smoke stack is of the inverted pyramid type, to take out the netting occasionally and setting it over a fire of shavings or other combustible matter, have it thoroughly cleaned. The same remarks apply to any kind of netting that may be in the smoke box. Some kinds of wood, especially in the South, have a tendency to clog the netting very rapidly and repeated cleaning is an absolute necessity. The closing of the ash pan lids and the opening of the blower, if there be a blower, should prevent any sudden blast of flame from the fire box door, but locomotives that develop peculiarities should be watched, and engineers and firemen, like other intelligent men, should not be bitten by the same dog twice. Before the general use of the blower, when wood fires were kindled, it was sometimes impossible to remain in the cab until the fire had brightened. The cleaning of the flues, the proper adjustment of the deflector, and the repeated and thorough cleaning of the netting, with the use of the blower when necessary, should prevent any kind of fire box from belching flame out of the fire box door. This, of course, is presuming that the front end and ash pan are properly fitted and in good condition.

COST OF LOCOMOTIVES.

61. J. W. Moon, S. D., writes: I have had a dispute with an ex-engineer as to the cost of a consolidation locomotive, simple engines, piston valves, cylinders 22 x 28 ins., and weighing about 95 tons. It is classed as D 4 on the C., B. & Q. R. R. It is about eight years old. The ex-engineer claims that the locomotive cost more than $25,000. I estimated the price as between $15,000 and $20,000. Which is right? A.—It is contrary to the policy of locomotive builders to give figures of this kind to uninterested parties, but from our own knowledge of such matters we would state that your estimate is much nearer the price of the locomotive alluded to than the estimate of the ex-engineer. The price he states would be excessive for a consolidation locomotive of that weight.

CYLINDERS AND PHOTOGRAPHS.

62. J. W. W., Streator, Ill, writes: In some designs of locomotives I observe that the cylinders are higher at the front or head end, the piston rods making an angle with the main rod when engine is on the center. I also observe that in nearly all photographs of locomotives in your valuable magazine the crank pins are on the bottom quarter. Why are these things so? A.—In early locomotive construction it was presumed that the angular position of the cylinders referred to aided in the adhesive power of the locomotive. Stephenson's "Rocket" was constructed on this idea. It was a gross error and was rapidly remedied. On some locomotives, particularly on those equipped with driving wheels of small diameter and with trucks that may interfere with the height of the cylinders it is sometimes necessary to raise the center of the cylinders above the center of the axles. In regard to the position of the main crank pin in photographs it will be readily observed that the lower quarter is the best position to show the other parts of the locomotive, especially if the valve gearing is of the outside type.

SIZE OF LINKS.

63 T. H., Belfast, Ireland, writes: (1) Why is an expansion link always about the same length, at least those built by British builders? Why could it not be made shorter than it is? A.—Links must be so constructed as to convey the desired amount of travel to the valve. Their length could be diminished by attaching them to a short-armed rocker, the link being attached to the short arm and the valve rod to the longer arm. Sometimes this is necessary on account of other peculiarities in construction, but it is no gain, as the seeming advantage in a shorter movement of the link is more than overcome by the greater amount of power necessary to move the valve by a short moving lever.

SUPERHEATED STEAM.

64. T. H., Belfast, Ireland, also writes: (2) Is it not more economical where superheated steam is used to increase valve lap, thereby bringing about an earlier cut-off and getting work out of superheated steam equal to saturated steam at a different point of cut-off? If valve remains the same as when saturated steam was being used, I cannot see where there is any economy in raising pressure by adding heat to steam before entering cylinders. Would not adding lap be more in an economical way? A.—Changing the dimensions of the valve in any particular could not be entertained. The parts of the valve are constructed to suit the steam and exhaust ports and any change in one necessitates a change in the other. The organic principle in the use of superheated steam lies in making the best use of the fuel in increasing the temperature and consequently the pressure of the steam. The result has been that a lower pressure of steam may be maintained in the boiler, and by conveying the steam through the heated gases from the fire the temperature of the steam is raised without any additional fuel being used, thereby effecting a considerable saving. The increase in temperature does not necessarily involve a change in the mechanism of the moving parts of the locomotive.

TRUCK AXLES.

65. L. C. B., Covington, Ky., writes: (1) Why is the wheel fit frequently made larger in diameter than any other part of the axle? This refers to driving and engine truck wheels. A.—The advantage of having that portion of the axle which is fitted into the wheel larger is owing to the fact that the tendency to break at the point of junction with the wheel is much lessened when the diameter of the axle is enlarged in the part fitted into the wheel. It will be noted that there is a fillet forming a rounded corner towards the bearing. Repeated experiments have shown this to be a factor of safety. The increased diameter of the part fitted into the wheel also furnishes a larger surface of adhesion anl consequently a lessened amount of pressure may be used in pressing the axles into place, thereby lessening the tendency to rupture the wheel.

MALLET COMPOUNDS.

66. L. C. B., Covington, Ky., also writes: What system of compounding is employed with reference to articulated Mallet engines? A.—The Mellin system is used on locomotives constructed by the American Locomotive Company, and the Baldwin Locomotive Company have also a system peculiarly their own. Both methods admirably suit the purpose.

To Test Mushet Steel.

Two machinists were one day discussing the merits of various tool steels and one held that all steels were about the same when the tools were old and that no one could tell the difference in the quality.

"Don't say, 'no one,'" exclaimed Machinist No. 2. "I can tell Mushet steel as long as it holds a cutting edge. It is easy making the test on an emery wheel.

"When so used Mushets will throw a stream of dull red sparks when ground and without sending off flying sparks. Other steels throw sparks in showers."

Air Brake Department

Conducted by G. W. Kiehm

Feed Valve Repairs.

A few years ago it was not generally supposed that the brake pipe feed valve had any bearing whatever upon the application of the brake, as its duty appears to end with the regulation of brake pipe pressure, and if the feed valve does properly regulate the brake pipe, the feed valve will not have any effect upon brake applications.

However, a defective feed valve may affect the application of brakes, and one that does is at once very undesirable and annoying, and furthermore it is absolutely essential to a successful operation of brakes that a feed valve that can affect the application, shall not be used.

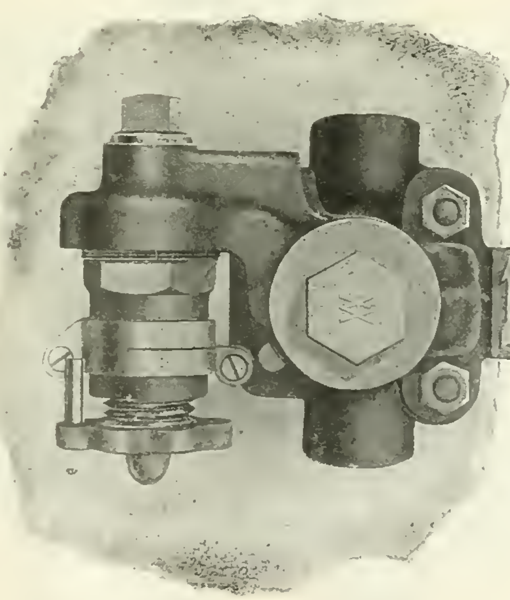
It is also generally understood that a feed valve that does not constantly maintain a predetermined pressure in the brake pipe is likely to allow brake pipe leakage, to apply the brakes during the time the feed valve is failing and if the feed valve permits brake pipe pressure to fall just previous to a movement of the brake valve handle toward application position, the effect will be the same as that termed "loafing on lap," that is, brake pipe leakage is likely to start the application of brake which it is intended for the brake valve to start the brake pipe reduction. Again a defective feed valve may overcharge the brake pipe at any time, or just previous to an application, either of which may bring about further undesirable results.

When in perfect condition, the feed valve and its entire effect is cut out the instant the brake valve handle reaches lap position, and it again resumes its interrupted duties the instant the valve handle returns to running position, having played no part whatever in the brake application, or having had no effect thereon, but, as stated, this cannot be said of a defective valve.

Undoubtedly, the most important function of the feed valve is the prompt supplying of the slightest fall in brake pipe pressure, and its sole duty is the perfect regulation of pressure. Some years ago the principal duty of a feed valve was considered to be a prompt closing when the desired pressure was accumulated in the brake pipe, but improved equipment and a more intelligent understanding of air brake conditions makes the prompt opening to supply any lowering of brake pipe pressure the feature of paramount importance.

The terms "improved equipment" has reference to the E T brake and type K and L triple valves, as these are so much more positive in their application they are more easily affected by slight variations in pressure, and this becomes more apparent with the understanding that with type K or L triple valves or with any quick service valves, a movement to application position means a further reduction of brake pipe pressure through the quick service ports; consequently a positive brake application as a result of a slight variation of pressure, and the possibility of a general reduction of brake pipe pressure that would not have occurred with old style valves.

This action of improved triple valves, if originating from leakage, and a defective feed valve, is very conducive to an overcharge of brake pipe pressure by a movement to release position with the brake valve; in fact, this action may be said to bait an overcharge and will generally result in one if the man using the brake valve has not a very practical knowledge of air brake operation.



B-6 FEED VALVE, FRONT VIEW.

Once a brake system with type L triple valves is overcharged, assuming, of course, that there is some brake pipe leakage, it nearly always means carrying the brake valve handle in release position when a pump governor less sensitive than the average may allow further variations in brake pipe pressure, consequently, subsequent applications or creeping on of brakes. The other alternative in overcoming the effect of an overcharged brake pipe is a stop to bleed auxiliary and supplementary reservoirs as a reduction or depletion of both auxiliary and supplementary reservoir pressure by means of the brake valve is a very difficult operation, in fact, a very uncertain one, as this brake equipment was designed with a view of preventing a depletion of pressures during service operations, therefore considerable skill would be required in securing an equilibrium of supplementary reservoir pressure by means of the brake valve, especially if there is considerable brake pipe volume.

The feed valve's effect on brakes applying is very noticeable with the E T brake, as a slight fall in brake pipe pressure results in an application of the brake and the principal reason is that the distributing valve's operation is usually more positive than the operation of a locomotive triple valve and the brake cylinder supply is from an unlimited source.

It is evident then that the two most annoying defects the feed valve can have are "too slow in opening," and "too slow in closing," and the cause is nearly always due to either too loose a fit or too neat a fit of the supply valve piston. By too slow in closing is meant a delayed return of the supply valve piston in cutting off the flow of air into the brake pipe when the figure of adjustment has been reached, and by too slow in opening it is meant that the feed valve permits a considerable reduction in pressure by being what is termed "sluggish."

There are other causes besides an improperly fitted piston that will vary the time of opening and closing of the feed valve, but the fit of the supply valve piston in its bushing must be absolutely accurate as there is but a slight difference between the sizes of pistons that will be too loose and that will be too neat, and the feed valve must be tested in order that the fit of the piston may be determined.

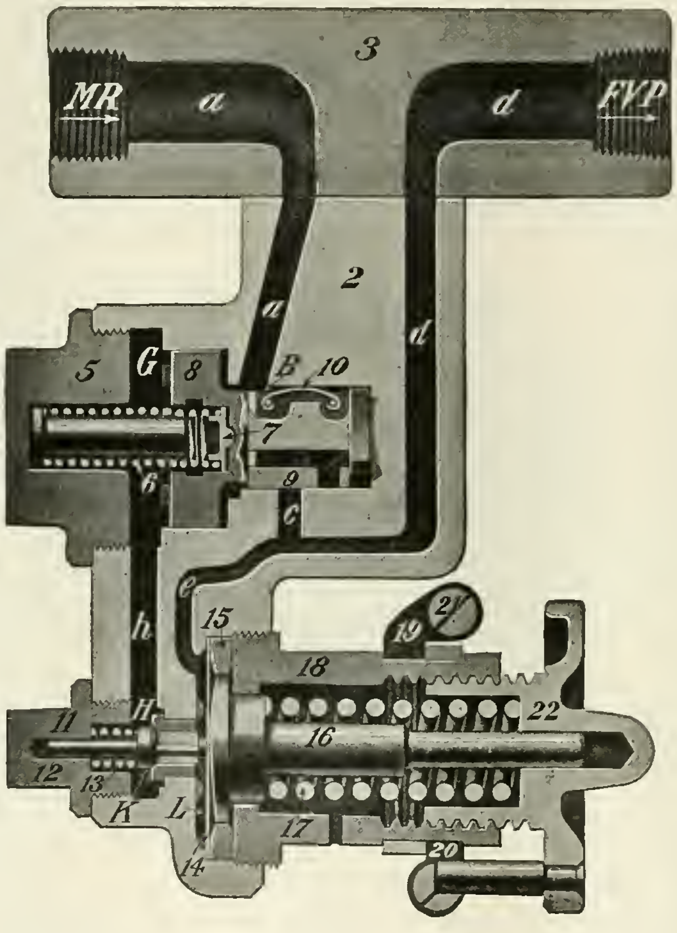
Taking a feed valve to a roundhouse vise bench and wiping the movable parts with a piece of oily waste and returning it to service again without a test is a thing of the past, as a feed valve receiving this treatment will not do for service with modern brake equipments, and if they are used, air brake troubles may be expected, as they are sure to occur.

Now, in testing a feed valve, no special apparatus is required, but an ordinary test rack for brake valves can be used; then the feed valve can be attached to a G 6 brake valve and there should be a stop cock in the brake pipe near the brake valve, and just past this cock and within easy reach should be another stop cock in a branch pipe leading to a large auxiliary or a small main reservoir, which should be used for storing a brake pipe volume, and if possible a triple valve and auxiliary reservoir should also be connected with the brake pipe then at some convenient point where cutting out the brake pipe volume reservoir will not interfere with it, a cock with a small opening should be used to create brake pipe leakage.

The size of opening in this cock will depend somewhat upon the volume in the brake pipe, that is, exclusive of the volume reservoir and a 3-64 of an inch opening is generally favored then, by means of an air gage showing brake pipe pressure, the fluctuation produced by leakage can be observed and the feed valve's action in charging an auxiliary reservoir can be noted along with the usual test.

After cleaning or repairing, the feed valves should be bolted to the brake valve with the spring box removed, the brake valve handle on lap position and the stop cock under the brake valve closed. When the brake handle is then placed in running position, a heavy blow will occur at the port exposed by the removal of the spring box, and as the supply valve piston returns the slide valve to its normal position, this flow should be cut off, after which slide valve or regulating valve leakage can be noted; there being absolutely no leakage, the supply portion should be operated a few times by pressing the finger against the regulating valve which will unseat it and destroy the equilibrium of pressure surrounding the supply valve piston, and if this produces prompt responses and no leakage, it should be observed that the end of the regulating valve is flush with the shoulders on which the diaphragms rest. After the ends of the regulating spring are known to bear evenly on the spindle and on the regulating nut, the spring box may be screwed in place with no tension on the regulating spring, and this should not produce any rise in brake pipe pressure as indicated by the air gage. If there is a rise in pressure before the adjusting nut is screwed up to produce a tension on the regulating spring it indicates that the regulating valve is too long and has become unseated due to screwing the spring box into place.

However, before making any changes in the length of the regulating valve it should again be measured and at this time it must be observed that there is absolutely no supply valve or regulating valve leakage. When screwing up the spring box results in no rise in pressure, the brake valve cut-out cock should be opened and the triple valve cut in, then the adjusting spring should be screwed up and the action of the feed valve in charging up the reservoir can be noted. If the gage had fluctuates from 2 to 4 lbs. until the reservoir is charged, the cock with the restricted opening should be used and it should produce a gage hand movement of from 1 to 3 lbs., which represents the opening and closing of the feed valve.



B-6 FEED VALVE, CLOSED.

The feed valve then being adjusted to some definite pressure, the brake pipe volume reservoir should be cut in and the rate of "feed up" noted; the time is, of course, proportioned to the size of the reservoir, and to find the time that should be consumed a test with a new feed valve should be conducted and this time used as standard.

When the feed valve has closed, the pressure delivered should be noted and the brake valve cut-out cock closed, the closure should not result in an increase as shown by the gage, that is, the same number of pounds pressure should be maintained regardless of the volume, and if the feed valve passes this test it is in fit condition for any class of service.

But to return to the time the spring box is removed and the supply valve piston is operated by means of pressing the thumb against the exposed portion of the regulating valve, there should at this time be an exhaust of air from the regulating valve and a heavy blow from the port leading to the brake pipe; if there is not, it indicates a restriction in the small ports and they can be opened by using a 3-16-in. drill to remove the brass plugs in the ends of the port holes, after which they can be opened with the same drill. If there is no leakage from the ports or valve seat and cap nuts, the work of repairing must have been done properly up to this time at least, and the length of time the supply valve piston remains away from its closed position during operations bears directly upon the fit of the supply valve piston.

If the blow is exceedingly short it indicates too loose a supply valve piston; if the blow is unusually long it indicates too neat a fit of the supply valve piston, but before any attempt is made to reduce, the piston leakage, especially from the cap nuts, should first be looked for and the tension of the supply valve piston spring should be determined, and even if these parts are all right the piston should be wiped thoroughly dry and operated a few times before the emery cloth is used on the piston. In passing it may be well to observe that the supply valve piston spring of the B 6 feed valve is a rather heavy one, known as piece No. 18286, a standard with the brake pipe vent valve graduating spring and considerably heavier than the springs used in the B 4 valves.

It is also important that no lubricant should be used on the supply valve piston and but a very small quantity on the supply valve and supply valve spring, as well as a drop on the piston spring tip, and in all cases that a piston appears to be too neat a fit, it and the bushing should be wiped perfectly dry, that there may be no water or oil to act as a packing. If the piston is then too neat a fit there will be a wide variation or fluctuation shown by the gage hand while the auxiliary reservoir is being charged through the triple valve, if the hand rises and falls 5 or 6 lbs. or more the piston should be rubbed a trifle with a piece of fine or well worn emery cloth until the variation is but 2 or 3 lbs. and should not go far beyond this when supplying the leakage created by the small restricted opening in the brake pipe.

If there is no noticeable movement of the gage hand during the charging or leakage supplying test, the supply valve piston is too loose and the critical test comes as the brake pipe reservoir volume is cut in, and when chared and pressure noted the brake valve cut-out cock should be closed and the fit of the piston is gaged by the movement of the gage hand.

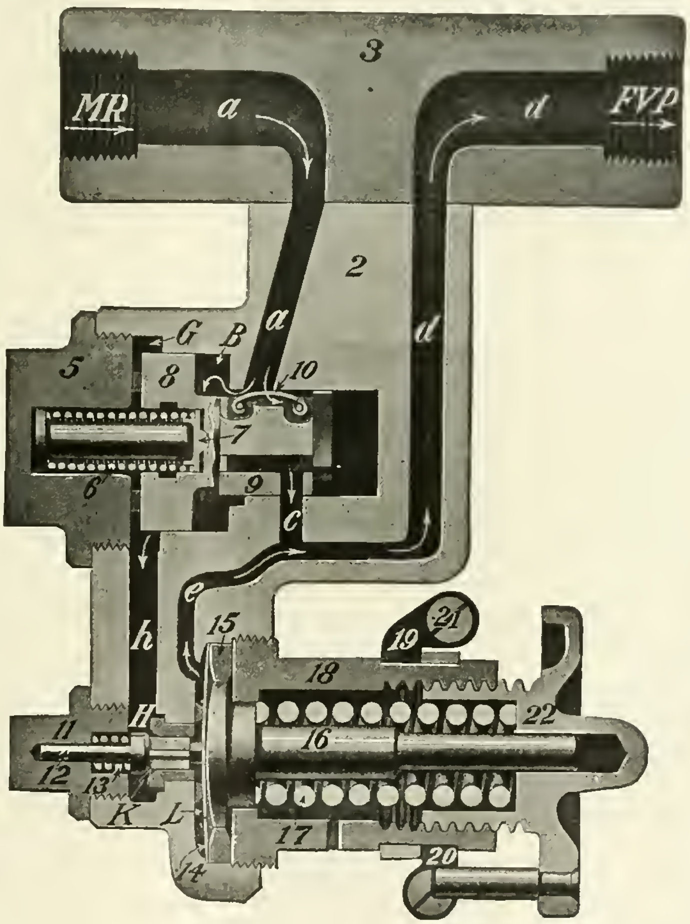
If the hand rises but 1 or 2 lbs. and stops, the feed valve will pass in a case of emergency, but if the hand rises 4 or 5 lbs. or more the valve is unfit for use, but if the pressure is same for both volumes the piston must fit the bushing properly.

Of course the piston may be loose enough to vary the pressure 8 or 10 lbs., or while charging the auxiliary reservoir the feed valve may partly close; in fact the supply valve is closed when the pressure nears the adjustment; then the last 3 or 4 lbs. accumulate very slowly and during the time the last few pounds accumulate the supply is past the piston and through the regulating valve. The distance the hand creeps at this time can sometimes be reduced by using a heavy-bodied oil on the supply valve piston and a somewhat lighter supply valve piston spring, but any comment upon this character of repair work is unnecessary.

There are other important operations in repairing feed valves, but a repair man's mechanical training will teach him that the slide valve seat must be in line with the piston bushing and that a valve may have a perfect bearing on its seat and yet be held off by some cause, and furthermore no system of repair work is successful if not economical.

The proper way to maintain a fit of the supply valve piston is to fit a new piston until the bushing becomes too large for a new one. The feed valve body should then be rebushed with a bushing a trifle smaller than the standard, which will permit of the use of the old pistons and make a perfect repair job, but such work should not be attempted in an engine house or a very small repair shop.

Before leaving the subject of feed valve disorders we would mention one annoying feature that is prominent in some valves which is a buzzing or sometimes even a squealing sound that is from the vibration of the diaphragm spindle. This is more noticeable with the C 6 reducing valve on account of the greater differential in pressure and the wider the differential the louder the noise becomes. This can sometimes be remedied by adding a diaphragm, but the most effectual means of stopping this noise is to separate the extreme ends of the adjusting spring from the next coil, but the end of the spring must be ground perfectly square after the end has been sprung away.



B-6 FEED VALVE, OPEN.

While not affecting the operation of the feed valve this is very annoying and should be remedied.

In conclusion it may be said that a great number of words have been employed in describing this test, but it does not follow that it will require a great deal of time to test the valve, because, if all parts are in a condition that will enable the valve to pass the test, not over 3 or 4 minutes will be consumed in attaching the spring box, testing and adjusting the feed valve.

Questions on Air Brake Subjects.

SAFETY VALVE ADJUSTMENT.

67. J. M., Ft. Wayne, writes: Why is the safety valve of the No. 6 distributing valve set at 68 lbs. instead of 53 lbs., at which all other driver brake safety valves are set? A.—This figure of adjustment for the safety valve of the No. 6 brake provides for a higher emergency braking power on the locomotive, and the system of leverage is arranged to produce a lower service braking power than that developed by the A 1 type of brake. A full service brake pipe reduction results in a 50-lb. brake cylinder pressure with all brakes, but on the locomotive with the No. 6 brake the leverage ratio produces 60 per cent. braking power based upon 50 lbs. cylinder pressure; while with the A 1 brake it is 70 or 75 per cent. based on 50 lbs. cylinder pressure, thus the No. 6 equipment yields 20 per cent. less braking power in service operations and 10 per cent. more in emergency than the A 1 brake does.

BRAKES CREEPING ON.

68. A. B., Youngstown, writes: We have an engine equipped with the No. 6 E T brake and when pushing a train of cars, the double heading cock closed and the head engine handling all the brakes, the brake sometimes applied with both handles in running position, and when released with the independent valve will sometimes reapply. What causes this and how can it be remedied? A. —This is caused by variations in brake pipe pressure emanating from the head engine, which the rear engine cannot prevent. It may be due to a number of causes, such as excessive brake pipe leakage, a defective feed valve or faulty manipulation of the brake valve, but the independent valve should not be used to release the brake on the rear engine after it has applied under the conditions mentioned; instead, the brake valve cut-out-cock should be opened for an instant, or rather partly opened and closed in the shortest possible space of time, which is termed "flashing" the brake off. This permits of a slight increase in brake pipe pressure, just sufficient to force the equalizing valve of the distributing valve to release position without overcharging the brake pipe. Should the smaller gage show that the brake pipe pressure is higher than the pressure maintained by the feed valve, place the automatic brake valve in release position and then "flash" the brake off.

DISTRIBUTING VALVE LEAKAGE.

69. J. M., Ft. Wayne, writes: After an

emergency application on a distributing valve with the quick action cap, there is a blow of air from the exhaust post, accompanied by a buzzing sound, which continues until the valve is hammered with something when it ceases until another emergency application is made. The slide valve of the quick action cap has a perfect bearing on its seat and there is no leak at the exhaust port until after the emergency application. What could cause this? A.—It is evident that the emergency valve becomes unseated, due to the winding action of the graduating spring when returning the emergency valve to its closed position.

Use a drop of oil on each end of the graduating spring, note that the spring's bearing surface against the cap nut and valve stem are fairly smooth; be sure there is a slide valve spring between the emergency valve and the valve stem and if the wearing surfaces of the valves and seat are true, with no ridges along the edge of the seat, your trouble will disappear.

Air Brake Questions and Answers.—Third Series.

AIR PUMP.

1. Explain how an air-pump should be started and run on the road.

A. It should be started slowly to permit the condensation to be drained off. The lubricator should be started carefully, and the pump worked slowly until about 40 lbs. have been accumulated in the main reservoir to cushion the steam and air piston of the pump. Then the throttle should be opened wider, giving a speed of about one hundred and thirty or one hundred and forty single strokes per minute. The amount of work being done really governs the speed of the pump.

2. How should the steam end of the pump be oiled?

A. By the sight-feed lubricator, with a good quality of valve oil, and at the rate of about one drop per minute This amount will vary with the condition of the pump and the work being done.

3. How should air end of a pump be oiled, and what lubricant should be used?

A. High-grade valve oil, containing good lubricating qualities and no sediment should be used. A good swab on the piston rod will help out a great deal. Oil should be used in the air cylinder of the pump sparingly but continuously, and it should be introduced on the down stroke, when pump is running slowly, through the little cup provided for the purpose, and not through the air suction valves. An automatic oil cup, such as has recently come into practice, is preferable to hand oiling.

4. When first admitting steam to the 9½-in. pump, in what direction does the main valve move?

A. If the main piston is at the bottomof the cylinder, as it usually is after steam has been shut off and gravity controls it, the main valve will move to the position to the right.

5. With the main valve to the right, which end of the cylinder will receive steam?

A. The bottom, or lower, end.

6. When the main piston completes its up stroke, explain how its motion is reversed so as to make the downward stroke?

A. When the main piston reaches and is nearly at the top of its stroke, the reversing plate catches the shoulder on the reversing valve rod, moving the reversing rod and valve to their upper positions, where steam is admitted behind the large head of the main valve, forcing this main valve over to the left, carrying with it the slide valve which admits steam to the top end of the cylinder and exhausts it from the bottom end, thereby reversing the stroke of the pump.

7. Explain the operation of the air end of the 9½-in. air pump on an upstroke and on a down-stroke.

A. The air piston is directly connected with the steam piston, and any movement of the steam piston will consequently be transmitted directly to the air piston. When the steam piston moves up, the air piston will, of course, go with it, thus leaving an empty space or a vacuum in the lower end of the air cylinder, underneath the air piston. Atmospheric air rushes through the air inlet, raising the lower receiving valve, and filling the bottom end of the cylinder with atmospheric pressure. At the same time the air above the air piston will be compressed. The pressure thus formed holds the upper receiving valve to its seat, and when a little greater than the air in the main reservoir, the upper discharge valve will lift and allow the compressed air to flow into the main reservoir. When the piston reaches the top of the stroke its motion is reversed, and on the down stroke the vacuum in the upper end of the air cylinder is supplied by atmospheric pressure passing through the upper receiving valve. The main reservoir pressure is held by the upper discharge valve, and the air being compressed in the bottom of the cylinder holds the bottom receiving valve to its seat, and when compressed sufficiently, forces the lower discharge valve open and passes to the reservoir.

8. Give some of the causes of the pump running hot.

A. First, air cylinder packing rings leaking. Second, discharge valves stuck closed or the discharge passages so obstructed that the pump is working against high air pressure continually. Third, poor lubrication. Fourth, high speed. Fifth, discharge or receiving air valves leaking. Sixth, air piston rod packing leaking.

9. If the pump runs hot while on the road, how would you proceed to cool it?

A. First, reduce the speed of the pump, and look for leaks in the train line. Second, make sure that the packing around the piston rod is not too tight or in bad condition. Third, see that the main reservoir is properly drained. If the pump still runs hot it should be reported at the end of the trip.

10. If the pump stops, can you tell if the trouble is in the pump or in the governor?

A. Yes. It may be tested by opening the drain cock in the steam passage at the pump, and noting whether there is a free flow of steam; if so, there is a free passage through the governor and the trouble is not there.

11. State the common causes for the pump stopping.

A. There are several reasons. First, it may be stopped by the governor being out of order; second, the valves may be dry and need lubrication; third, nuts may be loose or broken on the piston rod or one of the pistons pulled off. Fourth, the reversing valve rod may be broken or bent, or the reversing plate may be loose, or the shoulder on the reversing valve rod or the reversing plate may be so badly worn as not to catch and perform their proper functions. Fifth, nuts holding the main valve piston may be loose or broken off. Sixth, excessive blow past the packing rings of the main valve.

12. Should a pump make a much quicker down stroke than up, what effect does it indicate?

A. An upper discharge air valve leaking, a lower receiving air valve stuck to its seat or broken.

13. Should it make a much quicker up stroke, what defect does it indicate?

A. The lower discharge valve leaking badly, or the upper receiving valve is probably broken, or stuck to its seat.

14. Should an engineman observe the workings of a pump on the road, and report repairs needed, and do you consider yourself competent?

A. Yes.

An impression prevails even among blacksmiths that tool steel is necessarily brittle, but it can be made nearly as soft as common steel by proper annealing. When this process is properly conducted it is an easy matter to machine and forge tool steel.

Electrical Department

The Development of the Electric Motor.

By A. J. Manson.

(Continued from page 306).

In our last two numbers we have outlined the history of the electric motor beginning with the discovery of the principle in 1821, and have described the electro-magnetic engine built by Davidson of Scotland in 1842; the electro-magnetic engine built by Page of Washington, D. C., in 1851;

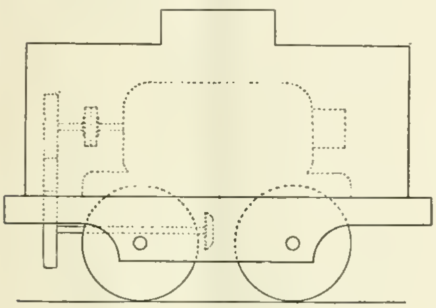


FIG. 3. SIEMEN'S LOCOMOTIVE, 1879.

the first electric locomotive, built by Siemens & Halske Co. and exhibited at the Berlin Exposition in 1879; the locomotives built and work done by Thomas A. Edison at Menlo Park, N. J., in 1880-2; the Lichterfelde road in Berlin, built by Siemens & Halske Co. in 1881; the electric road at the Paris Electrical Exhibition in 1881; the Portrush road, Ireland, in 1883, and the work done by Field, describing partially the locomotive exhibited at Chicago in 1883 called the "Judge."

In previous locomotives the speed had been regulated by the slipping of the clutch, but the clutch just described was only for furnishing a means for connecting and disconnecting the motor from the drivers and another method was made use of for the change in speed. A "throttle" or what we would call today a rheostat was provided, which consisted of a few contacts connected together by iron wire of suitable size so that same would not overheat when the motor current was passing through them continuously. By means of another lever a sliding contact could be connected to any segment and suitable resistance in series with the motor could thus be obtained for the speed desired, or all of the resistance could be cut out when the locomotive would run at full speed. The locomotive was reversed by means of a third lever and cog wheels which moved four brushes. Only two of these brushes were in contact with the commutator at one time and by throwing the lever the other two brushes would be placed in contact, reversing the flow of current through the armature and thus causing a change in the rotation. With the lever in the midway position none of the brushes were in contact with the commutator and the motor was out of circuit.

A third rail was used and the current was collected by means of a sliding contact. On account of the low voltage of the generator, wires were laid under each of the running rails and under the third rail so as to improve the voltage at the motor.

There was another man who was pushing forward on electric railway work and who did much to get the electric railway into commercial shape. This man was Daft, of the Daft Electric Light Co. In June, 1883, he had about completed his preparations for building and operating an electric road from Bloomfield to Newark, N. J., a distance of 2½ miles. This decision of his was based on trials and experiments made by him with a locomotive at Greenville, N. J., where his shop and laboratory was located, on a test road ¼ mile long which he had electrified. This test locomotive was 4 ft. long and 24 ins. wide and weighed 450 lbs. A load of two tons was hauled by it over the track and same was operated through snow and rain without difficulty.

On the result of these experiments

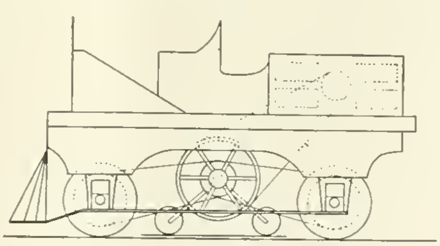


FIG. 5. THE "AMPERE," 1883.

money was advanced to Daft and, in the latter part of November, 1883, he made the first public trial of a new locomotive at Saratoga on the Saratoga, Mt. McGregor & Lake George Railway. A third rail had been laid previously between the tracks, which was the only change needed for a distance of 1¼ miles along the main line of the railroad which included grades and curves. The locomotive was coupled to a regular passenger car belonging to the railroad company, weighing 10 tons, in which were 68 persons. Five persons were able to ride on the locomotive, which weighed two tons, and, with the total load approximating 16 tons, a speed of 8 m. p. h. was reached going up the grade, developing about 15 h. p.

This locomotive was called the "Ampere," and is shown by Fig. 5. It was about 10 ft. long with the body mounted on four wheels. The motor was mounted at the rear end of the locomotive, covered over by a wooden box. At each end of the armature shaft was a pulley belted to two large pulleys on a shaft located between drivers. This shaft was connected to the driving axles by belts reducing the revolutions of the motor in the ratio of 8 to 1. The current was collected

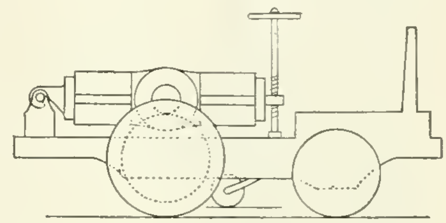


FIG. 6. THE "BENJAMIN FRANKLIN," 1885.

by means of two small wheels of phosphor bronze which ran on the third rail. These wheels were held against the rail by spring pressure so that one was always in contact. In front of the driver's seat on the dashboard were three switch boxes. To the right was the main switch so that current could be connected to or disconnected from the motor. The regulation of speed was controlled by the middle box. The switches, or contacts in this box were so arranged that a great number of resistance values and changes in the field strength could be obtained without a lot of idle resistance. Iron wire was connected in series with the outer coils of the field magnets and the amount of current through these coils, and hence the field strength could be changed and controlled. With change in field strength there is a change of speed in any motor, the stronger the field the slower the speed and vice versa. The third box to the left was for controlling and operating the electric brakes. These brakes consisted of an iron shoe fastened to a bar of iron around which was a coil of wire, the whole suspended from the car body and hanging just behind the wheel. Current could be connected to this coil, which produced a magnet of the bar and brake shoe. As the magnet was movable, the attraction between it and the wheel caused the brake shoe to press against the tire and brakes were applied. The reversal of the locomotive was accomplished in a similar manner to that of the "Judge," namely by a lever at the side of the seat controlling four brushes, either pair being placed in contact with the commutator.

In 1883-4 a franchise had been obtained and a railway was in operation on the iron pier at Coney Island. Daft was not interested in this road except that he furnished the electrical apparatus. The length of track was 780 ft. and was of 24-in. gage. The locomotive was modeled after the "Ampere" and was 6 ft. 6 in. long and 3 ft. wide with four wheels, each of 12-in diameter. Two passenger cars each 12 ft. long, with seating capacity for 20 persons, were used and as many as 50 people were carried at one time at 12 to 15 m. p. h. No third rail was used, one of the running rails being positive and the other negative. The wheels on one side were specially constructed, with the hubs of oak to prevent the current flowing from one of the rails to the other through the axles. This road was the first electric railway in America for commercial use. The other electric locomotives we have described had been exhibited at expositions, etc., and although they were a source of revenue, the electric railway was not a commercial proposition as was the one at Coney Island.

During the fall of 1884, Daft exhibited an electric locomotive called the "Volta" at Mechanics' Fair, Boston, Mass., which had only a box for a cab. It had four 12-in. wheels, was 6 ft. long, 3 ft. wide, and 3 ft. high. It was designed after and was practically the same as the "Ampere." It was in constant operation on a 400-ft. track carrying 4,000 to 5,000 persons per week. The next year it was exhibited at New Orleans Exposition and worked perfectly. Three cars, each weighing 1800 lbs., each suitable for 18 passengers, were hauled over a track 900 ft. long.

Due to the success of the "Ampere" and the railway at Coney Island, Daft obtained permission to electrify the tracks on Brooklyn Bridge, New York City, and had all the rails laid when the president of the railroad company died and Daft was not allowed to proceed with his work. This was a great drawback to him, but later he was offered the use of the Manhattan Elevated Railroad Company's tracks on Ninth avenue, which he accepted. He commenced at once to design and build a locomotive suitable for use on the elevated railroad.

The work which Daft had completed was very satisfactory. During the previous fifteen months he had built motors which, together, had run several thousand miles. The Union Passenger Railway Company, one of the largest in the city of Baltimore, operating 25 miles of road with 400 horses, became interested in the various locomotives Daft had built and operated, and immediately investigated. They were so pleased with the success he had attained that an order was placed with him for two locomotives to operate on the Baltimore & Hampden branch, a stretch of two miles, with several curves and many grades, the village of Woodbury at the end of the line being nearly 200 ft. higher than Baltimore. Work was rushed and the first locomotive, called the "Morse," was shipped in June, 1885, after same had been tested at the factory. While the locomotives were under construction a third rail of T section, 25 lbs. to the yard, was laid in the center of, and a little above the track rails, which were spaced 5 ft. 4½ ins. apart. This third rail was laid on insulators made of wood with an iron cap placed on top provided with an overhanging edge, resembling somewhat an umbrella, so that rain could not run over the wooden block and thus decrease the insulation. The third rail was held to the iron cap by two screw spikes. A dynamo rated at 300 amperes at 125 volts had been installed for supplying power to the locomotives.

The "Morse," with dimensions of 12 ft. 6 ins. long over all and 6 ft. 6¾ ins. wide was a regular wooden frame box car with wheels 30 ins. in diameter, in which was mounted the motor. This motor weighing 1,100 lbs., could develop eight horsepower. It had a series compound field with wide range of resistances, so that almost any speed could be obtained within limits. Connection was made with the driving axle by gears, reducing the speed in ratio of 9 to 1. The total weight of the locomotive was a little over two tons. The controlling apparatus was similar to that of the "ampere." There was a switch for connecting and cutting off the main current to the motor, another for connecting either of two pairs of brushes to the commutator, and a third, which constituted the controller. This controller contained four heavy brushes bearing on large and properly shaped contact pieces, mounted on a soapstone base. Combinations of resistances and fields were obtained so that the resistance of the magnets varied from approximately 0.4 ohm to 375 ohms. The higher the resistance the less the amount of current through the field coils, therefore the weaker the field and the higher the speed. The current was collected by a contact wheel held on the third rail by spring pressure.

The locomotive was tested several times during July, but was not put into regular operation until August, at which time the second locomotive, called the "Faraday," had been delivered. The two locomotives were operated, each attached to a horse car, and were able to make the trip to Woodbury and return, four miles, in less than twenty-five minutes. The travel increased rapidly, and at times two large cars loaded with 100 passengers were hauled by one locomotive.

The operation of the Baltimore road was very successful and was not interrupted by the heavy storms which occurred during the first winter. The "Morse" and "Faraday" could not handle all of the travel and two more locomotives, the "Ohm" and the "J. L. Kech," were delivered at Baltimore early in February, 1886. Each of the locomotives made about 75 miles daily.

The electrification of the branch line of the Union Passenger Railway Company of Baltimore was the first electric street railway in America. It can be called the pioneer of American electric railroads. The third rail proved troublesome, as horses received shocks, and the rail was taken out and an overhead wire installed. A trolley pole, controlled by bell crank levers, was placed on top of each locomotive and could be raised and lowered by the engineer.

Daft immediately opened negotiations for equipping a road in Los Angeles, and same was in operation New Year's Day, 1887. It was three miles long of single and double track and the overhead wire system was used. Eight motor cars made up the equipment.

As mentioned above, Daft had been given the use of the Ninth avenue elevated tracks between 14th and 59th streets, and while the work on the Baltimore road was progressing he was also electrifying this stretch for testing out the locomotive which he was building, of sufficient capacity to handle the elevated trains, and which was to be the largest electric locomotive ever constructed up to that time. Daft was an Englishman by birth, but he was a good American, and he received the good will of the public in calling this locomotive the "Benjamin Franklin."

Both tracks were electrified with a third rail placed in the center of the track on Daft's patent umbrella insulators. The power station was located at 15th street and contained three dynamo electric machines. The first run was made the last week in August, 1885, but was not a real trial run, for a small motor was placed in front to clean off the rust on the rails. Trials were made on following nights and a speed of 20 miles per hour was reached. The first public trial was made on the night of October 1st, when four cars and a large party of officials and invited guests, making a total load of 60 tons, including the locomotive, were hauled over the line successfully.

Although these trials were most gratifying, they showed, however, that the locomotive was not suitable for the requirements. In order to give proper acceleration and schedule speed, 120 horsepower was required of the steam locomotives, and the "Benjamin Franklin" was not able to develop this amount of power. Also the third rail interfered with steam operation. The trials were discontinued in order to replace the third rail by a copper rod ⅝ in. in diameter, located at one side and parallel to the track, and to remodel the locomotive.

Fig. 6 shows the running gear and motor over which was placed a box-shaped cab. As shown, Daft avoided the use of belts, and transmitted the power from the motor to the drivers by friction. Keyed to the driving axle was a corrugated friction wheel three feet in diameter. To the armature shaft was fastened another corrugated friction wheel nine inches in diameter, which could be brought into contact with the larger wheel and as much pressure as desired could be obtained by means of the hand wheel, shown in the figure. Following are a few of the dimensions: Length over all, 14 ft. 6 ins.; width, 7 ft.; height, 8 ft.; diameter of driving wheels, 48 ins.; diameter of trailing wheels, 36 ins.; weight of armature and shaft, 850 lbs.; total weight of locomotive, 9 tons. The motor was designed to give 75 horsepower at a speed of 18 m. p. h. As with all the previous locomotives built by Daft, the motor could be reversed by placing either of two pairs of brushes in contact with the commutator, and the locomotive was fitted with the electric brake.

(To be continued.)

Politeness of Trainmen.

Railway trainmen as a rule are as polite as any other class of people who come in contact with the public, but exceptions are sometimes found in men who forget that civility is the first duty of their employment. We have heard numerous complaints recently about the brusque manner of urban and suburban train conductors. These men are trained to urge passengers to move quickly, and it is very easy to advance from the order "Step lively" to more rude expressions.

The domineering order, "Step lively," incenses some passengers and moves them to feelings if not actions similar to those of a tenderfoot in a Colorado terminal station in the long ago. The stranger asked one of the trainmen to direct him to a hotel and was told to go to hell.

"You need some lessons in good manners," remarked the stranger. "Pick up that bag, blank you, and carry it to the best hotel within reach, or I shall blow the top of your head off"; and as evidence of good faith he presented a six-shooter. The bag was carried with due meekness.

Inventor of the Dynamo.

In the rush of business today there is little attention given to the origination of the great inventions which keep the wheels of industry humming in our midst. One of the greater inventions of modern times was the electric dynamo. The underlying principle of all dynamos and motors, whether direct or alternating, was discovered by Michael Faraday in the year 1831. Faraday is now generally regarded as the founder of modern electrical engineering, and rightly so, because to his discoveries we owe the most important applications of electricity.

The life of Faraday is an excellent example of what industry and perseverance will accomplish under the most adverse circumstances. The parents of Faraday were poor and the boy was apprenticed to a bookbinder. He had received no education beyond reading, but he displayed a remarkably keen interest in the scientific books he was employed to bind, so that he fell into studious habits and succeeded in attending evening classes for the study of science.

About the time that his apprenticeship was completed Faraday had improved himself so much that he was able to accept the position of amanuensis for Sir Humphrey Davy. That brought him into the Royal Institution and into touch with the scientific atmosphere of his new surroundings. He became a most accomplished chemist and took a lead in electrical experiments which led up to his invention of the dynamo.

Long Island Road is Safe.

More than one-third of a billion passengers carried in eighteen years and a half, and not one killed as the result of a train accident, is the record of the Long Island Railroad. The official figures show that this subsidiary of the Pennsylvania Railroad has carried exactly 335,148,826 passengers since June 1, 1893. The Long Island Railroad has probably the densest passenger traffic in the country, and, due to the restricted territory covered, all of this traffic is properly termed suburban. It is thus seen that commuting on the Long Island has been made as safe as modern science and enginering can make it. The density of the traffic is shown by the fact that the number of passengers carried one mile since 1893 is 4,904,736,994, very nearly five billion, or more than one-third of the population of the entire world. The growth of Long Island is shown in a striking way in the figures furnished by the railroad. In 1900 the number of passengers carried was 12,387,649. Five years later it was 18,199,162; in 1907 it was approximately 24,000,000; in 1909 something over 27,000,000, and last year it had reached to 31,000,000.

Training of Mechanics.

A contemporary greatly given to guessing says that the future mechanic will be a very different person from the present and past mechanic. The organ of human regeneration, according to our contemporary, will be the training school which is going to develop skill and sense much more rapidly than the shop has ever done. The boy in the shop works on a machine and sees the work done without asking the reason why. The boy in the training school will be taught the whys and wherefores, therefore the conclusion is come to that he must be the more valuable workman.

We think there has been a lot of senseless gush written on this subject. If training schools could alter the nature of boys and convert them all into the material from which first class mechanics are made, there would be a great improvement in the future machanic. As it is, a boy intended by nature for a dry goods clerk passes through the training school for mechanics and comes out a hopeless incompetent. The training school does him no more good than the shop does for similar graduates.

The boy cut out for a mechanic comes out of the shop as well equipped to perform the duties of a workman as he would be if subjected to years of training school work. The special advantages enjoyed in a training school are those needed by the men who become foremen and leaders in the business. Only a small number of the workmen can reach this elevation. The man with the natural parts for making a foreman generally manages to acquire the knowledge necessary, even when his experience is confined to the shop. When we find a better place than the shop for the training of good mechanics, we will write about it for the benefit of our readers.

Sound Not Transmitted.

Many people think that when they speak over the telephone that the transmitter, battery and wire in some way carry the voice to the ear of the listener. This is not the case. The transmitter and the battery are a sort of miniature transforming station in which the vibrations of the air caused by the sound of the voice are caught upon the diaphragm and turned into electrical energy. As the diaphragm vibrator in front of the pole piece of the transmitter it may assume many shapes. The vibrating areas and the nodes or non-vibrating lines are at one time star-shaped, at another like the spokes of a wheel, they are generally geometric figures, but the various forms of vibration cause varying pulses of electrical current flow to traverse the wire. At the receiving end the varying electrical flow attracts the diaphragm so as to cause, in similar sequence, the geometric figures to be formed by it, and thus give out the very tones of the speaker's voice. What traversed the wire was not sound but current, and the ear-piece or sounder re-transformed this energy back into the form of sound.

General Foremen's Department

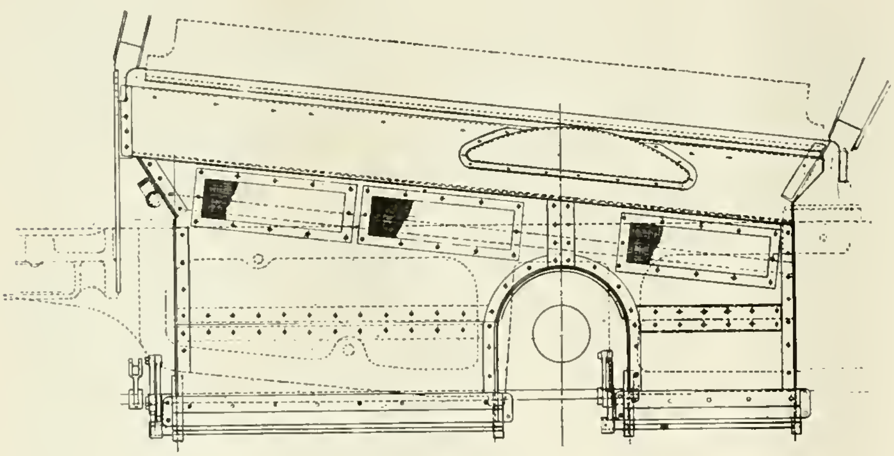
Self-Cleaning Ash Pan.

Editor:

The Sykes patented ash pan has the entire bottom of the pan open for the discharge of cinders and offering no obstruction to the cinders. In most of the ash pans in use the cinders rest against the flat bottom or angular sides, and the slide has to be moved, and on account of the weight of the cinders the springing of the bottom plates makes it very difficult and sometimes impossible to operate the slide, and frequently, therefore, when the slide is opened, it is not closed tightly, leaving the pan in a partially open condition at the bottom, and in some cases causes delay in endeavoring to open or close the slides on account of the slides being very hard to operate.

With the Sykes pan the bottom revolves in two sections, and as above stated, leaving the bottom of the pan entirely open and nothing in the bottom on which the cinders could lodge or would prevent the pan from cleansing itself freely and close absolutely tight, and in case there might be a cinder or some obstruction and the pan does not close, it can be readily removed by simply operating the doors, and can be seen from the outside if not properly closed; whereas, with the pans generally in use this cannot be discovered except on careful examination by going under the pan or partially under it.

The further advantages of the Sykes Ash Pans are that they have a flow of water extending the full length of the ash pan just over the revolving bottom, which can be, if desired or needed, washed off with a stream of water from the injectors or from a blower attached direct to the boiler, and this being in the form of a sprinkler simply washes the plates, or after the cinders have been dumped to the track can be used for putting out the fire while on the track, which should be done so as not to leave a fire risk after the engine has departed. The advantages also are that this bottom can be applied to ash pans commonly used on all classes of engines and at the same time use the old ash pan formerly applied to the engine by simply putting in a new bottom or possibly making very slight changes in the bottom of the pan, and the levers operating this revolving bottom are simple, inexpensive and out of the way, both in repairs to other parts of the engine and injury to itself. The cinders can be discharged from this pan from the locomotive by hand, air or steam, as desired, or from the footboard, or by a lever operated by a man standing on the ground to prevent dumping cinders on bridges and trestles while the engine is in motion. It operates very easily, and the ashes can be dropped from the pan in a very much less space of time than other styles of ash pans, reducing labor and saving delays while on line of road. It has many advantages over the blower from the fact that hot cinders are not blown promiscuously around the engine, train and track; does not have any dirt or steam arising around the point at which the pan is being blown, and no dirt or cinders are blown in the machinery of the engine that would cause it to wear faster than it should, which is in many cases very expensive in the maintenance of engines.



SELF-CLEANING ASHPAN.

It has advantages over the slide and revolving ash pan from the fact that it cannot become distorted from the heat to prevent it working freely and safely. In case any of the levers become deranged it would not be necessary to go under the engine in violation of the law to close or open the pan, as it can be closed or opened from the side of the engine with a bar, and readily seen when properly closed or opened.

In cases of extreme cold weather, when the cinders in the pan will freeze, this style of pan is advantageous from the fact that the hot water and steam from the boiler can be connected up to overflow pipes and discharged into the pan prior to dumping it, which will thaw out all the ice and allow the cinders to be discharged without trouble.

L. A. Strader,
R. H. F.
Southern R. R.
Richmond, Va.

Some Queries Answered.

VALVE STRIP BLOWS.

Editor:

In regard to my promise to make answer to the remaining three questions of Three Times Seven, page 191, May issue, Railway and Locomotive Engineering.

As to query five, relative to locating valve strip blows, there are some methods, and fairly accurate ones, by which blows of this character can be determined. About as reliable way as we have found, when it has been ascertained that the engine is afflicted with a blow of this kind, is to place the engine on the centre, say on the right side, apply the brakes, open the throttle and admit steam to the steam chests. Then move the reverse lever from one end of quadrant to the other. If the strip that is causing the trouble is on the right side the lever can be moved, as indicated, but this will require some little effort by the operator, owing to the pressure on top of the valve. In this position of the engine the valve will only travel the lap and lead distance, about, and owing to this short travel of valve quite a heavy load can be moved. On the left side the valve ought to travel the throw of the eccentric five to five and one-half inches. In order to be fully satisfied as to the proper side on which the blow is located change the position of the engine, *i. e.*, place it on the centre on left side, move the lever, as was done for the test on right side, keeping in mind that about the same throttle opening is used for this side as was used in the former test. If the lever cannot be moved from one end of the quadrant to the other the strip that is causing the trouble is on the right side. In this latter test, owing to the full travel of valve, the load cannot be moved as was done in the former test. Always alternate these tests with a view of learning which side the troublesome strip is located on.

The real object of making a test of this kind is to be able to make an intelligent report of the proper location of the strip that is causing the trouble. The real merit in locating and making the proper report of defects of this kind is to prevent taking up two steam chest covers where taking up one is sufficient. This should materially result in reducing the cost of repairs of such work as this.

It might be added that defective balance strips are a source from which spring many engine failures. If they do not fit up properly and make a steam-tight joint on the pressure plate—especially with heavy modern power—then there is trouble for the men who operate the engines with broken valve yokes, bent and broken rocker arms, broken transmission bars, broken eccentric rods, known also as "blades"; hot and broken eccentric straps, etc. On the other hand, a loss to the company from failures, such as result from neglect to keep them in proper repair, tonnage set off along the line of road, delay to other trains and traffic in more ways than one, to say nothing of the loss of time the engine is tied up awaiting material and repairs, etc. This is a live proposition, all right, especially to mechanical officers, who have to deal with repairs made necessary by leaky balance strips.

LAME VALVES.

Then there are a couple of other items worthy of mention here; "lame valves," "engine out of square." Expressing it in the common vernacular: And what does it mean? Simply to the extent that "she is lame" or "out of square," it means to that extent, uneven steam distribution, cutting off at 8 inches on one side and 11 inches on the other, and the release out in proportion.

Speaking of the No. 6 inquiry, there would be very little, if any, difference in the intake of air with a broken strip, as against side where strips were intact. A locomotive "drifting" piston would be creating a partial vacuum as it receded, air would then rush in to destroy this partial vacuum, and it matters very little whether or not the balance strip was broken; all the air that could possibly get in would do so, through this restricted orifice, and it's hardly likely that it could be ascertained whether a balance strip was broken or not by this method. As I view it, the question is rather a mooted one, and perhaps it would require an actual test to demonstrate it, one way or the other.

RELIEF VALVES.

Speaking of relief valves for locomotives raises another important question. They certainly have proven to be expensive in this way. It is fair to assume that the metal in cylinder castings will be heated nearly to the temperature of the steam used in them about 387 degs. The engine arrives at the top of a grade, the throttle is closed off and the engine allowed to drift for 20 miles. Necessarily a change of temperature will take place in the metal of the cylinders, they will be cooled down to the temperature of the atmosphere, contraction will take place rapidly, and this contraction will invariably result in cracked bridges with the "D" slide valves, and in cracked valve chambers with piston valve locomotives. This is costing railroad companies who use relief valves no very small item of expense annually. The relief valves could be done away with, all right, and the money saved from their discontinuance used to many better advantages.

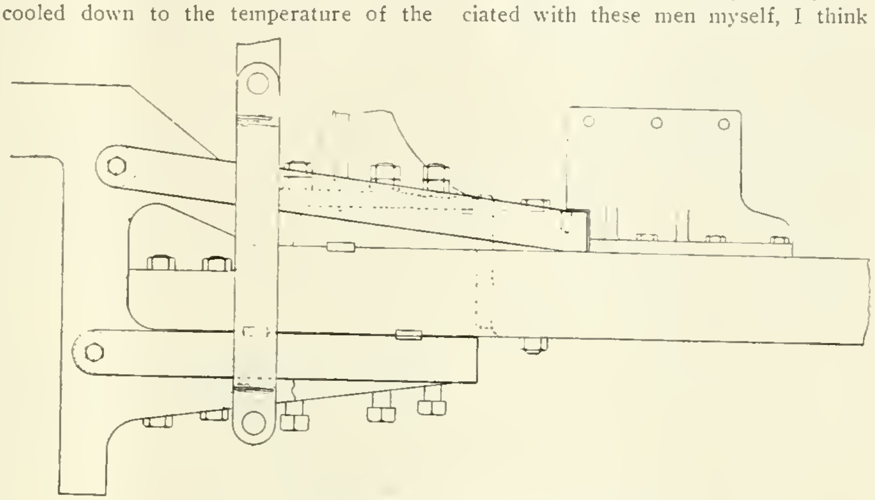
We say that their use is expensive and the statement is correct if we care to make proper application of it. The defects referred to in above statement are responsible for great waste of fuel, as some of the steam generated by the fuel is wasted through the aforesaid defects, obscuring the vision of the engine crew, as it escapes from under the cylinder saddle, thereby enveloping the front end in a cloud of steam, and thus the engine passes along, as the boys say, "in a cloud of glory." And through these cracks and crevices pass a lot of the oil that is intended to lubricate packing rings and cylinder walls and is lost totally. Here again we find a waste of fuel, as the dry valve seats and cylinder walls offer added resistance and detracts very materially from the draw bar pull of the engine.

HYDROSTATIC LUBRICATOR.

Now as to query No. 7, it is absolutely necessary to so locate the hydrostatic lubricator that there will be an even gradual fall for the oil to pass unimpeded from it to its destination in the steam chest, where it begins the function for which it is intended—lubrication. There should be no bends or kinks in the oil pipes where water can lodge and thus prevent proper feeding of oil to the steam chests and cylinders.

At some future day, perhaps, I will have something to say relative to the question of lubrication and the economical use of fuel. These two items go hand in hand, so to speak, and are, or should be, of considerable importance to operating officials. Being closely associated with these men myself, I think I can see where some benefits can be brought about by a full and free discussion by all concerned. All together, yo heave.

JAS. SPELLEN,
Road Foreman—Engines.
B. R. & P. R. R. Co.,
DuBois, Pa., July 1 1911.

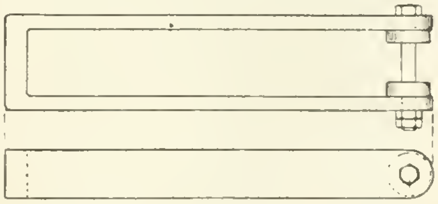


TEMPORARY CLAMP FOR CRACKED FRAMES.

Clamp for Cracked Frame.

Editor:

The attached print shows the method of patching broken engine frames at front splices. This method will positively hold a broken frame on engine with 21-in. cylinders carrying 200 lbs. of steam. As you will note, it is a shrink patch and if properly done it makes a cheap first-class job.



VIEW SHOWING STYLE OF CLAMP

Its construction is as follows: A 1-in. hole is drilled through the frame and then counterbored 3 ins. in diameter on each side. The two bosses on patch are turned up to fit the two counterbored holes in frames and when in place are held by 1-in. turned bolt. When ready to apply it is made 3/16-in. short and when heated to red heat it is readily applied and when cool it pulls on end of frame and bosses in counterbored holes. This design originated at Chicago shops and I never knew it to fail where applied. This drawing gives full details.

CHAS. MARKEL,
Shop Foreman, C. & N. W. Ry.
Clinton, Pa.

Countersinking Tool.

Editor:

Attached blue print shows hand tool that is used to bring the countersink in line with tapped hole where patch is applied to firebox. This tool is operated as follows, patch bolt holes in patch are drilled and half countersunk at drill press in the usual manner, after which the patch is applied to fire box sheet and spindle screwed in tapped hole and countersink placed on spindle and fed to its work by thumb nut shown. This brings the bevel or countersink in line with tapped hole and makes a perfect fit for bevel on patch bolt. Drawing gives details and will be plainly understood.

Yours truly,
CHAS. MARKEL.
Shop Foreman C. & N. W. Ry.

Locomotive Design.

Editor:

The last ten years has been a strenuous period in the development of the American locomotive; not only have existing types of engines been perfected, but new types have been introduced as well. Recent development has been along the line of increased power and more economical engines. Although an attempt has been made to produce speedier engines, little has been accomplished in that direction.

When the eighteen-hour trains were put on between Chicago and New York a number of years ago, the pace was set for fast passenger engines. Since that time the schedule has not been cut, but heavier equipment has been put in service. The problem has been to develop an engine that will maintain that same exacting speed, and still do it with several hundred tons more behind the draw-bar.

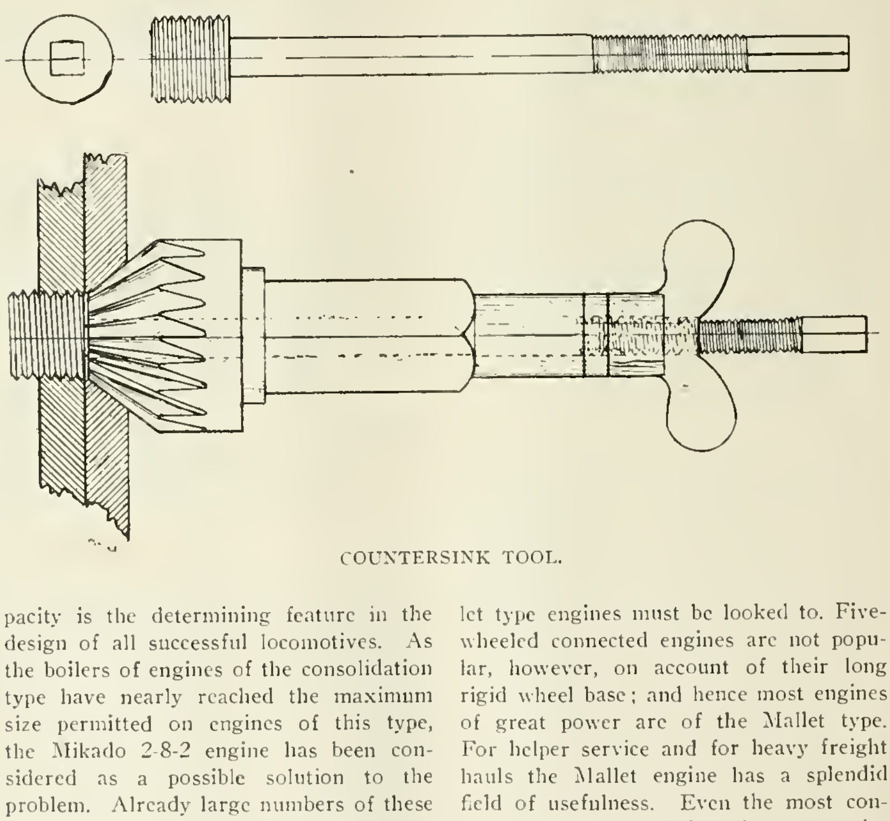
It is a well-known fact that no matter whether the work to be done is pulling a heavy-tonnage freight train at slow speed or a fast limited train at lightning speed, it is the steam-making capacity that is the most vital feature in determining the success of the design. On account of its large steam-making capacity, the service given by recent Pacific-type engines has been in most cases eminently satisfactory. Since its introduction a number of years ago this type engine has been developed until it has in one instance reached the limit of tractive power for the allowable load per axle. However, increased capacity in the boiler can be attained through the medium of superheated steam. It is the consensus of opinion at the present time that the superheater is a necessity on the larger engines of this type in order that the fireman may have more range. There have been instances recently where the full possibilities of these engines could not be realized, on account of the firemen not being able to supply the necessary coal. With two firemen, one of these engines recently maintained an average speed of nearly sixty miles per hour with a special train consisting of fifteen Pullman cars. The remarkable part of this was the long distance—the division was two hundred miles long.

For a number of years the consolidation 2-8-0 type engine has held the supremacy as a freight puller. The best-designed locomotives of this type have given splendid service. They are commonly known as "battleships," and we all will agree that it is an appropriate name for them, as stated above, the steam-making capacity is the determining feature in the design of all successful locomotives. As the boilers of engines of the consolidation type have nearly reached the maximum size permitted on engines of this type, the Mikado 2-8-2 engine has been considered as a possible solution to the problem. Already large numbers of these engines have been put in service, and have been very successful on long freight hauls. The large reserve boiler capacity makes it a free steamer under the most severe service conditions, and hence it is able to maintain a better average speed with a tonnage train than its proto-type, the consolidation engine.

The Mikado engine is preferred to the Mallet type by some railway officials on account of the decreased maintenance cost, and its reliability in service. In fact, it is very little more expensive to maintain than the 2-8-0 type—the only difference being in the up-keep of the trailer and the larger boiler. The large firebox and long tubes of the 2-8-2 type offer splendid possibilities for burning lignite and other low-grade fuels. The spark troubles are largely eliminated by the low rate of combustion and the long passage through the tubes. Some grades of fuel require a deep firebox; this can be more conveniently placed over the trailer wheels of the Mikado than over the drivers of the consolidation. The trail wheels are also useful in guiding the engine when backing into switches and cross-overs.

In order to keep the tubes within a reasonable length the combustion chamber has been resorted to in a number of these engines. The larger firebox heating surface that it gives, and the opportunity for more complete combustion adds steam making capacity to the boiler.

When engines of greater tractive power than that available with the 2-8-2 type are required, five-wheel connected or Mallet type engines must be looked to. Five-wheeled connected engines are not popular, however, on account of their long rigid wheel base; and hence most engines of great power are of the Mallet type. For helper service and for heavy freight hauls the Mallet engine has a splendid field of usefulness. Even the most conservative have been forced to recognize the possibilities of these engines; and at the present time they are being built in large numbers. It was first thought that the best service could be obtained from Mallets in helper work on the steepest grades. Experience, however, has demonstrated that the best work is done by these engines at moderate speeds and with full tonnage on light grades—that is, they operate at greatest efficiency under those conditions. The almost uniform



COUNTERSINK TOOL.

drawbar pull which they give on through freight hauls is an advantage that cannot be too highly commended.

Some of the Mallet engines recently built are without question large power plants on wheels; they are supplied with all of the accessories which go to make up an efficient power plant, such as superheaters, feed water heaters, reheaters, and combustion chambers. It is a question in the minds of some whether all of these are worth while. There is no doubt but that these auxiliaries increase efficiency, but they do not increase the reliability of service—a fact that is very important from an operating standpoint. Those connected with the maintenaance of Mallet compounds know what an army of men it takes to keep these engines up when they are so encumbered. The maintenance charges go up considerably, and it is sometimes necessary to hold engines two and three days a week for work to be done. The most successful Mallets are those which have but few attachments.

There is no question as to the merit of the superheater for this type engine when it is of the firetube design, giving a high degree of superheat; it insures dry steam for the low pressure cylinders, makes a reheater unnecessary, and gives a decided economy in the high pressure. The use of a high degree superheater requires that the steam must be conducted forward in a dry pipe, in the customary manner for a simple engine, and outside steam pipes extending from the front end to the high pressure cylinders. The moderate degree superheaters which are used in connection with a reheater reduce the steam generating capacity of the boiler, in that the front flue sheet is set back and the boiler tubes shortened. The reheater may be of value in raising the temperature of the low pressure steam, but it has a wire drawing effect that reduces the pressure, hence the low pressure does not develop full power.

The combustion chamber offers the same advantage to Mallet compounds as it does to the Mikado—that is, it reduces the length of tubes to a reasonable limit without a sacrifice in steam making capacity. It also removes the back flue sheet from the direct blast of the firebox, and hence there is not as much wear and tear on the flue beads.

The feed water heater has shown a fair degree of economy when used in connection with engines of this type, but its use complicates the boiler; and hence it has not been extensively used.

We have discussed the relative merits of the attachments used in connection with increasing boiler capacity, and now it is in order to look into the appliances used for giving the engine greater efficiency. Although slide valves have been used, for both high and low pressure cylinders in a number of cases, it is the concensus of opinion that the piston valve gives the most satisfactory results with the high boiler pressures used. A double ported slide valve has been used for distributing steam to the low pressure cylinders, and with good results. The American Locomotive Company has equipped most of their Mallets with this valve. The Walschaert valve gear or some other form of outside gear is almost a necessity with this type of engine in order that the space between the wheels may be available. A few converted Mallets, however, are equipped with Stephenson gear.

The new Baltimore and Ohio Mallets using high degree superheated steam are without question the most efficient engines of this type yet built. It is hard to conceive that one of these engines could handle 132 tons more than three consolidation engines, though the latter have in the aggregate 19,000 pounds more tractive power. This was possible because the single locomotive and tender weighs much less than three units. All this power is saved for moving the train.

It has been intimated that the advent of the Mallet compound has indefinitely deferred the electrification of steam roads. When we hear of such remarkable performances as that given by the B. & O. Mallets we cannot help but believe it.

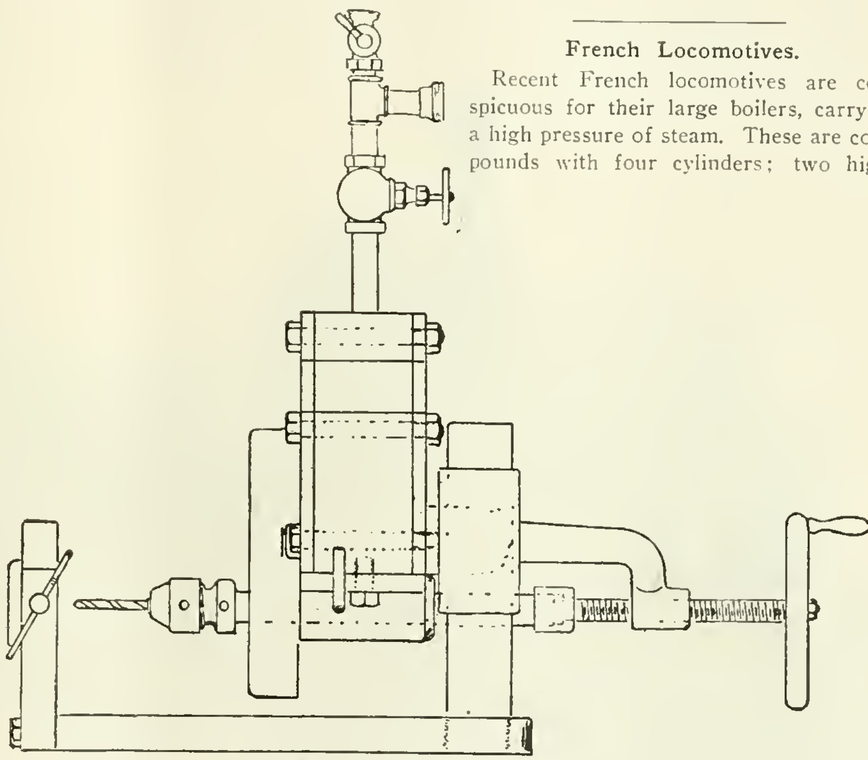
W. SMITH,
Division Foreman, C. & N. W. R. R.,
Fremont, Neb.

Drill for Tell-Tale Holes.

Editor:

This blue print shows the Clinton shop method on the Chicago & North Western Railway of drilling detector holes in stay bolts before they are applied to the firebox. A simple rotary air motor is bolted to a bed plate on top of a shop bench. The bolts are held central by the brass bushing shown and the thumb screw holds the bolt from turning when power is applied to turn wheel which feeds the drill into the end of the stay bolt. All bolts are drilled before the threads are cut on them and different sized bushings are provided for different sized bolts to hold them central with drill spindle.

CHAS. MARKEL,
Shop Foreman, C. & N. W. Ry.
Clinton, Ia.



C. & N. W. RY. DRILL FOR TELL TALE HOLES.

French Locomotives.

Recent French locomotives are conspicuous for their large boilers, carrying a high pressure of steam. These are compounds with four cylinders; two high-pressure placed outside drive, one axle, and two low-pressure are connected with another axle. By their use the two pistons on each side of the locomotive may be set with cranks at 180 deg., so as to have always opposite movements.

The dimensions of these fine engines as under: Grate area, 25 13/16 sq. ft.; heating surface, 1,439 3/16 sq. ft.; boiler pressure, 199 lbs.; cylinders, two high pressure 13 3/8 ins. by 25 1/8 ins., two low-pressure 20 7/8 ins. by 25 1/8 ins.; four-coupled driving wheels, 6 ft. 7 1/8 ins.; total weight in running order, 48.72 tons; adhesive weight, 30.51 tons.

With the four-cylinder system the strain on each individual mechanism is largely reduced. Owing to the very limited available space, it is difficult in an ordinary locomotive with two cylinders, either inside or outside, to provide sufficient surface for the wearing parts when high power is required, as in modern construction.

Gas Electric Generating Set.

General Electric Company, Schenectady, N. Y.

The advantages of electricity for illumination and power make it indispensable to this enlightened age, yet many people who would like to use it are not within the zone of distribution of an electrical system and so to enjoy the advantages of electricity must install their own plants.

The General Electric Company, who manufacture gasolene-electric generating sets of capacities 3, 5, 10 and 25 kw. have added to this line a 1 kw. set which is designed for furnishing electricity for power and lighting in private residences, small hotels, rural railroad stations, etc., not now served by central stations and on board boats. This set comprises a single cylinder, vertical, 2-cycle water cooled gasolene engine direct connected to a 1 kw. D. C. generator. The regulation and steadiness of the voltage of this set is so good that it is possible to supply current direct from the generator, thus avoiding the expense of installing and maintaining a large battery and the loss of power and troubles incidental to the operation of the latter.

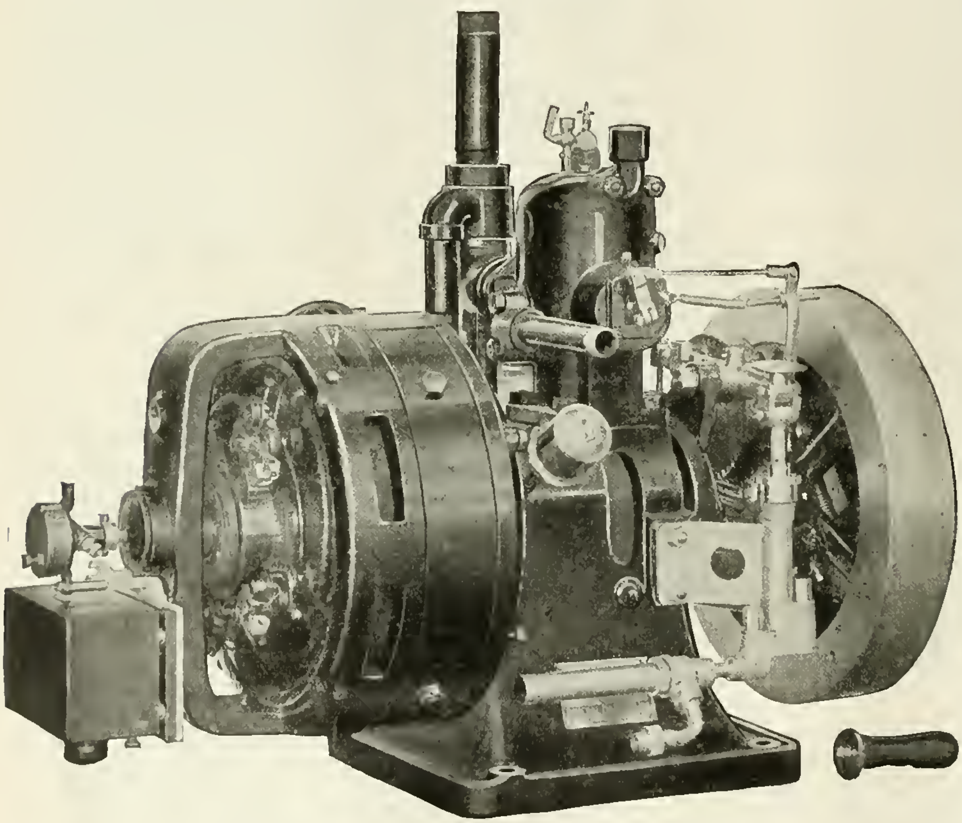
The engine is provided with a suction gasolene pump for lifting fuel from a tank placed under ground and located at some distance from the engine, thus fulfilling the requirements of the National Board of Fire Underwriters.

The cooling is by thermo siphon, thus doing away with the necessity of a pump to provide forced circulation of the cooling water.

The governor is located in the engine fly-wheel and operates a throttle valve, giving very close regulation and satisfactory operation at all loads.

The dimensions of this 1 kw. set are: Length, 2 ft. 6⅝ ins.; height, 2 ft. 2 ins.; and width 17⅝ ins., and the total weight is 350 lbs.

Recognizing the fact that it is frequently desirable to install a small storage battery to provide a few lights on occasions when the generating set is not running, the General Electric Company manufactures for use with these sets a suitable board for controlling both the generating set and such a battery, as well as two types of switchboard for controlling the set alone.



NEW ONE KW. GAS ELECTRIC GENERATING SET.

The combination generator and battery switchboard is so arranged that the battery can be charged at the same time that the generating set furnishes power for lights or motors, without affecting the operation of these appliances, while when the battery is fully charged it can be connected with the system so that the generating set can be shut down without interrupting the service.

The adaptability of this electric generating set to rural railroad stations is being rapidly appreciated.

Mr. C. E. Chambers, S. M. P., C. R. R. of N. J., on Frame Breakage.

"We have a large number of cast steel frames in service, a number of frames made of 40 per cent. carbon steel, introduced on our latest switching engines, and as far as these switching engines go we have had no trouble." The particular engine Mr. Chambers referred to had a cross spring from one driver box to the other, and the frame was cut out a trifle on an angle, which weakened the frame at that point. "When we got out the new cast steel section we added two inches to the depth of the frame at that point, and have had no trouble."

Proper design and the best material obtainable will do much to reduce frame breakage to its lowest terms; but prompt repairs will do more than anything else to reduce breakage. The use of vanadium has an excellent effect in making frames durable and the material ought to be used more freely than it is now.

Neglected Canals Brought Ruin.

It has always seemed a most extraordinary thing that the land between the Tigris and the Euphrates, which was the seat of the greatest empires of the ancient world, and which shared with the Nile Valley the distinction of being the richest corn-growing land, should have for so many centuries laid desolate and waste. But the natural richness of the soil is not the only factor in the fertility of the land. Even more than Egypt it was dependent on careful and scientific irrigation, and in the days of the great sovereigns of Babylon the canals were most strictly and jealously guarded. But when the ancient empires finally fell the canals and irrigation works were neglected and left uncared for, with the result that in a few years' time the sand of the desert and the weeds choked up the waterways, and the land relapsed into desolation. But the new ministry at Constantinople have awakened to the importance of the matter and results may be expected.

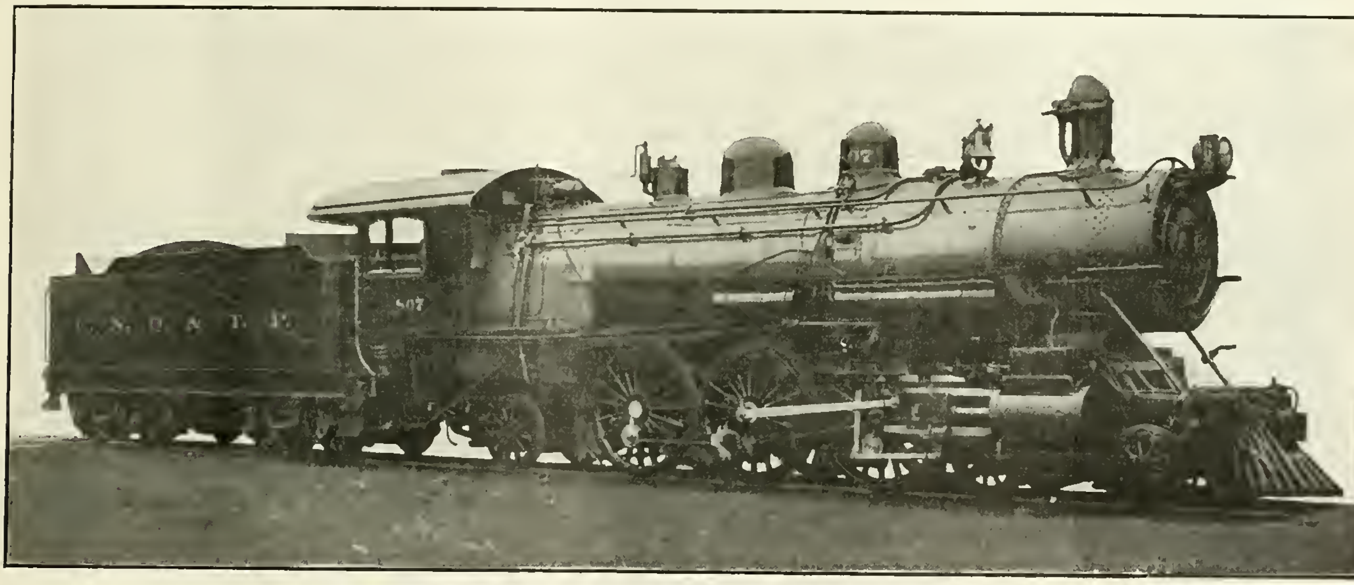
Labor and capital combined are said to produce all the wealth of the world. How is it at this time when labor is walking the streets idle and capital is searching for investment that the combination fails to be put into action?

New construction planned by Burlington includes new stations at Oscaloosa, Iowa, Grand Island and Nebraska City, Neb., and Moline and Downers Grove, Ill., also a $300,000 freight house at Omaha.

Illinois Central has begun electrification of second track of road it leases to Chicago, Lake Shore & South Bend, between Kensington and South Bend, Ind.

Locomotives for the Cincinnati, New Orleans & Texas Pacific

The recent reconstruction of a number of bridges on the main line of the Cincinnati, New Orleans & Texas Pacific Railway has made possible the use of considerably heavier power than that formerly employed, and full advantage is being taken of the opportunity to increase the efficiency of the road by replacing the light engines formerly used with new units of high capacity. Fifteen such engines have recently been built at the Baldwin Locomotive Works and have just been placed in service. Five are of the Pacific type and ten of the Consolidation type, and all were built by the Baldwin Locomotive Works. The following tables indicate the increase in capacity of the motive power built for this road during the past few years.



PACIFIC TYPE OF LOCOMOTIVE FOR THE C., N. O. & T. P. RY.

J. F. Deems, General Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

PASSENGER LOCOMOTIVES.

Date	Type	Cylinders	Drivers	Heating Engine	Total Wt Surface	Tractive Force
1906	4-6-0	19" x 26"	68"	1928	129,500	23,500
1911	4-6-2	22" x 28"	72"	3906	224,650	35,200

FREIGHT LOCOMOTIVES.

Date	Type	Cylinders	Drivers	Heating Surface	Total Wt. Engine	Tractive Force
1903	2-8-0	20" x 24"	53"	1790	123,000	27,700
1911	2-8-0	22" x 30"	56"	3226	204,350	44,000

The new Pacific type locomotives are similar in many respects to engines which have been operating on the Southern Railway since 1903. Two are equipped with the latest design of Baker valve gear, while the remaining three have the Walschaerts gear. One of the former engines is shown in the accompanying illustration.

The cylinders are lined with hard iron bushings, and have cast steel heads. The steam distribution is controlled by Allen-Richardson balanced valves, which are set with a maximum travel of 5½ in. and a lead of ¼ in. The outside lap is 1 in., and the inside (exhaust) clearance 1-16 in.

The frames, including the front rails, are of cast steel. The principal transverse braces are the guide yoke, the motion bearer (located back of the first pair of driving wheels), and a broad steel casting which spans the upper frame rails between the main and rear pairs of driving wheels. A substantial cast steel brace is also placed under the front end of the firebox, where the main and rear frame sections are spliced. The mud ring is supported by sliding shoes in front, one intermediate crosstie and an expansion plate at the rear. The rear truck is of the Rushton type, with inside journals. Easy riding qualities are secured by supporting the frames, at the back, on half elliptic springs.

The boiler has a straight top, and provides 318 sq. ft. of heating surface per cubic foot of cylinder volume—a liberal ratio, even for an express passenger locomotive. The firebox has a brick arch, which is supported on four 3-in. water tubes. The staying is radial, and flexible bolts are liberally used, as 600 are installed.

The tender frame is composed of 12-in. channels weighing 40 pounds per foot, with end sills of oak. The trucks have cast steel side frames, and the wheels are of solid rolled steel, manufactured by the Standard Steel Works Co.

Of the ten Consolidation type locomotives, four are equipped with the Baker gear and six with the Walschaerts. In many respects these engines are similar to those described above, and interchangeable details are used in the two classes where practicable.

The following table contains the principal dimensions of the Pacific type of locomotive:

Cylinders, 22 x 28 ins.

Valve, balanced slide.

Boiler, type, straight; material, steel; diameter, 70 ins.; thickness of sheets, ¾ in. and 13/16 in.; working pressure, 220 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 108⅞ ins.; width, 72¼ ins.; depth, back, 66¾ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water space.—Front, 4½ ins.; sides, 3½ ins.; back, 3½ ins.

Tubes.—Material, iron; thickness, 0.110 in.; number, 314; diameter, 2¼ ins.; length, 20 ft. Heating surface.—Firebox, 195 sq. ft.; tubes; 3,683 sq. ft.; firebrick tubes, 28 sq. ft.; total, 3,906 sq. ft.; grate area, 54.2 sq. ft. Driving wheels.—Diameter, outside, 72 ins.; journals, main, 10 x 12 ins.; others, 9 x 12 ins. Engine truck wheels.—Diameter, 34 ins.; journals, 5½ x 10 ins.; diameter, back, 42 ins.; journals, 8 x 12 ins.

Wheel base.—Driving, 12 ft. 6 ins.; rigid, 12 ft. 6 ins.; total engine, 31 ft. 4½ ins.; total engine and tender, 66 ft. ½ in.

Weight.—On driving wheels, 135,000 lbs.; on truck, front, 44,250 lbs.; on truck, back, 45,400 lbs.; total engine, 224,650 lbs.; total engine and tender, about 380,000 lbs. Tender—Wheels, number, 8; diameter, 33 ins.; journals, 5½ x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 12½ tons; service, passenger.

Items of Personal Interest

Mr. F. A. Downs has been appointed trainmaster of the Illinois Central, with office at Princeton, Ky.

Mr. A. B. Cuthell has been appointed chief engineer of the Boston & Maine, with office at Boston, Mass.

Mr. E. F. Mitchell has been appointed chief engineer of the Missouri Pacific, with office at St. Louis, Mo.

Mr. C. C. Fralich has been appointed assistant master mechanic of the Ann Arbor Railroad, with office at Owosso, Mich.

Mr. T. H. Williams has been appointed master mechanic of the International & Great Northern, with office at Mart, Texas.

Mr. T. J. Carter has been appointed assistant engineer of the Gulf, Colorado & Santa Fe, with office at Galveston, Texas.

Mr. Thomas B. Kennedy, trainmaster of the Cumberland Valley, has been appointed assistant engineer, with office at Chambersburg, Pa.

Mr. G. E. Fuller has been appointed chief locomotive superintendent of the Ferrocarril Longitudinal de Chile. Office at Coquimbo, Chile.

Mr. G. B. Gunn has been appointed superintendent of construction of the Long Island Railroad, with office at Jamaica, N. Y.

Mr. G. J. Kennedy is now assistant engineer of maintenance of way of the National Railways of Mexico, with offices at Mexico City, Mex.

Mr. F. W. Green has been appointed to the newly created office of general manager of the Louisiana & Arkansas, with office at Stamps, Ark.

Mr. J. A. McDougal has been appointed superintendent of the Arkansas division of the Missouri Pacific, with office at Little Rock, Ark.

Mr. R. H. Collins has been appointed inspector of roundhouse and shop efficiency of the St. Louis & San Francisco, with office at Springfield, Mo.

Mr. John M. Egan has been appointed superintendent of the Mississippi division, Illinois Central R. R., with headquarters at Water Valley, Miss.

We are informed that James D. McKay, a locomotive engineer living in St. John, N. B., has invented a smoke raiser that dispenses with the steam blower.

Mr. D. M. Knox, mechanical engineer of the Missouri Pacific at St. Louis, has been appointed mechanical engineer of the St. Louis & San Francisco Railroad.

Mr. F. G. Jonah has been appointed chief engineer of the St. Louis, Brownsville & Mexico, and the New Orleans, Texas & Mexico, with office at St. Louis, Mo.

Mr. Charles F. Giles, assistant superintendent of machinery of the Louisville & Nashville Ry., at Louisville, Ky., has been appointed superintendent of machinery, with office at Louisville.

Mr. Louis Eugene McCabe, who has been assistant superintendent of the Illinois Central for several years, has been appointed superintendent of that road, with office at Mattoon, Ill.

Mr. C. W. Ford has been appointed general superintendent of the Grand Junction & Grand River Valley, with office at Grand Junction, Col., succeeding J. H. Brinkerhoff, who has resigned.

Mr. J. E. Osmer, assistant master mechanic of the Chicago & Northwestern Ry., at Boone, Iowa, has been appointed master mechanic of the new West Iowa division, with office at Boone.

M. C. H. Rae, general master mechanic of the Louisville & Nashville Ry., at Lousiville, Ky., has been appointed assistant superintendent of machinery, succeeding Mr. C. F. Giles, promoted.

Mr. J. T, Robinson, lately master mechanic of the Seaboard Air Line, at Jacksonville, Fla., has been appointed master mechanic of the Missouri Pacific, with office at Osawatomie, Kan.

Mr. A. W. Gibbs, general superintendent of motive power of Pennsylvania Railroad lines east of Pittsburg, has been appointed chief mechanical engineer, succeeding Mr. T. N. Ely, former chief of motive power.

Mr. W. H. Bradley, formerly master mechanic of the Iowa division of the Chicago & Northwestern Ry., at Clinton, Iowa, has been appointed master mechanic of the East Iowa division, with office at Clinton, Iowa.

Mr. W. J. Blakeburn, road foreman of engines of the St. Louis Southwestern Railway at Pine Bluff, Ark., has been appointed master mechanic, with office at Pine Bluff. Mr. E. H. McFadden has succeeded Mr. Blakeburn.

Mr. F. S. Rodger, general car and locomotive foreman of the Chicago, Milwaukee & St. Paul Ry., at Marion, Iowa, has been appointed assistant district master mechanic of the Superior division, with office at Green Bay, Wis.

Mr. E. M. Wise has been appointed general manager of the Missouri & North Arkansas, with office at Eureka Springs, Ark., and Mr. N. J. Groves, trainmaster, has been appointed superintendent of transportation, with office at Leslie, Ark.

Mr. A. W. Munster has been appointed engineer of tests of the New York, New Haven & Hartford R. R., with office in the South Terminal Station, Boston, Mass., succeeding Mr. B. S. Hinckley, who has been transformed to other duties.

Mr. Richard N. Durboran, who has been for nearly ten years superintendent of motive power of the Eastern Pennsylvania Division, has been appointed general superintendent of the Pennsylvania lines east of Pittsburg, Pa., with offices at Altoona.

Mr. O. H. Linten has resigned his position with Niles-Bement-Pond Company, New York, and has become associated with Griggs & Holbrook, consulting engineers, New York, and will have charge of the Canadian branch of the business at Toronto, Canada.

Mr. G. W. Deats, geenral foreman of shops of the Texas & Pacific at Fort Worth, Tex., has been appointed master mechanic there. This is a new position, combining with the International and Great Northern shops, Mr. Deats acting as master mechanic in both shops.

Mr. J. G. Price, road foreman of engineers, has been appointed assistant trainmaster of the Western division in addition to his other duties. Mr. Price has had twenty years of practical railroad schooling: that of station agent, despatcher and locomotive engineer.

Mr. C. M. Hoffman, superintendent of motive power of the St. Louis, Brownsville & Mexico, with office at Kingsville, Tex., has also been placed at the head of the mechanical departments of the New Orleans, Texas & Mexico, the Beaumont, Sour Lake & Western and the Orange & Northwestern.

Mr. W. B. Ott, assistant engineer motive power of the Pennsylvania Railroad at Altoona, Pa., has been appointed master mechanic at the company's shops at Trenton, N. J., succeeding H. H. Maxfield, who has been transferred. Mr. M. J. Davis, assistant master mechanic at Altoona, succeeds Mr. Ott at Altoona.

Mr. Walter Byrd, for over twenty years in the employ of the Canadian Pacific Railroad, has accepted the position of Master Mechanic of the Dominion Lumber, Saw Mills, Locomotive & Steamboat Company, with headquarters at Revelstoke. Mr. Byrd had occupied various positions with the C. P. R. Company, and is a mechanic of wide experience and marked ability.

Mr. W. H. Holland, the well-known railroad master mechanic, who has been located in the Philippines for the last five years, is enjoying a well-earned holiday, and favored the staff of Railway and Locomotive Engineering with a visit one day last month. We have never met a railroad man who could make a visit so alluring as Mr. Holland. He has the rare faculty of seeing things worth noticing, especially their humorous phases, and describing them with graphic humor. He is an enthusiastic admirer of Railway and Locomotive Engineering, and is tireless in expatiating upon the help the paper gives to all railroad men in foreign countries.

Mr. John E. Stuart, vice-president of the Erie Railroad, took a holiday in June and took a trip to the Pacific Coast by way of the Santa Fe going west, and returning by the Canadian Pacific. All went well until Mr. Stuart reached Winnipeg, where he stopped off to pay his respects to General Manager Bury and other officials of the Canadian Pacific. Some press reporter gifted with imagination heard of Mr. Stuart's visit and immediately started the report that the Erie vice-president was out there arranging for a consolidation of the Canadian Pacific and the Erie system of railroads. News being scarce, the rumor traveled like wildfire, Wall street speculators heard about it and began booming Erie stock. Mr. Stuart had much difficulty in convincing people that there was not a word of truth in his reported mission, but the incident was the means of causing gains and losses among the people who speculate in railroad stocks.

A Veteran Holds On.

Those who enjoyed the pleasure of reading Locomotive Engineering in the 90's will remember highly interesting articles giving war reminiscences by Carter S. Anderson, a veteran railroad conductor of the Confederacy. Mr. Anderson, although 73½ years old, is still hale and hearty and performs the duties of assistant storekeeper of the Chesapeake & Ohio Railway at Richmond, Va., a position he has held with various changes since 1858. The president of that railway offered lately to retire Mr. Anderson on full pay, but the generous offer was not accepted. Writing about the incident, Mr. Anderson says: "I felt so well, and so loved railroading and railroad men, and the officials are all so very kind and nice to me that I felt that I must keep on. I was first employed as assistant agent in 1858, baggage master 1860, conductor passenger train 1862, and every day and nearly every night railroaded for the Confederacy."

Official Estimate.

Every tenth person met within the United States depends upon railways for the means of livelihood.

Theodore N. Ely.

The inevitable tooth of time has drawn another notable member out of the railway world, through the resignation of Theodore N. Ely, the celebrated chief of motive power of the Pennsylvania Railroad, after 43 years of faithful and particularly efficient service.

The rule of the Pennsylvania Railroad Company that regulates the retirement of employees, works no doubt for the benefit of the majority, but it seems of doubtful utility when it deprives the company of an official who is still in the glory of his manhood—still the condition of Mr. Ely.

Theodore N. Ely was born at Watertown, N. Y., June 23, 1846, and graduated from the civil engineering course of Rensselaer Polytechnic Institute in 1866. After two years' experience in different lines of work, he entered the service of the Pennsylvania Railroad as civil engineer on the Pittsburgh, Fort Wayne & Chicago, from which he was advanced to the Erie division of the Pennsylvania. From there he went steadily upwards through the grades of superintendent, assistant general superintendent, and then superintendent of motive power. In 1874 he was made superintendent of motive power of the Pennsylvania Railroad division; in 1882 he became general superintendent of motive power, and in 1893 was advanced to the position of chief of motive power, which he filled at the time of his retirement.

We know of no motive power official who received no detailed mechanical training that put his mark so indelibly upon railroad machinery as did Theodore N. Ely. Freedom from the restraints of stereotyped usage may have rendered his mind free to follow its own judgment in entering fields of improvement that others hesitated to enter upon.

Mr. Ely is an honored member of many technical and scientific organizations. The honorary degree of Master of Arts was conferred upon Mr. Ely by Yale University, and that of Doctor of Science by Hamilton College.

Obituary.

Henry F. Shaw, a well-known inventor, died at Boston last month in his eighty-first year. He was a native of Maine, and among his inventions were swivel plows, hay-spreaders, corn shellers, fire engines and automatic scales. Among others he patented the first air spring for the closing of doors. In 1881 he completed the construction of a four-cylindered locomotive which ran on the Shore line from Boston to Providence. This was the fastest train in New England at that time. The locomotive attracted much attention, paricularly on account of its finely balanced parts. The locomotive was also said to have made the highest speed up to that time known in the East.

Master Mechanics' Association Committee.

The Executive Committee of the American Railway Master Mechanics Association met in Chicago on July 13 and appointed committees to carry on the investigations for reports at next convention. The subjects and the committees are:

1. Advisory Technical.—G. W. Wilsin, A. W. Gibbs, W. A. Nettleton.
2. Revision of Standards.—T. W. Demarest, J. D. Harris, H. T. Bentley.
3. Mechanical Stokers—T. Rumney E. D. Nelson, C. E. Gossett, J. A. Carney, T. O. Sechrist, S. K. Dickerson, G. S. Hodgins.
4. Design and Specification for Cast Steel Locomotive Frames.—E. D. Bronner, D. J. Redding, E. W. Pratt, O. C. Cromwell, C. B. Young, C. E. Fuller, L. R. Pomeroy.
5. Main and Side Rods.—W F. Kiesee, Jr., H. Bartlett, G. Larya, H. B. Hunt, W. E. Dunham.
6. Consolidation of Associations.—D. F. Crawford, H. H. Vaughan, G. W. Wildin.
7. Safety Valves.—F. M. Gilbert, Jas. Milliken, W. D. Robb, W. J. Tollerton, L. C. Schmidt.
8. Safety Appliances.—H. T. Bentley, M. K. Barnum, C. B. Young.
9. Design, Construction and Maintenance of Locomotive Boilers.—D. R. MacBain, D. F. Crawford, T. W. Demarest, J. S. Bell.
10. Contour of Tires, with Minimum Thickness of Tires.—W. C. A. Henry, J A. Pilcher, O. C. Cromwell, H. C. Oviett, G. W. Sidel.
11. Steel Tires.—L. R. Johnson, L. H Turner, J. R. Onderdonk, C. H. Hogan, R. T. Ettinger.
12. Flange Lubrication.—A. J. Poole, M. B. Franey, J. C. Mengel, Geo. L. Fowler.
13. Minimum Requirements for Locomotive Headlights.—D. F. Crawford, A. R. Ayers, C. H. Rae, I. H. Scheffer, Jos. Roberts, Wm. Moir.
14. Standard Tinware.—A. J. Poole, M. D. Francy, W. G. Menzel, Geo. L. Fowler.
15. Best material for packing rings and bushings for cylinders and valves of locomotives using superheated steam.—D. R. Smith, W. H. Bradley, H. H. Vaughan, Joseph Chidley, J. B. Kilpatrick.

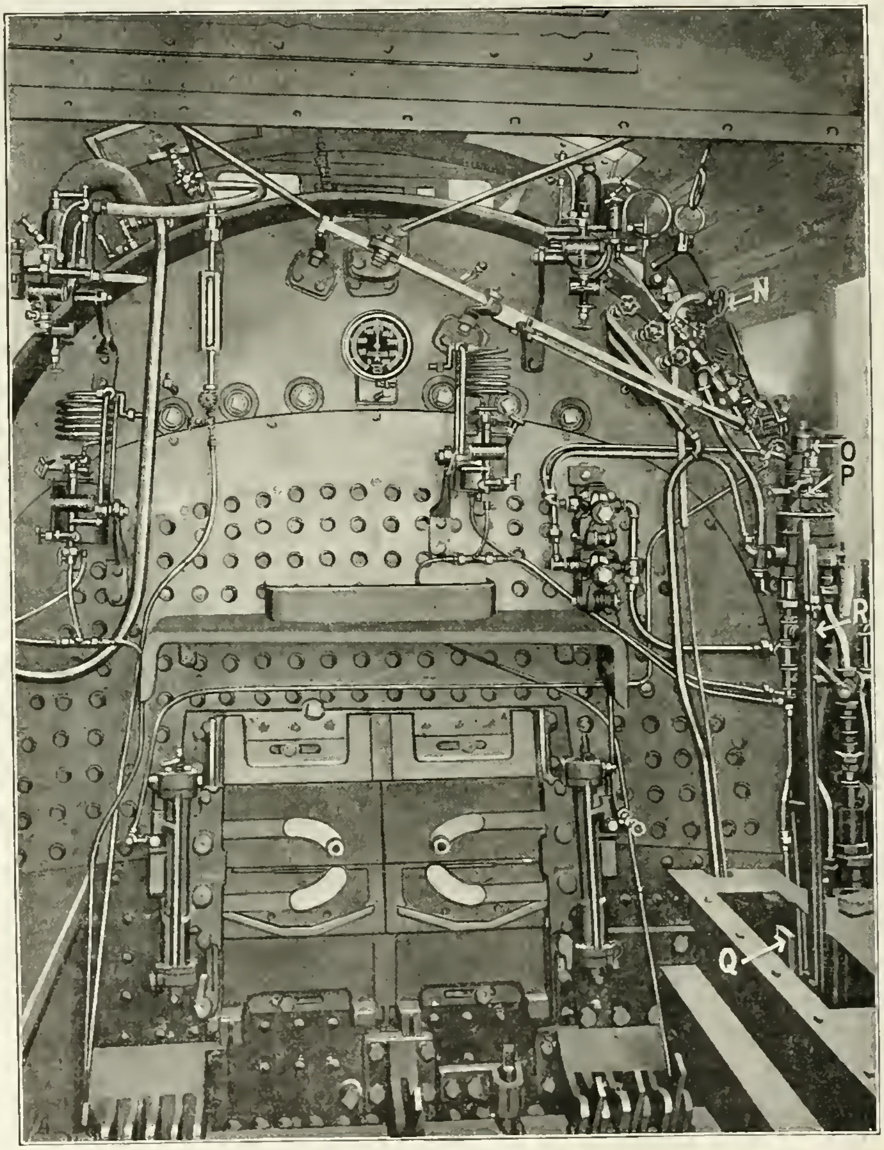
The American public have no patience with the people who organize movements to promote our mercantile marine. That manifests much self-denial in trade rivalry, for Britain has 11,500 ships engaged in foreign trade, Germany over 2,000, Japan about 1,000 vessels, while the United States trails far behind the procession with only nine ships so engaged.

Applying Shop Quickening Methods to a University.

In a recent issue of *Harper's Weekly* appears a delightful satire on the widely advertised methods of quickening industrial operations. This is supposed to be the reforming work of the president of Bulstrode University. This president was after results, just as much as are the shop experts. After making all sorts of revolutionary changes to promote the attainment of knowledge by lightning processes he reports:

"The test came when the professor of American history reported that out of a class of sixty, forty-eight had flunked on the date of Washington's first inauguration, some putting it as early as 1492 and some as late as 1861. I immediately ordered that all papers be re-examined, counting as correct all answers which came within 100 years of the true date, before or after. Similarly, in marking answers to the question, 'What is a quadrilateral?' I instructed the professor of mathematics to count as correct all answers describing a quadrilateral as having not less than three sides or more than seven. There was one special case that was submitted to me for adjudication. It had to do with a sophomore who defined a quadrilateral as an animal having four corners. My decision was that the answer should be considered correct, for the reason that though the answer was not strictly right, it showed that the student had grasped the etymological significance of the term 'quadrilateral.'

"But perhaps the most fruitful step for facilitating success at examinations was the list that I drew up with my own hand of variant spellings for use in freshmen examinations. In accordance with this list it was correct to write 'mutch' and 'moche' as well as in the ordinary and usual way.



INTERIOR OF CAB ARTICULATED COMPOUND ENGINE.
(Courtesy of American Locomotive Company.)

Pennsylvania Railroad Activities.

Preparations for moving during the next three months about a half-billion passengers—more than 50 per cent. of the number carried the whole of last year—have been completed by the railroads of the country, and tariff sheets on interstate rates have been filed with the Interstate Commerce Commission in Washington. About 200 railroads concur in the arrangements for handling the summer travel east of the Mississippi river.

These facts and others are brought out in statistics compiled by the Pennsylvania Railroad in preparing for the summer, when approximately 90,000,000 passengers will be hauled on the lines of its system. A large majority of these will be excursionists. Special rates are named to 804 pleasure resorts this side of the Mississippi. The seashore, mountains and quiet country places are included in this number.

In its efforts to stimulate travel, the Pennsylvania Railroad has prepared to take the seashore and mountains into every city and town on its lines. Every well-defined district on the lines east of Pittsburg, including Buffalo, Baltimore, Washington, Philadelphia and Pittsburg, will this year have its special train excursion to the seashore, mountains and Niagara Falls. The manner in which the railroads actually scour the country in their endeavor to increase travel is aptly shown by the arrangements which the Pennsylvania has made for these excursions, for each of which special rates are named for about 150 stations. In addition, arrangements have been perfected for a large number of special local excursions between various stations. Excursions are usually for but one or two days.

An important feature of the arrangements for summer travel on the Pennsylvania covers personally conducted tours to Lake George, Niagara Falls, Thousand Islands, Yellowstone Park, California, Gettysburg and Washington, in addition to a number of other far-away points in North America. These tours are made under the direction of the Personally Conducted Tourist System of the Pennsylvania Railroad.

Inducing people to ride on days when equipment is plentiful is what the railroads are doing in their summer business this year. This is shown in the fact that nearly all of the Pennsylvania's special excursions start on Thursday, a day when equipment is not needed for week-end travel, and the day when the average housewife in the small towns takes her leisure. Inquiry at the Pennsylvania's Passenger Department develops the fact that every Thursday in the summer is taken up by excursions. This relieves the pressure incident to the travel at the end of the week.

Highest Drilling Records

At the recent joint conventions of the Railway Master Mechanics' and Car Builders' Associations, held at Atlantic City, June 14-21, 1911, great interest was aroused by some phenomenal results obtained in a demonstration test of twist drills. As the durability and efficiency of tools are such important factors in economical production, these results should be welcomed by all interested in this subject.

The Cleveland Twist Drill Co., of Cleveland, has a Foote-Burt No. 25½ high duty drill press in operation in connection with their exhibit, and the results obtained from tests of Cleveland milled and flatwist drills taken from stock are tabulated below:

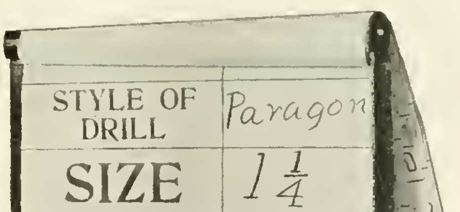
COMPLETE OFFICIAL RECORD OF THE TESTS.

Size and Kind of Drill.	Material.	R. P. M.	Feed per Rev.	Inches Drilled per Min.	Peripheral Speed in Ft. per Min.	Cu. In. Metal Removed per Min.
1¼-in. Paragon	Cast Iron, 3½ ins. thick.	500	.050	25	163.6	30.68
1¼-in. "		325	.100	32½	106	39.88
1¼-in. "		475	.100	47½	155	58.29
*1¼-in. "		575	.100	57½	188	70.56
1½-in. "		300	.030	9	117	15.90
1½-in. "		325	.100	32½	127.6	57.43
1½-in. "		335	.100	33½	131.5	59.19
1½-in. "		355	.100	35½	139.4	62.73
1¾-in. "		235	.100	23½	107.6	56.52
1¾-in. "		350	.100	35	160	84.19
2 5/16-in. "		190	.050	9½	115	39.90
3-in. "		120	.100	12	94	84.82
1¼-in. "	Mach. Steel, 4¼ ins. thick.	350	.030	10½	113.7	12.88
1⅝-in. "		225	.040	9	94.8	18.66
2 5/16-in. "		165	.020	3¼	100	13.65
2 5/16-in. "		200	.020	4	121	16.80
2½-in. Milled		150	.015	2¼	98	11.04
2½-in. "		150	.040	6	98	29.45
2½-in. "		175	.040	7	114.5	34.36
1¾-in. Paragon		275	.030	8¼	125	19.84
3-in. "		150	.030	4½	117.8	31.81
3¼-in. "		150	.030	4½	127	37.33

The first tests were made for the purpose of demonstrating what is good shop practice, i. e., the drills were put through at speeds and feeds that would be economical under average shop conditions. Then, to demonstrate the reserve efficiency and durability of the drills, "stunts" which demanded extremely high rates of speed and feed were attempted.

The highest rate of speed in drilling known to machine shop practice was attained by a stock 1¼-inch Paragon flatwist high speed drill in successfully removing 70.55 cu. ins. of cast iron in one minute, repeatedly cutting through a heavy billet at the record-breaking rate of 57½ inches per minute—nearly an inch per second. This drill ran at 575 revolutions per minute, with 1/10 (.100) in. feed per revolution, successfully withstanding the terrific strain of this extreme speed and feed. Before attaining this maximum performance, which was approached gradually, numerous other "Cleveland" drills were put through at the rates of 25, 32½, 33½, 35 and 47½ inches per minute, as can be seen from the complete records of the tests. In no case was the limit of strength of the drills reached, but the speed of 57½ inches per minute could not be exceeded on account of the inadequate capacity of the electric feed wires which brought current to the motor driving the drill press.

Drilling at such high speeds and heavy feeds is not to be recommended as economical shop practice, and this performance will in all probability not be repeated in many shops. These results were only made possible by carefully established ideal conditions, such as—absolute rigidity in the machine, uniform and sufficient driving power, solid clamping of the work, perfect grinding of the tool and most expert handling. They are of value chiefly in demonstrating the power and rigidity of the machine and the exceptional reserve strength of the drills.



FAC SIMILE OF THE BULLETIN WHICH GAVE THE FIRST DETAILED ANNOUNCEMENT OF THE RECORD TEST IN CAST IRON.

Another noteworthy test was made with a 2½-inch milled drill from stock. It drilled 68 holes through a billet of machinery steel 4¼ inches thick, without being reground. The drill was operated at 150 revolutions per minute, with a feed of .015 per revolution removing a total of 1,418 cu. ins. of material. Although the drill was still in good condition the test was cut short at this point by the convention coming to a close. This test demonstrated what can be done all day long in any shop properly equipped, and is indicative of what results should be expected in economical high-speed drilling.

Wireless Train Control.

The installation of the Wireless Train Control, which is being tried out near Toronto, was recently completed, and the report received from Mr. F. W. Prentice, the president of the company, is very gratifying. The engine with a full train was taken out over this installation in regular service. The wave was picked up just outside the city and carried the train along with the whistle valve closed by effect of this wave to the end of the section, and in four sections thereafter the whistle was blowing. In four seconds later the train was brought to a standstill by automatic application of the air. On the track returning, the wave was picked up at the desired point and carried the engine under safety conditions to a point where the block had been purposely set at danger by stopping the wave apparatus. When the train passed out of the block the whistle was blowing in four seconds, and in four seconds later the train line was opened. The push button on the engine was then applied and the train put through the block with the whistle blowing. During this operation, safety conditions prevailed on the outgoing track without any interference whatever. There will be further exhibition tests to satisfy railroad and government officials as well as others interested.

Saunders & Sons' Generous Gift.

A genuine surprise was given one day last months to the employees of D. Saunders & Sons, manufacturers of tools in Yonkers, N. Y., when the firm distributed $35,000 among twenty-seven employees who had worked twenty years or more for the concern. Five men who had worked in the shop for nearly forty years received $2,600 each. The others received $1,000 each.

One of the men, who had been in the Saunders employ for nearly half a century, said to a reporter of the New York *World* when asked why he and others have worked for so long a time in one shop:

"Our employers treat us as if we were members of their own families. They're white, all of them. You get a square deal all the time, and, what's more, they are appreciative. That's the secret for long service."

Iron That Has Defied Rust.

A melancholy reflection comes to most people when they look at a noble iron or steel bridge, the highest achievement of engineering skill, and feel conscious that within a few centuries the great structure will crumble to pieces through the affinity that oxygen has for iron. To put the case plainly, the iron forming the bridge will rust to pieces, when time is given for the work of destruction to be effected.

To prevent iron from rusting, it must be protected from dampness and from the access of air and nothing has been found better for this purpose than paints that are nearly impervious to atmospheric attacks. Various methods of working iron to make it rustless have been tried, but none of them have endured the test of time. Yet some ancient workers in iron must have known the secret of forging iron that rust would not touch.

Electrical Terms.

A volt is the practical unit of electromotive force or the pressure which forces the electric current through the resistance of the circuit.

An ampere is the practical unit of electric current, and represents the rate of flow or intensity of the current through the circuit.

The watt is the unit of electrical power. It is the rate of doing work when a current of one ampere is passing through a circuit, impelled by an electromotive force of one volt. The watts in direct current circuits are equal to the amperes multiplied by the volts.

The kilowatt is one thousand watts. Electrical energy is sold by the kilowatt hour, representing one thousand watts of energy for a period of one hour.

The H. P. is a mechanical term, and is the energy required to raise 33,000 pounds one foot in one minute. It is equal to 746 watts or approximately three-fourths of a kilowatt.

Information on Flue Welding Desired.

A prominent railway official in the southern countries is interested at the present time in American methods as applied to flue welding, and manufacturers of machines for this class of work will do well to communicate with Mr. W. M. Stokes, care Nitrate Agencies, Ltd., Iquique, Chile.

Machinery Catalogues Wanted.

Mr. C. E. Fuller, general locomotive superintendent of the Ferrocarril Longitudinal de Chile, wishes to receive catalogues of railway machinery and supplies.

Manufacturers are requested to forward printed matter descriptive of their products to Mr. Fuller, whose address is Casilla 219, Coquimbo, Chile.

The *Safety Heating and Lighting News*, No. 10, contains 25 fine illustrations of various appliances used in the heating and lighting equipment with descriptive text. The fine products of this company is designed for all classes of service and does not depend on the preferred care and liberal expense of limited trains for efficient service. There is a marked improvement in the recent designs of lighting fixtures, while the heating apparatus is such as to insure a guarantee of comfort while in a railway car in cold weather. The thermo jet injector, which is described and illustrated, seems to have completely solved the problem of car heating. Its actual operation in over 800 cars has been demonstrated, and the traveling public will soon realize the importance of the marked improvement.

The Railway Business Association has issued Bulletin No. 8, treating of the Revolution in Freight claims. It presents very clearly the story of how by co-operation the shippers, the railways and the government have transformed a material complaint into fast spreading satisfaction. The pamphlet describes the elaborate efforts of various railway associations in different departments to expedite claim settlements and prevent loss, damage and overcharge. There are also descriptions of the efforts made by business associations to bring about among shippers an improvement in packing, marking and the presentation of claims, and a chapter on the activities of the government, which in the matter of packing now regulates the shipper in the interest of lower operating costs, and hence lower freight rates and regulates the railroads to be sure that no freight claims are paid as disguised rebates.

Not Disappointed.

It is worth reviving, that sweet little story of one of the princely grandsons who asked Queen Victoria for a sovereign and received instead a lecture against extravagance in the royal handwriting. The boy politely thanked her. "Dearest Grandmama.—I received your letter, and hope you will not think I was disappointed because you could not send me any money. It was very kind of you to give me good advice. I sold your letter for £4 10s."

"Vot iss it?" asked Karl, hoping that perhaps he might overcome the difficulty.

"Why it's all on the outside," said Bentley. "If there were only some apparatus that would enable you to get inside a fellow's head and clear out the pains of the morning after, what a blessing it would be."

"Vell," said Karl, "I t'nk that maybe some day dose vacuum-cleaner fellers vill do dot already yet. Vot?"—*Harper's Weekly*.

Breakage of Staybolts.

"The Breakage of Staybolts" is the subject of a handsome publication of 34 pages issued by the Flannery Bolt Company of Pittsburgh, Pa. This is the most exhaustive treatise published on the subject by this enterprising company. Besides much original matter it embraces the excellent paper read before the New York Railroad Club by Mr. D. R. Macbain last year, and an analytic discussion on expansion of locomotive boilers. The illustrations, of which there are 34, are of the best. The publication is sure to receive the warm attention of the leading minds interested in the subject of boiler construction generally and boiler staging particularly. Copies of the publication may be had on application at the company's office at the Frick Building, Pittsburgh, Pa.

Gill Selectors on the Seaboard Air Line.

The Seaboard Air Line Railway, which has had Gill selectors in successful operation in telephone train dispatching circuits for more than a year and a half, have now ordered 74 additional Gill selectors for an extension of 639 miles. The Seaboard was not only the first railway in the South to install selective telephone train dispatching, but is notable for its length of circuit, 276 miles, and the number of selectors thereon, 52. It is understood that the operation of telephone train dispatching on the Seaboard has been closely scrutinized with respect to its economies and the extension of this service is looked upon as significant of approval.

Small Investors.

If some means could be taken to induce the small investor, whom Brother Bryan calls the common people, to invest in the stocks or bonds of corporations, it would do a world of good in changing public sentiment. I believe that any man who holds stock or bonds in a corporation and gets his dividends regularly—knows something about it—learns that it is fairly and honestly managed and conducted on principles of integrity and truth—will be far more favorable to corporations than he is now, to judge by the general trend of public opinion as expressed in the newspapers of this country. And if corporations—especially railroads—would issue bonds of the value of $100, so as to put them within the reach of the small investor and encourage him to keep his money out of the saving institution, where he gets 3 or 4 per cent., and invest it in corporation bonds that pay 6 or 7 per cent., or even 5 per cent., it would in a reasonable time do much to create a better understanding and induce small investors to interest themselves in a safe investment.

Pennsylvania Railroad Thriving.

In April of this year 18,728 trains were operated over all divisions of the Long Island Railroad, and the percentage of those that made the schedule was 94.67, according to the rating established by the Public Service Commission.

As the Long Island Railroad carries more passengers and runs more trains than any other road in the United States having an equal mileage, the problem of operating trains on time is an intricate one. When the Pennsylvania Railroad's East River tunnels were opened last September an entirely new traffic was created, which required the operation of several hundred additional trains every month. Considering this large increase in passenger travel and train service, the Long Island management is gratified at the regularity with which trains are maintaining their schedules.

Figures for May show a total of 19,537 trains run, an increase of 809, or 4.14 per cent., while the percentage on time was 92.73. Although during May there has been a decrease of 1.94 per cent. in trains on time, compared with April, an increase of 4.14 per cent. in the number operated leaves an actual gain in efficiency of 2.20 per cent. for the month of May.

After Scalps of Express Companies.

Victor Murdock, the red-haired representative from Kansas, is after the express companies as vigorously as any of his craft have ever gone after railroads. The New York *Sun* says that Mr. Murdock is reported to have said:

"It is extremely doubtful whether any express company has a legal right to exist. It is by its very nature a preferred shipper, enjoying special rates, rebates and the identical discriminations which the country has struggled a quarter of a century to correct. The citizen who would offer the express rate for the transmission of a package, and offer it directly to the railroad, would find that, in that instance, the railroad was not a common carrier. The railroad would immediately and emphatically refuse to carry the package for the individual for any such rate."

Borrowing.—No remedy against this consumption of the purse; borrowing only lingers and lingers it out, but the disease is incurable.—*Shakespeare.*

An Iowa teacher encourages her pupils to ask questions likely to increase their knowledge. She was sometimes embarrassed, as she was the other day, when Tommie Wilson asked, "Where do all the figures go to when you rub them off the slate?"

New Western Road.

The new double-track, high-speed electric interurban between Seattle and Tacoma seems fast approaching an existence in fact. Franchises are now all secured, the preliminary proceedings are completed and the many obstacles incident to the promotion of any new project have been overcome.

Seattle and Tacoma are today the fastest-growing cities in the United States. More railroads terminate there than elsewhere, and Puget Sound is the largest American seaport in the West, being the nearest to the Orient and to Alaska.

The first shipments of copper from Alaska are now being brought to the Tacoma smelters and it is estimated that there is enough uncut timber in the State of Washington to supply the whole of the United States for fifty years. It is also stated that Washington has among its other natural resources as much coal and iron as in Pennsylvania.

The undeveloped waterpower within a radius of one hundred and fifty miles of the Seattle-Tacoma territory is estimated equal to that of Niagara, and the soil, some naturally watered and some irrigated, is the most fertile in the world.

The Seattle-Tacoma Short Line will carry freight and passengers; the road is to be free from grade crossings, running on its own right of way between the two cities, having an average width of one hundred and twenty-five feet, which allows for four tracks where needed, as well as extra sidings.

The present mode of communication between the two cities is by boat or by a road which has a less direct route than the Short Line, the present facilities seemingly being entirely inadequate to meet the growing demands of this twin-city problem.

The golden opportunities offered by this section of the country are realized only in a measure by those having a general idea of the location, but the public is rapidly being educated to a realization of the magnitude and wealth of this, the clear blue, white gem of the great Northwest.

Had a Light Luncheon.

An old North Side darkey was sent to a hospital in Charlotte for treatment. Upon his arrival he was placed in the ward and one of the nurses put a thermometer in his mouth to take his temperature, and, when the doctor made his rounds, he said to him:

"Well, my man, how do you feel?"

"I feel right tol-ble, sar."

"Have you had anything to eat?"

"Yassar."

"What did you have?"

"A lady done gimme a piece of glass to suck, sar."

Pleasant Long Island.

The 1911 summer resort booklet, abounding in illustrations portraying scenes on Long Island, and containing brief descriptive notes of towns and villages, hotel accommodations and train service, has just been issued by the Long Island Railroad Company. In the introductory pages attention is called to Long Island as "a charming expanse of seabound land, right at the door of New York City, where everything that can minister to health, rest and recreation is offered." The island is 123 miles long, from 15 to 25 miles wide, with over 400 miles of salt-water shore line, covering more territory than Rhode Island and almost equalling the state of Delaware in size.

After exploiting Long Island's advantages as a pleasure resort, place of permanent residence, and a profitable field for the farmer, gardener, poultry raiser, fruit grower and manufacturer, the booklet refers to the Pennsylvania station in New York City as "a very convenient means of transportation from any point reached by the Pennsylvania Railroad and connecting lines, to points on Long Island under protection of a roof from the time passengers enter the train until they reach their destination on Long Island." The last chapter of the booklet contains a list of hotels and boarding houses, situated at 115 different points, which have accommodations for 25,000 visitors at rates ranging from $6 to $35 weekly. The number of trains stopping at each resort daily is enumerated, and instructions for forwarding and receiving baggage are also given.

Good News for Erie Mechanics.

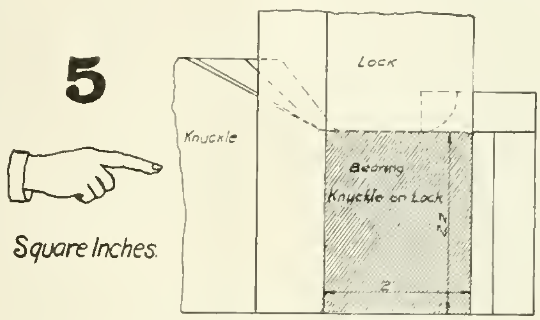
The management of the Erie Railroad have decided to increase the motive power of the road by about seventy engines. A large proprtion of the locomotives will be of the heavy 2-4-2 type. The builders are invited to bid on the engines, but it is the intention of the management to do as much as possible of the work in their own shops, which will be good news to the mechanics, who have been patiently working on short hours these many days.

Pure Robbery.

An old Scottish woman went up to London to visit her son. She was taken with a nagging toothache, and visited a dentist, who soon extracted the offending molar. With a sigh of relief the old lady climbed out of the chair and asked—"Hoo much?" "Ten shillings, mam," replied the dentist. "Ten shillings, ye robber," screamed the woman, "Why, Sandy MacPherson wad haul me all aboot the smithy for saxpence."

Penn Freight Coupler

The McConway & Torley Co., of Pittsburg, Pa., have a new design of freight couplers which they call the "Penn." This coupler is a combination of the features of the Pitt and Janney "X" Couplers manufactured by them, providing for an increased bearing surface between the locking pin and knuckle, this surface being increased to 5 sq. ins., as shown by the line cut below.



PENN FREIGHT COUPLER.

This coupler is of the Janney type with a vertical locking pin which does not extend through the bottom of the coupler. Another important feature is the easy accessibility of parts, the locking pin and knuckle opener can be removed and replaced without removing the knuckle. The coupler also has a heavy section of metal in its contour face. It has the features of a "Lock-to-the-Lock," which positively prevents the locking pin from climbing or creeping by the oscillation of the cars in bumping over rough frogs or switches, a "Lock-Set" which retains the locking pin in the open position without the necessity of locking up the uncoupling lever on the side of the car, and a positive "Knuckle-Opener" which pushes the knuckle open to its fullest range of movement by the operation of the uncoupling lever at the side of the car, thus preparing for automatic coupling without any further adjustment or attention from the trainmen.

The coupler has a long head designed to meet the latest requirements of the Interstate Commerce Commission in regard to the distance between certain cars when coupled up in trains.

The Buhoup Flexible Truck also manufactured by The McConway & Torley Co., is attracting attention on account of its novel construction and features. It embodies the desirable features of the cast steel side frame, which as a substitute for the built-up construction has passed the experimental stage, and has other distinctive features peculiarly its own. The truck consists of two cast steel side frames in combination with a cast steel bolster, taking any style or make of standard oil boxes as used with the arch bar type of truck, with forged bottom tie bars. The brake hanger brackets are attached to the inside of the side frame, the construction of the truck dispenses with the usual spring plank, and is the acme of simplicity. The truck is flexible to vertical movement, but rigid to any twisting or angular horizontal movement. This vertical flexibility allows the truck to adapt itself to all uneven conditions of track, high or low joints, with the wheels firmly on the rails, without any undue strains to any part of the truck.

The load is distributed over a large area instead of being concentrated in the middle of the side frames.

The distribution of springs is such that an increased spring capacity can be secured, and this feature with the large area of distribution of load insures an easy riding and long-lived truck.

Several of these trucks have been in operation for some months past under tenders of locomotives in switching service, and their operation seems to warrant all the claims as to their desirable features.

The side frame and bolster and other parts of the truck are made from acid open hearth steel, thoroughly annealed, and conforming to standard cast steel specifications.

Another Blow at the Honest Farmer.

The authorities of New York, becoming impressed with the belief that the baskets of country produce brought to the markets for sale were deficient in measure and weight so one day a commissioner of weights and measures stationed about a dozen of his inspectors early in the morning at Wallabout Market and when the "simple and honest farmers of Long Island," as one of their defenders called them in the City Hall, were unloading their wagons the commissioner and his men began to look over the bushel baskets in which the farmers sent their produce to market. They confiscated about 1,500 baskets which were found to be short from two to four quarts to the bushel.

After the baskets had been seized they were taken to the City Hall and were stacked at the back of the building with tags attached to each stack bearing the word "condemned."

Heating Surface.

The heating surface required per horsepower as 2 sq. ft. for compound locomotives, and for single-cylinder engines cutting off earlier than half-stroke, 2 1/3 sq. ft.—a difference of 16 2/3 per cent.: a result which is in substantial agreement with many repeated experiments.

Indicative of the efforts of the Pennsylvania Railroad to economize in every possible way, is a general notice which has just been issued to the employees of the Schuylkill Division. Employees are told what it would mean to the company on the Schuylkill Division alone if each one would save 10 cents a day. Enginemen are requested to be careful in the use of oil, firemen in the use of coal and clerks are asked to economize in the use of stationery and by avoiding errors.

The spirit of envy is becoming as rampant in the United States that provident people who save part of their income are looked upon as thieves. Time was, not so long ago, when frugal, saving people were considered the salt of the earth. The change that makes them out to be undesirable citizens brings serious danger to the whole nation.

Maud (before the laughing hyena's cage)—"How provoking! Here we've been twenty minutes, and the hyena hasn't laughed once."

Ella.—"Strange; and he's been eyeing your new broad-brimmed hat, too!"

Dentist.—"I'll have to charge you two dollars for pulling that tooth."

Patient.—"I thought you only charged one dollar?"

Dentist.—"Yes, but you yelled so loudly you scared three other patients out of the place."

"Tommy," said a teacher to a pupil, "what is the half of six?"

Tommy.—"I don't know, sir."

Teacher.—"Now, attend to me. If two men stole six shillings and agreed to divide it equally between them, how much would they get each?"

Tommy.—"Three months, sir."

A Scotch minister visiting an old female parishioner was trying to explain the meaning of the expression, "take up your bed and walk," by saying that the bed was simply a mat or rug, easily taken up and carried away. "No, no," replied the lady. "I canna believe that. The bed was a regular four-poster. There would be no miracle in walking away wi' a bit o' mat or rug on your back."—*Argonaut.*

Best to Keep It Quiet.

Daughter.—"This piano is really my very own, isn't it, pa?"

Pa.—"Yes, my dear."

Daughter.—"And when I marry I can take it with me, can I?"

Pa.—"Certainly, my child. But don't tell any one; it might spoil your chances."

"Must I always be like this?" said the tall recruit to the little sergeant.

"Certainly, that is the attitude of a soldier."

"Then I'll never see you again."

New Catalogues.

Catalogue No. 10, of the Bridgeport Chain Company, is just issued and as illustrating the fine products of this enterprising company it is the most complete publication that they have yet issued. The fifty-four pages are full of fine illustrations of their endless variety of chains with brief and lucid descriptions. Wire rings, hooks and swivels in every imaginable form are presented with sprocket chains and snaps of varied sizes and forms. The railroad specialties embrace platform chains, steam hose, fire-box door, seal pin and register chains. A new feature is the anti-rust nickel plated steel chains and also aluminum chains with German silver attachments. Copies of the catalogue may be had on application addressed to the company's office, Bridgeport, Conn.

The Pilliod Locomotive Valve Gear is described in a handsome bulletin issued by the Pilliod Brothers Company, of Toledo, Ohio. "The Crosshead Connection" is fully explained, and the uses of the involved cranks are made perfectly plain to the reader. As is well known, the gearing is of the outside type with all of the parts readily accessible. The movement is obtained from the crosshead only, and consequently is not subject to the distorting causes that are inevitable to the Stephenson gearing. The bulletin is finely illustrated, and is a valuable contribution to the sources of information that are published on the subject of valve gearing.

The Champion Power Hammer, manufactured by Beaudry & Co., Boston, Mass., is illustrated and described in a neat booklet, copies of which may be had on application. There undoubtedly are a number of clever improvements on the Beaudry hammer which must be seen to be appreciated, among others the spring head is acknowledged to be an improvement of much importance. It is generally looked upon as a labor-saving tool, and copies of the booklet should be carefully read by those in charge of blacksmith work on railways.

American Vanadium Facts, No. 5, is of particular interest to all who are interested in the improvement of the quality of steel. The pamphlet contains illustrations and descriptions of remarkable tests. These tests run from the heaviest forgings down to pocket knives and in each case the results are of a surprising kind. The latest adaptation shows that the vanadium steel properly made and heat treated makes the highest grade of saws known. Copies of the publication may be had on application to the company's office at Pittsburgh, Pa.

The Standard Steel Works Company, Philadelphia, Pa., has issued a new catalogue on steel tires, giving in detail the specifications which were adopted by the American Society For Testing Materials. The catalogue extends to 28 pages, and has 36 fine illustrations with descriptive text on elegantly toned paper. Copies may be had on application at the company's office, Philadelphia.

The United States Electric Company has just issued Bulletin No. 502, with Suggested Rules for Telephone Train Dispatching. The rules embrace in condensed form not only the general rules as laid down by the American Railway Association governing the movement of trains, but a full list of the fine appliances manufactured by the company are also present with directions for their proper care and use. The instructions in regard to frequent inspection are of special value, and a copy of the bulletin should be in the hands of all who are interested in this new and important appliance in railroad operations. Copies may be had from the New York office, 284 Pearl street.

The Baldwin Locomotive Works, Philadelphia, Pa., have issued Record No. 70, giving a description of the details of the Walschaerts valve gear, with instructions in regard to the proper adjustment of the parts. A large number of fine illustrations are given showing the setting of outside admission valves as well as inside admission valves. Special notes on travel irregularities are dealt with in a way which cannot fail to be of value to all who are entrusted with the proper adjustment of this particular kind of valve gearing. Hypothetical cases are presented with simple diagrams that render the operations very intelligible. Instructions are also added in regard to breakdowns. Copies of the bulletin may be had on application.

Middle Names Forbidden.

It is a curious fact that middle names were once illegal. The old English law was very definite as to the naming of children, and according to Coke, "a man cannot have two names of baptism." "It is requisite," this law goes on, "that the person be named by the name of his baptism and his surname and that special heed be taken to the name of baptism."

Royal personages have always been allowed to have more than one given name, but as late as 1600, it is said, there were only four persons in all England who had two given names. Even a century and a half ago double names were very uncommon. Until the English mania for double names crossed the Tweed about half a century ago, Scotchmen very rarely held a middle name.

New Observation Cars on the N. P.

The Northern Pacific's crack train, the North Coast Limited, was recently equipped with new observation cars. They are of special type original with the Northern Pacific, embracing two compartment smoking rooms and barber shop, bath room, library observation parlor and recessed platform. These cars are very popular with women, and the writing desk in one corner of the observation parlor is equipped with special embossed stationery of dainty design for patrons' use. Afternoon tea is served upon request, and a new library of 100 volumes of fiction, history, biography and travel, together with the current magazines, serve to pleasantly fill the idle hours. The train is electric-lighted, and the North Coast Limited was the first train in the West to carry sleeping cars with electric lights in upper berth, a feature which makes it very popular with transcontinental travelers.

An Easy Remedy.

The use of steam superheaters for locomotive boilers has developed much trouble in the maintenance of packing rings and bushings for valves and cylinders. A committee of the Railway Master Mechanics' Association has been appointed to investigate this defect and to report on the most practicable remedy. At the meeting of the Executive Committee in Chicago on July 13, when this subject was under discussion, several of the members remarked that they had ended the trouble by using Hunt-Spiller gun iron.

The Modern Way.

"Will you allow me to ask you a question?" interrupted a man in the audience.

"Certainly, sir," said the lecturer.

"You have given us a lot of figures about immigration, increase of wealth, the growth of trusts, and all that," said the man. "Let's see what you know about figures yourself. How do you find the greatest common divisor?"

Slowly and deliberately the orator took a glass of water.

Then he pointed his finger straight at the questioner. Lightning flashed from his eyes, and he replied, in a voice that made the gas jets quiver:

"Advertise for it, you ignoramus!"

The audience cheered and yelled and stamped, and the wretched man who had asked the question crawled out of the hall a total wreck.—*Tit-Bits.*

If you train a miss not to miss a train, you will somehow or other not have trained amiss.

The hard hand betokens the busy brain and the happy heart—work is life.

May Become Active Again.

The story goes that Mr. George Gould was making one of his last trips as president of the Missouri Pacific. His private car was laid out on a siding for some reason or other and he got out to stretch his legs. An old Irishman was tapping the wheels. Gould went up to him and said: "Good morning; how do you like the wheels?" "Not worth a darn," said the Irishman. "Well, how do you like the car?" "It's good enough for the wheels," was the reply. "What do you think of the road?" "It matches the car." Gould looked at the old chap for a minute and said, "Maybe you don't know who I am?" "Yes, I do," retorted the Irishman. "You're George Gould and I knew your father when he was president of the road, and b'gob he's going to be president of it again!" "Why, my father is dead," said Mr. Gould. "I know that," replied the Irishman, "and the road is going to h—l."—*B. L. T., in Chicago Tribune.*

A Model Husband.

The bridegroom of a year went down to his office one day grinning all over his face. All morning long he hummed and whistled till his partner asked him what he'd had.

"My wife told me this morning that I am a model husband," he answered proudly.

"I don't call that much of a compliment."

"I'd like to know why not?"

"Well, you just look that word 'model' up in the dictionary," was the advice.

He did, and this is what he read: "Model—A small pattern; a miniature of something on a larger scale."

Drinking Cups.

The people who are striving to prevent the masses from being poisoned by microbes that infest drinking cups may be saving lives by taking away the cups in cars and at drinking fountains, but they are inflicting much discomfort upon many persons. If the legislators who compel railway companies to withdraw the drinking cups could witness the sufferings inflicted during the hot weather they would derive small satisfaction from their law-making foolishness.

Golfers.

Two golfers had gone to a remote links for a day's golf. It was very hot, and at lunch time one of them opened the basket containing their sandwiches and "refreshment." Suddenly his face became "cickled o'er with the pale cast of thought." "What's the matter?" said his friend, "forgotten the corkscrew?" "Corkscrew be blowed!" was the answer. "I've forgotten the cork!"

Safety of Pintsch Gas.

We cordially endorse every word of the following article, which recently appeared in the *Safety News.*

Readers of this paper some years ago will remember the extensive discussion of the use of gas for car lighting which was carried on in our columns. The present generation accepts as facts what were then, in part, unproved theories. In view of the New Jersey public utility commissioners' report on the Martin's Creek derailment, it is well to recall the basic reasons for considering Pintsch gas a safe illuminant. No man can say that any combustible gas released in unconfined space *cannot* under some conditions be ignited. But we can say that in the case of this particular gas the chances are overwhelmingly against it. The pressure under which it is stored in the tanks and connecting pipe lines is such that, at a break, it escapes with sufficient velocity to blow out a torch. This has been proved by test. At such a break it is possible to ignite it only by some such means as a piece of incandescent metal. Furthermore, the combustible mixture of air and this gas is within unusually close limits. The small amount of this illuminant necessarily carried in the tanks of cars will, in case of a break, escape and expand in the atmosphere in two or three minutes; and of that time there is but a narrow zone, only a few seconds, in which even a high temperature will ignite it. There is no evidence of the explosion of Pintsch gas tanks in a wreck; and it is obviously impossible to have conclusive evidence of the behavior of escaping gas in a wreck. It would require an expert standing alongside of the track watching the train continuously from the moment of the derailment or collision. We have investigated, to the best of our ability, many of the alleged cases of Pintsch gas burning in a wreck, and have never found evidence to support the allegations. In the Martin's Creek wreck the piping was broken in many places. The tanks being under the car, and there being breaks in the piping near the tank, it is not possible to conceive of the gas escaping into a confined space; so there is every reason for believing that the gas was dissipated in the atmosphere so quickly that it had no part in the conflagration.

Rather Swim.

When the attempt was first made to introduce crude railways into France for the transportation of coal and other minerals, a hue and cry arose against the enterprise about Saint Etienne, on the ground that the people preferred canals, where they could bathe and swim in hot weather, and where they could fish when disinclined for work.

Workshop Tests of Steel and Iron.

Steel, when softened by annealing, if good, on being broken has a greyish appearance at the point of fracture; when hardened and broken the fracture shows a silvery white. If the steel is bad there will be cracks, flaws, or glassy particles where the bar is broken.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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On the Scenic Railways in Europe.

Apart from the well-traversed railways in Europe, whose purpose may be said to be purely of a commercial kind in conveying passengers and merchandise from place to place, there has sprung up during the last twenty years a number of short railroads for passengers only, particularly operated by rack, others by cable, and recently electricity has been introduced, the generating power being readily found in the mountain torrents that are plentiful in these regions.

In fact, the application of water power has given a new impetus to the scenic railroad, one of the most serious items termed deforestation, the motive power is right at hand in the tumultuous mountain streams. The initial expense of a generating station, even if the power is entirely confined to a short railroad, is comparatively trifling, and hence the increase in the number of these purely scenic railways.

VIADUCT ON THE SCENIC RAILROAD AT STUBAITHAL-BAHN, TYROL.

in the Alpine Mountains. Most of these are short routes that traverse scenic wonders and depend for their financial support on the brief tourist season, and, as may be expected, the charges are nearly as steep as some of the mountains that are climbed. Some of these roads are in the expense of operating a mountain railroad—the fuel problem—being largely eliminated. Instead of having to convey coal long distances, or in the case of wood-burning, having the communal legislatures prolonging their stormy sessions discussing the evils of what is

It is interesting to note that waterpower gave rise to an expression now generally known throughout Europe, "white coal" being used to indicate waterpower. It is stated that the expression had its origin in an appeal made by Cavour, the Italian statesman, who protested against the annexation of Nice by the French, on the ground that France would thereby be depriving Italy of its "white coal."

Apart from these associations there is much resemblance between the Alpine region in Europe and the Rocky Mountains in North America. There is, of course, the same shining peaks of eternal snow, the same luxuriant wilderness in the valleys. There is in Europe the unexpected glimpses of castellated palaces and elegant chateaux lacking in America. Among the Rockies, however, there is a rugged grandeur, a precipitousness, if we might so express it, of chasm and of canyon that is not equalled in European scenery, while the glow and glory of coloring of autumnal foliage in American forests is not approached in any part of Europe.

HALL OF FAME, MUNCHEN, GERMANY.

It would be impossible in a brief article to present even a passing mention of the names and locations of these scenic railways. While the Alpine region may be properly said to be the chief centre of their field of operations, we find them extending to the Ural Mountains in the East, in the Sierras of Spain, in the fiord-ridges of Scandinavia, in the Carpathian Mountains, and some of particular interest in the Tyrolese Mountains. They vary in length from one mile to twenty miles, few being longer than the latter distance, and all presenting visions of scenery of gorgeous grandeur and marvelous magnificence.

In a recent trip through southern and central Europe we had opportunities of observing much of the passing panorama as seen from some of these scenic railways, and while we hold that the wild wonders of the Grand Canyon of Colorado or the glow and glory of the Yellowstone Park of Wyoming is not matched in Europe, there is a superadded interest in nearly all European scenery in the historical associations that cluster around the localities. This attracts and interests the traveler in a way that leads to indifference to much that is magnificent in our own country, and the European passenger agents are in no way behind their American brethren in descriptive pamphlets that dwell eloquently on the heroic exploits of the warring people that have made all Europe classic land.

STATUE OF ANDREAS HOFER.

In regard to public buildings the traveler sees many magnificent visions of architectural beauty in Europe that rise upon the memory as being almost reconstructed in America. Like the fabled fountain of Arethusa that was said to disappear in the grosser elements of the earth, and rose again in perennial beauty and newness of life beyond the seas, so much of European architecture is rising and will continue to rise in added splendor in America.

The Hall of Fame at Munchen, which we reproduce, will remind many of our readers that the architects of the splendid new railroad depots at Washington and New York must have had their eyes on the exquisitely modelled building at Munchen, which is one of the architectural glories of Germany.

It need hardly be added that glimpses are had of statues of heroic characters whom it is well to remember. Among these we recall a colossal statue of Andreas Hofer, at Innsbruck, in Austro-Hungary. It will be remembered that Hofer commanded a large division of the Tyrolese army in the Napoleonic wars, and repeatedly defeated combined French and Bavarian forces. Hofer became the head of the Tyrolese government, but after the peace of Vienna Hofer was compelled to flee to the mountains. A price was set on his head. He was captured, and by the orders of Napoleon executed on February 20, 1810. In 1834 the marble statue, show in our illustration, was erected over his tomb, and a patent of nobility conferred on his family.

CASCADE OF THE TIVOLI, ITALY.

Great soldiers seem to be the favorites in these glimpses of statuary that pass along on the scenic railways; not the least interesting is one that is claimed to be the only genuine bust of Alexander the Great. It was claimed to have been discovered in a state of excellent preservation in one of the aqueducts at Rome, and verified by eminent authorities at the time of its discovery. It is now an object of much interest to the traveler who happens to pass, and whether it is genuine or not it tends to remind one in recalling the tedious and slow marches of the conquering armies; how months elapsed in passing from city to city, and how the same space can now be passed in a few days, and the thought naturally arises of what little consequence all their battles and alleged triumphs were in comparison with the triumph of mind over matter as seen in the modern locomotive.

We may close with the observation which, though it has often been made before, it remains a surprise to all thinking minds that the methods of transportation remained the same from the most remote period of antiquity until less than a hundred years ago, and when we consider that the principles of steam, electricity, wireless telegraphy, and aerial flight existed in the bosom of nature from the creation of the world, we cannot refrain from wondering why the genius of man, so fertile, active and prescient in other fields, could hold itself in felicitous aloofness from powers which, when at last discovered, so quickly made themselves the friends of civilization and the promoters of its most precious interests. The answer must be that while men were held in slavish subjection to the tyranny of the political and ecclesiastical systems through all the past ages they were not free to act and think for themselves. When, however, through the breaking up of feudalism and the destruction of religious uniformity in the fifteenth century, men were delivered from political and intellectual bondage, they began immediately to initiate measures for the improvement of human society; for the progress of civilization has been consistently guided, not by the enactment of laws, but by their repeal; and mankind was able to make for itself a substantial advance only when the pressure of government was taken off its shoulders. Then came a swift recrudescense of the best things that time had nourished in its cradle, when sculpture, painting and literature again flourished, as in "the grandeur that was Greece, and the glory that was Rome," culminating in Michael Angelo, Leonardo Da Vinci, and Shakespeare, and latterly in that greatest marvel of the ages—the steam engine—and while credit must be given to many master minds who worked towards the discovery and harnessing of the titanic forces of nature, the improvements and inventions of James Watt did more, perhaps, towards the means that developed modern transportation than all other forces combined.

American ingenuity has contributed much to the development of the modern locomotive, and the marked contrast between the comparatively light engines in use in continental Europe, and the colossal locomotives that pass from city to city on the American continent are one of the best proofs of our enterprise.

SUPPOSED BUST OF ALEXANDER THE GREAT.

Statistics of Railways in the United States.

The twenty-third annual statistical report of the Interstate Commerce Commission for the year ending June 30, 1910, has just been issued, and from it we gather the following:

There was a total single-track mileage of 240,438.84 miles in the United States, indicating an increase of 3,604.77 miles over the corresponding mileage at the close of the previous year. An increase in mileage exceeding 100 miles appears for the States of California, Florida, Georgia, Minnesota, Mississippi, Nevada, Oklahoma, Oregon, Texas, Washington and West Virginia, and the Territory of Arizona.

It appears that there were 58,947 locomotives in the service of the carriers, indicating an increase of 1,735 over corresponding returns for the previous year. Of the total number of locomotives, 13,660 were classified as passenger, 34,992 as freight, and 9,115 as switching, and 1,180 were unclassified.

The total number of cars of all classes was 2,290,331, or 72,051 more than on June 30, 1909. This equipment was thus assigned: Passenger service, 47,095 cars; freight service, 2,135,121; and company's service, 108,115. The figures given do not include so-called private cars of commercial firms or corporations.

The total number of persons reported as on the pay rolls of the steam roads of the United States on June 30, 1910, was 1,699,420, or an average of 706 per 100 miles of line. As compared with returns for June 30, 1909, there was an increase of 196,597 in the total number of railway employees. There were 64,691 enginemen, 68,321 firemen, 48,682 conductors, 136,938 other trainmen, and 44,682 switch tenders, crossing tenders and watchmen.

The total number of railway employees (omitting 95,328 not distributed) was apportioned among the six general divisions of employment as follows: To maintenance of way and structures, 504,979; to maintenance of equipment, 329,373; to traffic expenses, 21,652; to transportation expenses, 661,355; to general expenses, 53,385; and to outside operations, 33,348.

The number of passengers carried during the year ending June 30, 1910, was 971,683,199. The corresponding number for the year ending June 30, 1909, was 891,472,425. The increase in the number of passengers carried during the year over 1909 was 80,210,774.

The number of tons of freight shown as carried (including freight received from connections) for the year ending June 30, 1910, was 1,849,900,101, while the corresponding figure for the previous year was 1,556,559,741, the increase being 293,340,360 tons.

The average receipts per passenger per mile, as computed for the year ending June 30, 1910, were 1.938 cents; the average receipts per ton per mile, 0.753 cent. The passenger service train revenue per train-mile was $1.30.396; the freight revenue per train-mile was $2.86.218. The average operating revenues per train-mile were $2.24.628. The average operating expenses per train-mile were $1.48.865. The ratio of operating expenses to operating revenues was 66.29 per cent. The operating revenues of the railways in the United States (average mileage operated, 236,986.51 miles) were $2,750,667,435; their operating expenses were $1,822,630,433. The corresponding returns for 1909 (average mileage operated, 232,981.11 miles) were: Operating revenues, $2,418,677,538; operating expenses, $1,599,443,410. In connection with a summary for the report, it appears that the aggregate amount of dividends declared includes about $112,000,000, and the aggregate amount of interest accrued, about $28,000,000, payable by various companies to other steam railway companies reporting holdings of their securities.

BRIDGE NEAR GEORGETOWN, COL.

Boilers That Don't Leak.

One of the most reliable experts on boiler construction we have ever met is Mr. William H. Wood, of Media, Pa. Recent notes on boiler construction made by Mr. Wood reads: "The working of three boilers under daily inspection for three years, verifies our statements, for staybolt breakage is nil. They have never had a leaky mud ring, nor flue failure on the road, and there has never been a leakage of flues on the road. The only leakage of flues or crown stays is from dumping pit to roundhouse, and when the fires are lit again, the leakage disappears. If more care could be used in the dumping they would scarcely leak then. I ask you, what more can be done?

"If flues were welded in the regular boxes, the stresses would have to be dealt with in another form, and there is no way of binding the stresses up.

"What I have done is to give them every chance to liberate themselves, and unless this is done, I cannot see anything to remedy the troubles in loco boilers.

"You no doubt have heard of the breaking staybolt zone question during the last 25 years. This zone is entirely eliminated in my boilers.

Boiler Explosions in Great Britain.

It is a fact worth noting, that of the boiler explosions which occurred within the United Kingdom during the twelve months ending June 30, the number reported upon being 103, only 43 of them resulted in a loss of life, or personal injury, 14 being killed and 62 injured.

From a further inspection of the returns, it appears that twenty-six explosions were due to general deterioration or corrosion of the plates, thirty-two occurred through defective design or from undue working pressure—the largest source of trouble, sixteen are classed under defective workmanship, material, or construction, while failures from water-hammer action were five, with sixteen classed as miscellaneous, eight of these being attributed to the ignorance or neglect of the attendants.

It will be noted that in this report, which emanates from the British Board of Trade, out of over one hundred boiler explosions, only eight of these are attributed to the carelessness or ignorance of the attendants. The readiness to ascribe all boiler explosions to low water in the boiler does not seem to impress itself so readily on the British authorities as it does on some of our officials in America.

Metal Welding in Germany.

There are many systems of metal-welding apparatus made and used in Germany.

The use of welding apparatus has very materially increased in recent times. The quite general replacing of the older hydrogen by the acetylene apparatus makes the process not only cheaper, but also more generally applicable.

In the case of the latter system, the acetylene gas is generated directly from calcium carbide by the apparatus itself. The cost of acetylene gas thus produced is about the same as the market price for hydrogen gas, but only about one-fifth as much acetylene gas is required for a given piece of welding. Furthermore, the considerably higher temperature attained with acetylene gas makes possible the welding of metals of greater thickness. The temperature limit for hydrogen is 1,900° C. (3,452° F.) and of acteylene it is 3,500° C. (6,332° F.). The metal thickness that may be welded by the two systems are one-third and one and one-fifth inches respectively.

One authority estimates that welding apparatus is used in upward of 12,000 plants in Germany. There is an association called the Verband fur Autogene Metallbearbeitung at Stuttgart. Courses in the manipulation of welding apparatus have been given by German instructors, and the number of apprentices engaging in the new industry are increasing with a degree of rapidity unapproached by any other mechanical occupation.

General Correspondence

Firing at Stations.

Editor:

In February number, page 67, Question 50, Catechism of Railroad Operation:

In making station stops, should a fresh fire be put in at the time steam is shut off, or at starting.

Answer.—At the time of shutting of steam.

Now, as nobody has found any fault with the answer it may be O. K. But I cannot see it that way, and I think the smoke man would be after you if you didn't watch out.

Some might say, use blower. Well, you might do away with the smoke if you used blower good and hard. But with the gas, cinders, pops and blower, and the passengers trying to make conductors and brakemen hear, I do not know but a little smoke would be just as well. I should say there is a much better way. Take the next question, 51:

Why is that the preferable practice?

The answer is all right, but the fire could be put in shape at the stop much better and with less noise, less smoke and less dirt, and still firemen could be looking out and ring bell and be resting at the same time, leaving fire door ajar until engine was hooked up, when a fire would be put in. Steam gauge would show her to be near pop, and engineer would put water to work. Work this way a few stations and see how nice it goes.

The smoke question is a big one if you know nothing about it. But if handled right, I believe it can be cut down so it will give very little trouble. But you have got to know a little more than just to shovel, rake and blow.

J. W. Tighe.

Nashua, N. H.

Testing Slide Valves.

Editor:

In response to your invitation in the May issue of the Railway and Locomotive Engineering relating to the above subject, permit me to offer you for publication a method for testing defects in the balance contrivance of the Allen Richardson slide valve. To begin with, each valve must be tested independently and to accomplish this it is necessary to set the locomotive with one side on the dead center (either forward or backward). For example, we shall say the right side has been set with cranks on center. That being so, the right slide valve will practically have no travel over the port face while the engine remains stationary and the reversing screw is worked from full forward to backward gear. The next action to pursue is to secure the engine against any movement by putting all brakes hard on and chocking wheels if necessary, close the release cocks, then slightly open the regulator valve and work the reversing screw from full forward to backward gear. While the right valve is remaining stationary the left slide valve will travel practically the full length of its stroke. It is therefore obvious, seeing that the valve is balanced to about 75 per cent., if there is any defect in the ring or strips it will easily be detected by the energy required to work the reversing screw. The left side being thus tested, it remains then to set the locomotive with the left side on center and repeat the performance, which will complete the test for the right slide valve. I might state that I have on many occasions, during the past six or seven years, tested locomotives with this type of slide valve for defects in the valve balance, and I have in every instance, where there was a defect, had no difficulty in locating on which side of the locomotive it existed.

In alluding to the reversing screw, no doubt your thousands of American railway men are aware that nearly all of our locomotives in Australia are equipped with an adjustable screw instead of a reversing lever. The screw is slow in action, but always safe. It remains an open question which of the two methods is more preferable.

M. W.

Wellington, N. S. W.

Famous Old Timer.

Editor:

Being an old fireman and interested in anything pertaining to locomotives, especially the old timers, I am enclosing herewith a photo of the famous "Strong" locomotive which created such a sensation about eighteen (18) years ago.

The photo shows this engine standing at the water tank at Hamilton, attached to a through train.

This is the engine with the balanced valves, which was far ahead of her time, in those days.

W. H. Myers.

Hamilton, Ohio,

FAMOUS OLD TIME LOCOMOTIVE, HAMILTON, OHIO.

Superheated Steam.

Editor:

As you ask me pointedly to give the specific reason why superheat gives greater results than saturate steam, I shall endeavor to do so, and will beg leave to deal with the subject in its scientific aspect and would like to give some of my experiences in order to illustrate the matter and so impress it on the minds of the readers in such a manner as to clinch it there.

To start with, what is steam, of what is it formed, and how and why so changed from its original condition?

Steam, then, is a gas formed from water by heat, because each molecule of water takes on heat and changes from a homogeneous mass to a volatile mass. As water, a liquid H_2O or two parts hydrogen to one part oxygen, it is not at all rebellious, each molecule rests in blissful peace with its neighbor, add heat and confine the component H_2O in a tight receptacle, the molecules take on heat and fly from each other, become rebellious, don't want to stay in the same place, and if not confined within the tight vessel they would not, until condensation took place, and they again become water. As these molecules take on greater heat they become more and more rebellious and this same rebelliousness is what we term the expansive energy or force of steam and is manifested on the gauge in pounds pressure per square inch.

Now after we have heated water beyond 212 degs. Fahr., and it becomes an invisible gas having force, we still have that same H_2O, we still have those molecules of which it is composed and they still have the original capacity for taking on heat, and we find that as we increase the temperature we increase the pressure. For example, taking absolute pressure, *i. e.*, above vacuum 145 lbs. per sq. in. contains 355 degs. Fahr. 160 lbs. per sq. in. contains 363 degs. Fahr., 190 lbs. per sq. in. contains 377 degs. Fahr., which shows that the greater degree of temperature the molecules of water take on the more volatile it becomes, which is manifested in greater pounds per sq. in., of pressure, and it is not necessary that you should have a supply of water in a receptacle in order to get this increased pressure. Just keep imparting the heat and keep your rebellious product of water confined and you will increase your pressure, else how would a chemist take one volume of H_2O confine it in his glass test tube and with a spirit lamp raise it to say 150 lbs. per sq. in. and containing 184 volumes. Long ago the visible water was eliminated, but the H_2O molecules were there, and they had just the same affinity for heat and so kept increasing in temperature and adding pressure.

Now steam having been generated by the application of heat has only one way of losing the energy or pressure which it contains, and that is by condensation, which can only be done by in some way reducing its temperature, thus lessening its rebelliousness. Expansion, friction and radiation produce condensation, a tendency to return to the original state, and that is where saturate steam suffers its loss, the greatest being on entrance to the cylinder, where on account of contact with the much cooler surface of cylinder walls and piston head a very perceptible drop in temperature is produced and with it a lessening of pressure.

With a superheater the steam (water) goes through dry pipe and then to the superheater tubes, where it adds to its heat, becomes more and more rebellious, which can produce only one result, *higher pressure.*

I had a case happen me about twenty-one years ago during the time when I was a contributor to the *Firemen's Magazine* over the non de plume of "eccentric strap," which I want to introduce as an illustration. I was running a little 8-wheel, 17 x 24 Baldwin on a division 153 miles long. The first 100 miles 16 loads, other 53 miles 14 loads handled train over all hills until "Poker Tom" was reached, just four miles from terminal and there within a stone's throw of the summit and from that all down hill I stalled. She laid down flat, did not slip down nor fall down in steam. I tried slacking a couple of times, but lost about a car length. I did something then which ordinarily I would not do and in all my twenty-three years as an engineer I have never did it but that one time. I stuck a packing hook in the pop and while the fireman was getting her hot I took scoop and sanded the rails under her and for about a car length ahead, then when he had added enough heat, I whistled off, pulled the throttle and went over "Poker Tom" a-flying. The gauge registered 190 lbs., her regular pressure was 140 lbs. Now methinks I hear John Jones say: "Why that is simple enough, you had 50 lbs. more pressure." Now John always was a precocious kid, always hits the nail on the head, you bet, but John, why did I have more pressure? Because I would not let the safety valve raise, letting out *the heat.* I kept it there in the boiler to make the molecules of water more highly rebellious, as right then I wanted rebellion and lots of it and this is how, at 140 lbs. I had about 361 degs. Fahr., at 190 lbs. I had about 383 degs. Fahr., it was the added heat gave the added pressure or energy. Now suppose I could have put my packing hook some place where it would have imparted that additional heat to the volume of steam after it passed into dry pipe, don't you think it would have done the same? Mr. H. H. Vaughan evidently does not think so, and right there I must take issue with him on his view of the matter, as he thinks there is a loss of pressure due to the pressure required to force the steam through the superheater pipes, while as I stated above I do not believe there can be any loss to steam except through condensation, and as the superheat is just exactly the opposite to condensation there can be no loss from that source but a very material gain.

Now my other illustration. About ten years ago I quit the road, went to a big Portland cement plant in course of construction, made application for position as engineer, but temporarily took job as laborer until the engines would come. Just five days after I went to work the superintendent of construction singled me out of the bunch, told me to go with him, he wanted me to do a job of car unloading, some little articles about 30 ft. long, 11,000 lbs. weight, 5 ft. diameter, and steady employment depended on my success with that job. I put in my time of two years with them as rigger foreman instead of engineer and in that capacity had my other experience. I had to put eleven 24-in. and three 30-in. gate valves in the intake well and three 24-in. pipes from the well to the river through a coffer dam which we had constructed in a channel cut by a dredge boat. Our lower pipe had to go down 18 ft. below the surface of the river and the water came at a terrific rate, so we had a centrifugal pump to expel it. We had to get steam from the pump house boilers about 185 ft. distant. The weather was cold and the condensation of the steam was so great that it did not have *energy* enough to pull the pump at a high enough rate of speed to do us any good. I had the steam pipe lowered, ran it under railroad track and then out along close to the ground. Had a gang of roustabouts carry wood and built fires along the pipe. *I just stuck in my packing hook again.* In fifteen minutes the pump was singing a different tune, the water commenced to lower and even had to go so far as to *throttle* the engine, as she would run so fast the belt would fly off. Now I had still the same length of pipe to force the steam through, nor did it make any difference in the maintained efficiency of the boilers, as they were not taxed to one-tenth of their capacity. I had just made an outdoor superheat by building fires along about seventy-five feet of pipe and added a little heat to the molecules of H_2O as they went along; they entered the steam chest of engine with some vim and energy and produced the same result there in greater efficiency as that recorded by railroads using superheated steam.

Thus I conclude steam *pressure* is due to the temperature which the molecules of water can carry or absorb and as the molecules are still there after being converted into steam, they are still capable of adding heat which can produce only one result, higher pressure, as you know like causes produce like results, is a law of nature and cannot be refuted.

If steam at 190 lbs. absolute, *i. e.*, above vacuum, in a boiler containing water, was the direct result of the absorption of 377.352 degs. Fahr., then if you would boil water to 212 degs. Fahr., let the steam go through zigzag pipes through a furnace, until those molecules had absorbed 377.352 degs. Fahr., you would find your gauge at the other end read the same as that former one, 190 lbs. above vacuum, about 175 gauge, such as we use on locomotive.

I hope I have made my view plain enough, so it can be understood by all. Heat is the energy, which applied to the water makes a rebellious gas, the more heat the greater the degree of rebelliousness or pressure and thus its greater result in work performed.

Further details could be given in regard to this interesting subject, but I have already trespassed too far on your valuable space. A. J. Schmidt.

Shreveport, La.

In Oklahoma.

Editor:

I take pleasure in sending you some illustrations in connection with the shops of the St. Louis & San Francisco Railroad at Sapulpa, Okla. The first one is a view of the yards at Sapulpa. On the right a portion of the roundhouse yard is shown, and on the left are the yard offices. The extensive car sheds are seen in the back of the picture. The second picture shows Engine No. 628, a typical ten-wheel oil burner. This is the type of passenger locomotives running between Sapulpa and Oklahoma City. Their steaming qualities are of the best and the time made will compare favorably with any locomotives of their class.

ST. LOUIS & SAN FRANCISCO YARDS, SAPULPA, OKLA.

The third picture shows a group of mechanics comprising the roundhouse day force at Sapulpa. They are clustered around one of our smaller class of locomotives, No. 2236. In fact this is the smallest locomotive on the South Western Division, and is used on branch line passenger traffic. Our equipment is of the best, and, as you will note, our roundhouse force is a fine body of active, intelligent young men, typical Westerners, with a sprinkling of well-trained Eastern men. JOHN F. LONG,

Master Mechanic, Frisco Shops.

Sapulpa, Okla.

Flange Cutting.

Editor:

I have been much interested lately in the cure for flange cutting, and the various articles on this subject which appear from time to time.

We all know that the curvature of the road largely governs the percentage of wear on flanges, and therefore a comparative statement as to best methods of eliminiation or lessening of this trouble is not a criterion upon which to base an opinion.

I notice that a committee of competent men reports that there are upwards of a dozen different forms of lubricants, and I was much interested in their deductions made from exhaustive data they had gathered.

Allowing that we find a perfect lubricant for this service, then comes the trouble of confining the lubricant to the flange, and not spread it all over the wheel.

I noticed in one of your recent issues an advertisement of the Collins Flange Wheel Lubricator, and I assume that the lubricant used must be composed largely of graphite.

It would seem to me that a device of this kind, if properly adjusted, should prove a solution of the trouble, especially if the stick was hard enough.

I notice quite a decided tendency toward the use of crude oil, but this has its disadvantages.

Why not make a stick lubricant of crude oil, graphite and asbestos? Perhaps this is the composition employed in the Collins lubricator, but if not, their stick seems to be along the right lines.

NOAH AINT.

Speed Detecting Watch.

Editor:

For some years there was much talk among certain train speed experts about making 100 miles an hour. I have noted speed very carefully, but never was able to record a speed of 100 miles an hour. Perhaps that was because I habitually carry a stop watch that cannot lie. I call it George Washington. O. M.

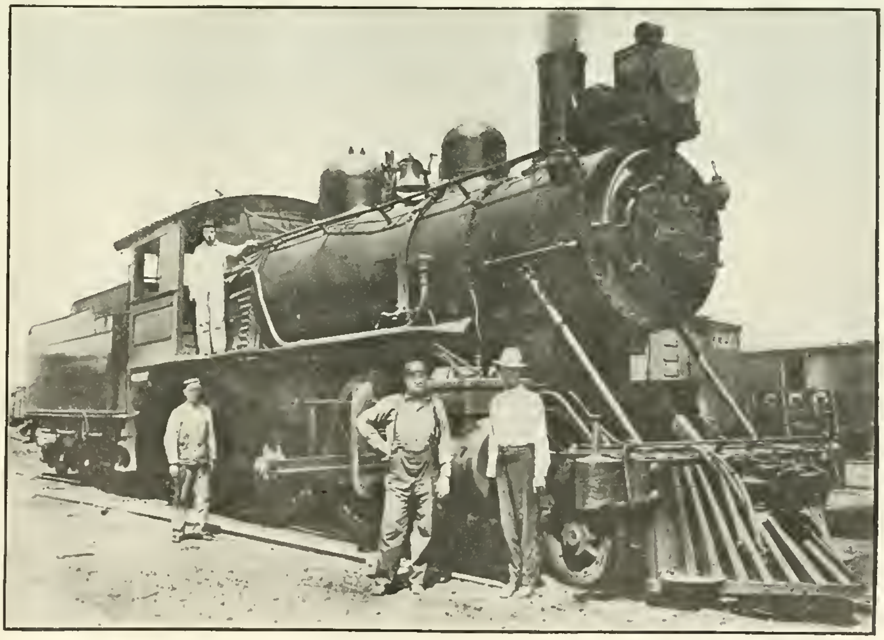
Wear of Emery Wheels.

Editor:

Regarding the article in your July issue, entitled, "Grinding Reamers," I would like to say a few words in regard to same.

First, there would be no glazing of the wheel in grinding reamers (or in any other grinding operation) if a wheel of the correct grade of hardness, and, to a lesser extent, the correct grain of coarseness was used. The glazing of which you complain, indicates that the wheel used was too hard, therefore, the abrasive grains could not break off when dulled. If the correct grade was used, each individual grain would break off when dulled, thus presenting fresh cutting points.

It is a hard task to convince the average wheel user that simply because a wheel is long-lived does not necessarily prove that it is most efficient. A wheel lasting only one-half as long as another wheel is more efficient than the longer-lived wheel if it does three times as much work. This is by no means an unusual occurrence. The softer a wheel is, the more free-cutting it is.



ENGINE NO. 628. ST. LOUIS & SAN FRANCISCO.

Whenever possible, grinding should be done with the use of water. The greatest advantage of wet grinding is that the water helps to carry off the heat generated at the point of contact. Water also improves the finish.

In conclusion, therefore, if a wheel of the correct grain and grade for the operation is used, there would be no necessity for using the remedy for glazing which you give.

James O. Smith,
Sales Manager,
American Emery Wheel Works.
Providence, Rhode Island.

Lining Guides.

Editor:

Different machinists have different methods of hanging guides, but there is a correct method which is simple and leaves the guides in the shape to keep the crosshead moving in a direct line with the piston. Here is the whole performance.

To begin with, have your guides straight.

Next, have the piston turned and fitted to crosshead keyed firmly to place. Then put the piston and crosshead on planer; clamp the piston-rod in V-block which is fitted to slots of planer. This makes sure that every cut taken on the crosshead is in line with the piston-rod. Then plane up the crosshead. Have the gland ready to slip on the piston-rod. This gland should fit exactly the stuffing-box in back cylinder head. Now, everything is ready for the guide hanging.

The next operation is to put the piston into the cylinder, pushing it back until the head is in the middle of the cylinder. Now, slip the gland into its place. Then if the spider does not fit the cylinder accurately, line to center of cylinder by strips of tin or thin wedges. Next, key on the crosshead and level it. Then clamp the guides to the crosshead, using a liner of heavy paper between the wearing parts of guide and crosshead. A little reflection will prove to you that the guides are now in their proper place, and the process of fastening them in this position comes next.

It is a good plan to have guide blocks that are considerably thinner than the crosshead. Put them in place and put liners on top and bottom of the guide blocks to fill up whatever space may be left. Now clamp both ends of the guides firmly to these blocks, ream out for bolts and put bolts in place. After that has been done, loosen all the bolts and take out the paper liners used between crosshead and guides, then tighten up the bolts. If you find that the guides have been sprung up or down, relieve them by paper until piston and crosshead move freely.

A. Macleay.
Philadelphia, July 10, 1911.

Kruger Book.

Editor:

I once had a book called "Kruger." I do not know if this is the exact way it is spelled or not, but anyway, it is a car man's book, the most complete in every detail I ever saw, and is what every car man needs.

Some one thought so much of it that it stuck to their fingers and I am left without any and need it badly. I have never been able to get hold of another one or get the address of the publishers to order another one. If you handle this book or can possibly tell me the address of the company that does, I shall certainly appreciate it greatly.

Thanking you in advance for the above information, I beg to hear from you in the near future, I am,

G. W. Lee,
Gen. Foreman Car Dept.
De Quincy, La.

[We have searched in vain for the publisher of this book. If any of our readers will give us information about it, we shall be under obligations.—Ed.]

The McKeen Motor Car.

By C. Hughes.

There are many things about this car which at first observation look quite complicated, still to the locomotive man I may say, "Apply the locomotive theory," and so far as the motor is concerned, it will supply a simple and effective starting point. The internal combustion engine is here to stay, so master it. It is a pleasant study, as well as useful. I disagree with the old adage that a man can "know too much."

Beginning the McKeen car has a reversible motor, double set of valves, intake valves serving purpose of steam edge of valve of locomotive, and exhaust valves serving same purpose as exhaust edge, either D or piston valve type. Valves are operated by cams similar to locomotive valve motion and obtained from crank shaft, though only in the different manner of driving valve gear, this being done by gear or sprocket wheels, which is an advantage as it is so accurate as to need attention except on very rare occasions, when valves can be set by tramming engine and then by an ingenious worm gear arrangement on cam shaft gear wheels, setting valves for one engine or cylinder sets valves for six cylinders for entire motor. Valve opening is regulated by threaded valve stem, with regulating nuts on stem and each

ROUNDHOUSE FORCE, ST. LOUIS & SAN FRANCISCO SHOPS, SAPULPA, OKLA.

valve is regulated separately. Valves are four inches diameter with false seat, which with removable cage make all these parts interchangeable and valves are easily removed. Can then chuck valve in small lathe and holding false seat in place by hand are quickly ground, this being one of the requisites of good gas engine performance, that is, tight valves. Reversible feature is obtained by simply using double cams, similar to go ahead and back up eccentric cams on locomotive and put in operation by sliding cam shaft, moving either go ahead or back up cam into position to operate valve.

Motor has air starting device operated by same cam shaft movements for both directions engine turns, placing an air starting valve in operation by moving air starting cams on cam shaft to starting position. In case of brake failure reversible operation provides a safety feature same as reversing locomotive.

Next comes method of "timing" or "firing" of charge of gas. This is also on intake cam shaft, and most important part of gas engine operation and probably least understood. The spark must be transmitted to each cylinder at proper moment or no results can be obtained and I may say that this can only be learned by practice and the engineer's instinct of when to "hook her up" or "drop her one," practically speaking the advance or retard of the spark controls the speed, the throttle the power. By advancing or retarding the spark means the time of explosion of the gas in cylinder and is regulated mechanically to be handled in the advance limit of from 24 degs. before crank reaches center, to retard of 24 degs. after passing center. Both storage battery and magneto systems are used, each being entirely independent of the other.

Motor is lubricated by McCord force feed lubricators, one to cylinders, another to all bearings on crank shaft, thus different grades or kinds of oil are used, leaving nothing to be desired in this matter.

Motor is four cycle marine or vertical type, built on front truck, setting crosswise of truck and extending up through hole in car floor, car body sits on trucks similar to any other car. Six cylinders 10 in. bore by 12 in. stroke cylinders cast in two sets, three cylinders each. Cylinder head all detachable and interchangeable with each set, that is Nos. 1, 2, 3 interchangeable with each other, and Nos. 4, 5 and 6 with each other. Cylinders and heads are water jacketed, and by means of circulating pump driven from crank shaft are cooled as water is circulated alternately through outside, coils and engine jacket water also heats entire car as necessary.

Pistons are coupled to cranks in pairs, thus cranks setting at 120 degs. to each other and cylinders firing one at a time a power stroke is always obtained. Crank shaft is solid with sprocket wheel in center from which a 5 in. Morse silent chain runs to transmission which is all hung on front axle this being the only driving axle. Transmission is, briefly speaking, a sleeve on a sleeve on the axle. Chain runs on sprocket wheel on axle, this wheel being outside sleeve, and to this wheel is fastened sprocket plate and friction ring which encloses other part of friction clutch, the hub plate which comes in contact on inside with friction ring, which revolves between hub plate and toggle plate which is on outside of friction ring. This completes friction clutch and power is transmitted to start car by air cylinder with leverage drawing hub plate on inside and toggle plate on outside against friction ring which is revolving by engine running while car is standing, then to continue, hub plate is secured to inside sleeve on axle which continues on axle to right side of center of truck and there this sleeve has smaller sprocket wheel which meshes with sprocket on a back shaft, which again has sprocket on other end to mesh again with still another small and independent sprocket sleeve on axle. All these sprockets having proper ratio, give a high and low speed, by means of a sliding clutch, which slides on a hexagon on axle between hub plate sleeve near center of truck and independent sleeve just inside of right drive wheel, holding solid in each sleeve as desired in high or low speed. This sliding clutch also operates with air cylinder. You will note that no part is solid on axle except drive wheels, yet in high speed with friction clutch thrown in, transmission is locked solid and direct drive is obtained. Driving boxes and journals are outside of wheels. Small air pump is driven direct from crank shaft, three large air storage reservoirs are used, air raises gasoline from large storage tank which holds 120 gallons and located in safe place under car to small tank in engine room from which is gravity feed to carburetor, this also being a McKeen patent and used only on these motors. This carburetor is very simple and effective, easily adjusted and controlled and water jacketed.

Car is also equipped with independent gasoline driven air compressor which has the unique feature of being gasoline engine and air compressor with only one cylinder, one end for air, other for power. This is also a four-cycle engine.

A particularly fine feature is the unlimited adjustability of speeds that embrace a range equal to the steam locomotive, and seems to surpass the ordinary automobile in the fact that it is completely free from the sudden jars that mark the change of speeds on the motor cars used on common highways.

First Agreement With Engineers.

The locomotive engineer has always held an honored position on American railroads, and the companies have generally been inclined to treat him fairly. As far as we can find out the locomotive engineers of the South Carolina Railroad were the first employees of any kind to enter into a mutual agreement with their employers as to terms of employment.

The South Carolina Railroad was really the first railroad put into regular operation in America, the locomotive "Best Friend" having been put to work in November, 1830. This company had the first one hundred miles of continuous track in the world, and was, in 1838, the largest railroad in the world.

In the front of the time book for engineers and foremen for 1835, which is still preserved, is to be found a copy of the agreement above referred to. It reads:

Pay of engineers:

While in Charleston, $2.00 per day.
Passengers laying over at this place on Sunday, $2.00 do.
With freight, $9.00 for trip of 3 days.
With passengers, $5.50 for trip of 2 days.

"If detained at Aiken for repairs, $2 per day. If the engineer returns without completing the trip nothing will be allowed for the time absent unless the trip be lost in consequence of breakage of the road or exchange of trains, or from other case than the failure of the engine. When thus detained on the road $2 per day for the time exceeding the proper time of the trip. Engineers running for wood or timber will be allowed $2 per day."

For Good Roads.

If a bill introduced in the Senate last month by Senator Cullom of Illinois is enacted into law the national capital will become the centre of a wheel of seven great national highways passing through practically every State in the Union.

If this bill ever becomes law it will have the tendency to equalize the business of railroads for good roads, and will enable shippers to convey their produce to railroad at all times when most convenient instead of waiting until the condition of the roads permit the movement of wagons.

It is estimated that the cost of the proposed highways would not exceed $148,000,000. It is proposed that the money be raised by the issuance of bonds. After the roads have been built it is proposed to pay their cost of maintenance by the collection of tolls.

Uniform politeness is a kind of godliness; it may not make a saint of a man, but it makes a lovely sinner.

General Foremen's Department

General Foremen's Convention.

The International Railway General Foremen's Association met in the Seventh Annual Convention at Chicago, July 25. There was the largest attendance ever present at conventions of this organization, and the discussions of reports were very active and well sustained.

PRESIDENT VOGES ADDRESS.

President Voges occupied the chair. In his opening address he congratulated the members on the prosperous condition. The principal parts of President Voges' address read:

Many men have been a great expense to their employer on account of lacking the technical knowledge of such topics as are discussed at our annual conventions. These men have to spend time and money in experimenting to gain such technical knowledge as is exchanged at our conventions by men whose knowledge has been proven by the results they have produced. I feel more than ever that our work is in front of us, and not back of us; we must give this work our keenest attention without hesitation or delay. Opportunity knocks once at every door; it is knocking at our door now, and it is up to every member of this organization to honor this opportunity. How can you honor this opportunity? You can honor it by pledging yourself to attend our next convention and bring with you at least one new member. Simply make up your mind you must do it, then you will be successful in your attempt.

Now, gentlemen, we have all come here for one purpose, and that is to attend this convention and get all the good out of it we can. I sincerely hope that everyone of you will take an active part. If you do not understand some of the technical subjects that will be discussed, ask questions, that's the only way to find out. That's what we are here for, to learn and find out how we can do better work for our companies. The more a man knows and accomplishes, the more pleased will his employer be to raise his salary. We all want more money, don't we? Well, now let us see if we can't do something big, something that will make our superiors sit up and take notice. You can't run a street car unless you have a live wire—neither can we expect a larger salary and better position unless we show our employers that we are "live wires" and "know something." "He who follows two hares catches neither." So let us not try to only get part of the benefits of this convention, but let us get all of it, let us only follow one hare instead of two. Understand, if you follow two hares you won't catch any game. "There may be a wrong way to do right, but there is no right way to do wrong." Let us find out if we are doing right the wrong way.

In thirty-six years Noah Webster wrote but one book. But that will be remembered. Let us try to do something at this convention for the good of our association and the companies we represent, something that will be remembered. Gentlemen, remember that difficulties are only made to overcome. If we all concentrate our minds on this convention and take an active part whenever possible, I know our achievements will surpass our expectations.

BANQUET TO GENERAL FOREMEN'S ASSOCIATION.

ADDRESSES.

During the convention addresses were delivered on Tuesday by J. F. De Voy, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul; on Wednesday by H. S. Bentley, assistant superintendent motive power, Chicago, Northwestern, replied to by Mr. R. V. Wright of the *Railway Age Gazette;* Thursday by Angus Sinclair, *Railway & Locomotive Engineering.* We expect to publish the salient parts of these addresses in future issues, as space permits.

SECRETARY-TREASURER'S REPORT.

Secretary-Treasurer Bryan's annual report showed that as secretary he had performed excellent work in drawing in new members and in collecting the funds necessary for carrying on business. Friends of this association are commending the excellent work performed by Secretary Bryan, who seems to have done more than any other man to keep the organization alive.

NEW OFFICERS.

On the second day of the convention the officers for the ensuing year were elected as follows:

President, F. C. Pickard, master mechanic, C. H. & D., Indianapolis, Ind.; first vice-president, J. A. Boyden, general foreman, Erie, Hornell, N. Y.; second vice-president, T. F. Griffin, Big Four, Indianapolis, Ind.; third vice-president, Walter Smith, C. & N. W. Ry., Fremont, Neb.; fourth vice-president, L. A. North, Illinois Central, Chicago; secretary-treasurer, L. H. Bryan, D. & I. R. Ry., Two Harbors, Minn.; new members of the executive committee, W. W. Scott, C. H. & D., Indianapolis, and W. G. Reyer, N. C. & St. L., Nashville, Tenn.

J. A. BOYDEN,
Vice-President, General Foremen's Association.

J. C. Manlove, of the H. W. Johns-Manville Company, Chicago, was chosen president of the Supply Men's Association, and H. J. Neeley, of the Jenkins Bros., Chicago, was chosen secretary. Chicago was recommended as the next meeting place.

The Executive Committee of the International Railway General Foremens' Association has elected as secretary William Hall, 322 Wills avenue, Escanaba, Mich. All communications concerning Executive Committee business should be addressed to Mr. Hall.

BEST METHOD TO PROMOTE SHOP EFFICIENCY.

A paper under this heading was read by Mr. C. F. Pickard. It is an extraordinary production and furnishes food for thought and discussion nearly unlimited.

F. C. PICKARD,
President, General Foremen's Association.

There are eleven questions for answers under the Plan of Organization.

"Methods of Supervision" has seven questions.

"Handling of Material" is ventilated under six heads.

"Shop Kinks and Methods" were to be expounded by twenty questions.

Mr. Pickard in opening the discussion on the first question: What plan of organization do you find most effective? said that to begin with details of a complete organization must be arranged. He believed that the members should tell about the organization they find most effective. The tin shop man was doing more for his dollar. These details were well worthy of the general foreman's attention.

Mr. William G. Reyer, N. C. & St. L., told that within the last year he had traveled extensively, visiting railroad shops, and had profited greatly from what he saw. Before the trip they were repairing eight or nine engines a month. On returning he changed the plan of organization, and in the month of June handled thirty engines of which fifteen were overhauled. The rest were light repairs. This improvement was effected without any increase in the force. The management had permitted him to employ an assistant foreman. The increase of results was due to specializing the work of keeping the men employed on the operations for which they were best fitted.

Mr. L. O. North, Illinois Central, said: "Our policy as nearly as I can explain it is a co-operative one with the men and the foremen. The general foreman of the locomotive department reports directly to the shop superintendent. The general foreman of the transportation department reports directly to the master mechanic. Under the supervision of the general foreman of the locomotive department is the machine side foreman and erecting foreman with seventeen gang foremen. The blacksmith shop has a foreman and two assistant foremen. The tin shop has a foreman and three assistant foremen. The boiler shop has a foreman and six assistant foremen. This works very satisfactorily, and there is no discord of any kind between any of the foremen or of the men employed. This is best illustrated by the action taken by the different foremen who assist each other in different ways. If one foreman notices something out of the ordinary that would be apt to cause a delay to the work of the other foreman, he takes it upon himself to consult with this foreman so as to assist him as much as possible, realizing that this is for the common good of all.

The transportation department, which controls the engine house, co-operates with the back shop, and if there is any work in the back shop which this organization is in need of, the general foreman consults with the back shop general foreman. By so doing we get very satisfactory results. The work performed by the engine house consists of light repairs and running repairs with a few general repairs in between. The special work on these engines, except for the actual erection, is done in the machine shop. This works very much more satisfactorily than it would to have each individual work on the en-

T. F. GRIFFIN,
Vice-President, General Foremen's Association.

gine in question and repair all of the special work, such as the steam chests, rocker boxes, links, cab work and other parts.

We have made satisfactory and thorough tests of specializing works as much as possible, and have installed this system wherever practical. We have a rule that when a specialist has been on a job six months and desires a change to become familiar with other work, it is granted to him. This will mean, in time, as the men have been shifted from one position to another, that they will practically become experts on any part of the locomotive. We will have men that we can place on any job and who will give us the best possible results.

Another system which gives good results is a weekly sheet or schedule which is compiled on a certain day once each week in the general foreman's office by the general foreman, boiler foreman, erecting side foreman and machine side foreman. It shows the pit number, engine number, date in shop, date boiler to machine shop in case of firebox work, date boiler ready for pressure, date wheels and boxes ready, date engine on wheels, dates valves set and engine on trial. By using a schedule of this kind we obtain satisfactory results in a great many ways. Each department thoroughly

L. A. NORTH,
Vice-President, General Foremen's Association.

understands when its work on the locomotive must be ready for the erecting side. Formerly confusion resulted from the number of engines in the shop and the number of pieces at the different machines, the foremen not knowing which pieces to finish first. With this schedule these foremen know which piece to have ready first, and there is no chance for an argument between the different departments as to who shall have the preference in the completion of the particular work, either in the bench gang or on the machine side.

We have twenty-five pits at the Burnside shops; one is used for stripping the engines for the boiler shop. We have four machinists and four helpers in the stripping gang, with one foreman in charge, who has additional duties assigned to him from time to

L. H. BRYAN,
Secretary-Treasurer, General Foremen's Association.

time. This gang strips two engines complete for the boiler shop each week. They also handle odd jobs from time to time, as we find it necessary to use them on other pits to strip other engines than the ones assigned to the regular stripping pit. This is brought about by the pit men following the engine they have overhauled to the roundhouse to complete it, and also to do necessary work after the trial trip. As the pits are kept filled with locomotives, this would leave the pit practically unprotected. By using the stripping gang for this purpose the work is taken down and distributed much more promptly than could be done in any other manner. As the work is stripped it is placed in a pile at the rear end of the pit; it is then taken by a gang of laborers to the lye vat, and thoroughly cleansed and distributed to the different departments which handle each class of work.

Mr. J. H. Ogden, Santa Fe.: The best form of organization depends entirely on conditions. There are too many men who have not confidence in the foremen under them. They will go to a man doing a certain class of work and say, "Don't do it that way." Do not interfere with your foremen. If they are not competent, get others. I want a man competent to take my place if I should be gone for three or four days. Have confidence in your men and appreciate the work they do for you. There are too many of our foremen who do not appreciate the men's work. Let us try and measure out a little of the milk of human kindness. That is necessary in a shop. We cannot succeed without the men behind us.

F. C. Pickard: The first thing to take into consideration is the local conditions and the environment. An organization is similar to a large gear wheel. The general foreman is the axis upon which it swings. If there is one irregular tooth in the gear the organization is not going to move smoothly. If there are two, it is a whole lot worse. If three are out and you do not have somebody to fill in, you are gone. You must have a man to bring in in the absence of the unit. As a general plan, dependent on the number of men employed, a good organization would be to have a general foreman who would have entire supervision over the shop. I do not believe one gang foreman should have over six pits. The machine foremen should be based upon the same methods of output. In turn each one of these men should have their forces so organized that in case they must be absent, right-hand men are available to take their places.

T. F. Griffin, Big Four: Referring to the engine house. The boiler foreman

W. SMITH,
Vice-President, General Foremen's Association.

should have charge of the boiler makers for the washing out, staybolt testing and hydrostatic tests required by the government. He should have a complete record, and if called upon by the claim agent should be able to give the exact state of any engine on a certain date. Have inspectors, both for engines and for air. Our engineers nowadays depend only on the inspector, and if we have a poor inspector we will have failures, and a failure nowadays is a disgrace. To overcome the failures we should have good inspectors and have the machinists manifest enough interest to see any defects and report them. We should have good hostlers, who will get the engines in the engine house as soon as possible. After the engine is in the house, the inspector reports to the roundhouse foremen and they distribute the work to the men. Any failures after the engine leaves the shop and goes out on the road are referred to the inspector.

T. H. Ogden: We make the hostler or roundhouse clerk an assistant to the round house foreman. He takes care of the blackboard in marking up the engines and starts them going; the roundhouse foreman tells him when he can have an engine and when he cannot.

W. W. Scott, C. H & D.: The success of your work depends upon how you are organized. The general foreman must possess a knowledge of roundhouse work, the despatching of engines, and some knowledge in a general way of all classes of repairs, so that he can pass on work from time to time. The responsibility of the shop rests on the general foreman. If there is any criticism, he is the man who has got to stand it. In our shop we have a general foreman and sub-foreman over all departments. Harmony ought

W. W. SCOTT,
Member Executive Committee, General Foremen's Association.

to prevail. When you have men who cannot get along with one another, it is time to make a change.

William Hall, C. & N. W.: The form of shop organization usually depands upon the size of the shop. If the shop warrants it there should be a general foreman, who should have supervision over every other foreman on the ground. He should have under him the machine shop foreman and the erecting foreman; they in turn will have their assistants, such as gang bosses. The roundhouse foreman, if the house is large enough, will want an assistant in order to enable him to conduct his business properly. The great difficulty comes from lack of supervision.

W. W. Scott: I believe in building up the shop organization from the men

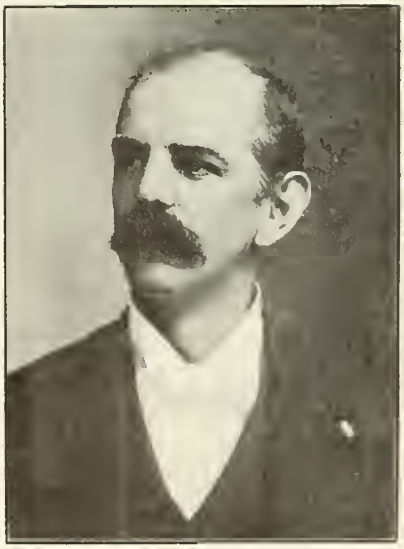
WM. HALL,
Secretary Executive Committee, General Foremen's Association.

in the ranks. I find this to be very effective in keeping up the "hope eternal" for better things which burns in the breasts of most men. Successful organization is kept alive by the relation which should exist between officers and subordinates. Do not erect any insurmountable barrier between yourself as general foreman and your men. You can command respect and still be tolerant to the point of good nature if you try. I do not place much confidence in the general foreman who struts around wrapped in the mantle of assumed dignity, and is a passing joke with the men on the job. I like to know my men personally and make it a point to be interested in my men's personal welfare, and I want to say it is an honest interest.

I believe in frequent meetings of the staff officers with the master mechanic as presiding officer. Many little kinks are straightened out at these meetings and much good has resulted on our road from it. I heartily recommend a card system in the general foreman's office covering data on locomotive repairs; this data being furnished by the roundhouse foreman, road foreman of engines, or from any other source possible. This gives advance information on actual conditions.

I also recommend and use a system of keeping in touch with repair parts. A card is put in circulation when an engines arrives in the shop. Inspection is made by the erecting foreman, who fills in the repairs needed and the time when the parts are turned over to the machine foreman. The erecting foreman retains the original and the machine foreman is given copy of the report. When the several classes of repairs are made the foreman checks off from the list until the work is completed. You can readily see how a foreman can keep in touch with his work by consulting his repair sheet and the erecting foreman and checking up daily without walking all over the shop to note the progress of the work.

W. Smith, C. & N. W.: Some one has spoken of the lack of supervision in most organizations; that is a point that it would do well to bring out, especially in the large roundhouses. Where there are forty or fifty stalls the roundhouse foreman is often expected to look after all the work. He is so busy he cannot gain the most efficient results. Some master mechanics seem to be averse to increasing supervision; they think it is non-productive. I think it is a mistake. The organizations in the roundhouses of the Lake Shore and Pennsylvania are ideal in this respect. They have a passenger foreman, freight foreman and boiler foreman—with the roundhouse foreman over all. The organizations is ideal. Where the roundhouse foreman has



W. G. REYER,
Member Executive Committee, General Foremen's Association.

everything to carry in his head he cannot give the most efficient results; he may overlook certain important work, with the result that engines go out and make failures. When the passenger foreman is in charge of such engines and is responsible for them, he can see that the work is properly done and can plan ahead.

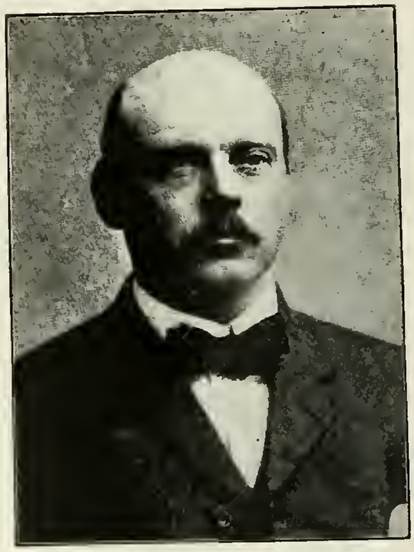
J. A. Boyden, Erie: In our engine

house we have working leaders who report direct to the roundhouse foreman. We have a leader over the passenger department and one over the freight department; the report to the roundhouse foreman, and he to me. We also have engine despatchers; the roundhouse foreman has nothing to do with the despatching of engines. In the back shop we have an assistant to the general foreman, who handles all piece work. We have a system whereby each gang foreman, when he finishes his part of the work, sends a note to the general foreman's office, *i. e.*, "rocker box complete." It is thus easy to follow up all the separate parts of a locomotive.

W. C. Sears, C. H. & D.: A general foreman should have an organization such that each foreman knows just exactly how far he should go and where the line is drawn between his department and the other departments. This facilitates the work in the shop considerably and eliminates work going out of the shop not up to standard, due to one man looking to another to take care of it.

J. Schlageter, Toledo Ter.: We have only a little handful of business, but it includes everything. The foreman of the different departments attend weekly meetings in the general foreman's office and discuss various subjects. We find out a lot of things the general foreman would otherwise never find out. It is surprising how much good comes out in this way. The general foreman issues a shop list weekly, showing what should be accomplished by the following Saturday. It is typewritten and sent to each department head. Every man in the shop can see what is expected of him. You will be surprised to see how much it has accomplished. Diplomatic handling of men will certainly accomplish more than the headstrong man who wants every man to be his own way of thinking. He will never be a success. He cannot keep the men nowadays. Our master mechanic or myself can be gone a week, and when we return, are surprised at how much more has been accomplished than we thought could be done. A man must be gentle, but he must be firm. When he says "yes," he must mean "yes."

U. T. Gale, C. & N. W.: We have an organization of our foremen that meets once a week. Each one submits any shop propositions that he thinks worthy of consideration. We have a stenographer who takes notes of the proceedings, and a chairman, who, as a general rule, is the general foreman; he leads the meeting and directs the discussion on the various subjects. We find just where the weak points are as far as the work on hand is concerned. We come in touch with each other in that way and gain a closer understanding of the possibilities of what can be done. By these weekly meetings we perfect our organization in its details. We bring matters right before the various leaders of the different departments. They have a complete and proper understanding of the matter before it is passed along to the gang foremen, and then the gang foremen pass it along to the men. They have a regular programme or schedule arranged. This schedule is detailed among the individuals who are interested—I mean the workmen. We have leaders of the different groups of men and give to each one an understanding of the programme for the coming week.



E. F. FAY,
Member Executive Committee, General Foremen's Association.

T. J. FINERTY,
Member Executive Committee, General Foremen's Association.

W. W. Scott: Sometimes a foreman in his zeal to get out a certain class of work will criticize the tardiness of the other foremen. The pit foreman will find fault with the machine foreman for not getting out work; the machine foreman will put it on the blacksmith foreman, and he on the storekeeper, and so on down the line. If that condition is allowed to exist you are going to suffer. I find the best way is to put a systematic check upon the work. When an engine arrives over the pit we show on it the date of arrival and afterwards the time it gets out. The several foremen meet in consultation once a week and the storekeeper is also called in. We find out what has to be done—push the work.

(To be continued.)

The Man Behind the Shop.

The General Foreman is "It." He is supposed to run the shop—not let the shop run—but run it. He must please the officials at headquarters, keep up his production, keep down his expense and labor account, keep his men good natured, settle shop scraps, keep up the power, keep down the failures and above all keep his temper.

If things go wrong on the line, we all know who "hears of it." If there is any matter which really belongs to nobody in particular to settle, it usually finds its way to the General Foreman. It's another case of "Let George do it."

It is a positive certainty that when you see a General Foreman you behold a man who is an inventor, a draughtsman, a foundryman, a mechanic and withal a diplomat.

Out of Harmony.

While the discussion on best form of organization was going on at the General Foremen's Convention, Mr. T. H. Ogden, of the Santa Fe, made a strong plea for the subordinate foremen. "There are too many men," he said, "who have not confidence in the foremen under them." There is an eloquent sermon in these few words, for they express the cause of no end of heartburnings that maintain discord where harmony ought to prevail. If a general foreman ceases to have confidence in any of his subordinate foremen, the proper course is to change them, otherwise the break in harmony will demoralize the whole shop. When the shop manager ceases to have confidence in any foreman he might as well shout the fact from the traveling crane, for everybody about the place soon comes to know who is in disgrace and act accordingly. Human nature tends to look down upon the person who is no longer in favor, as this seems to be peculiarly the case in a railroad repair shop. There are always plenty of good men to select from in such places, and an element of discord should not be permitted to hold an influential position for one day.

Unparalleled Run on the Lehigh Valley.

The officers of the Lehigh Valley Railroad have been devoting a great deal of attention lately to economy of the coal used in operating their locomotives. Believing that the engineers, firemen and others had fallen into a rut in the use of coal, from which they would not emerge of their own volition, the company employed a specialist for some time, who was engaged instructing all interested in economical methods. This resulted in the publication of a booklet on fuel and steam economy, a copy of which is supplied to each engineer and fireman, who are required to know the principles laid down for their instruction. This has been supplemented by the appointment of assistant road firemen of engines on each division, whose duty it is to ride on engines, instruct the men in the proper methods of firing and watch closely all maters pertaining to fuel consumption.

In order to present actual figures to prove what can be accomplished by the united efforts of the engineers and firemen on the Lehigh Valley Railroad, it was decided to make a test on a passenger train, running one engine through, without change, from Buffalo to Jersey City, a distance of 446.6 miles.

That the argument might be stronger and more appealing to Lehigh Valley men, it was decided to use a locomotive which was a Lehigh Valley product. Class F-6 locomotive No. 2,475 was chosen for the test. This is one of five Atlantic type locomotives which were designed in the office of the mechanical engineer of the Lehigh Valley Railroad, and remodeled at the Lehigh Valley Shops at Sayre, Pa., being placed in service in November, 1910.

The principal dimensions of these Atlantic type locomotives are as follows: Class, F-6 type, Atlantic; cylinders, 21x 26 ins.; diameter drivers (over tires), 77 ins.; boiler pressure, 200 lbs.; tractive power, 25,310 lbs.; total weight of engine and tender, 303,100 lbs ; weight on drivers, 99,700 lbs.; fuel, bituminous coal; fire-box, semi-wide; flues, 374, 16 ft. 2 ins. long; grate area, 51.2 sq. ft.; heating surface, flues, 3,164 sq. ft.; heating surface, fire-box, 160 sq. ft.; heating surface, total, 3,324 sq. ft.

On June 21, 1911, locomotive 2,475, with Engineer John Covey and Fireman Frank Pettit in charge, left Buffalo on train No. 4, consisting of ten cars, and started on the run of 446.6 miles to Jersey City. Engineer Covey and Fireman Pettit were in charge of the locomotive the entire distance and their efforts were successful, as the locomotive hauled the train the entire distance without taking coal. Between Wilkes-Barre and Fairview, a distance of 16.3 miles, with a grade of 95 ft. per mile, a helping locomotive assisted the train, which is the usual practice.

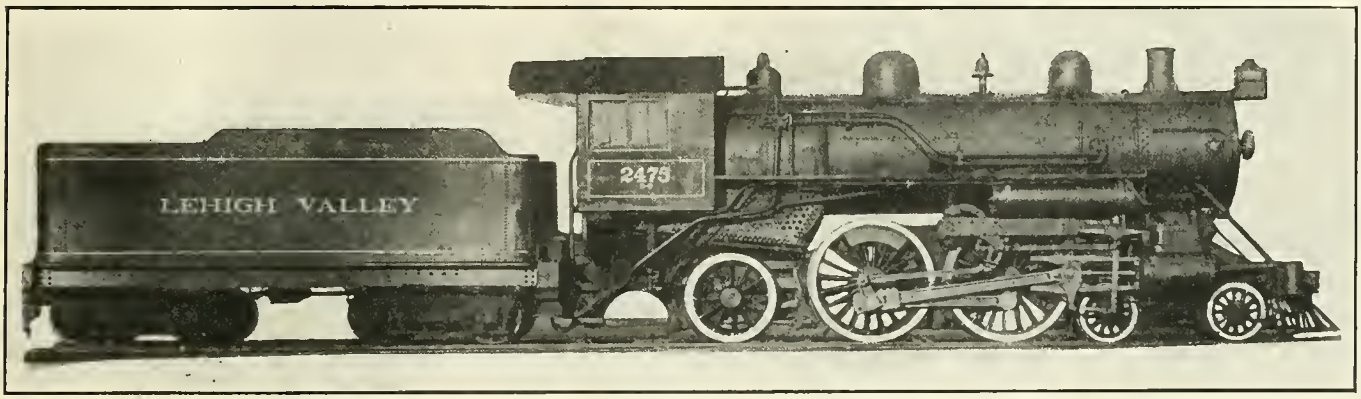
The regular locomotive crews east of Sayre acted as pilots, as Engineer Covey and Fireman Pettit were not familiar with that part of the road.

The following details present the weight of the train and the distance each weight was hauled: Buffalo to Bethlehem, 359 miles; cars hauled, 10; tons behind tender, 560; car miles, 3,590; ton miles, 201.040. Bethlehem to Easton, 11.6 miles; cars hauled, 8; tons behind tender, 433; car miles, 92.8; ton miles, 5,022.8. Easton to Jersey City, 76 miles; cars hauled, 7; tons behind tender, 372.8; car miles, 532; ton miles, 28.332.8. Total miles run, 446.6; total car miles, 4,214.8; total ton miles, 234,395.6.

The number of stops made were thirty-one. The train left Buffalo at 9:58 a. m. and arrived at Jersey City at 10:01 p. m., spending 12 hours and 3 minutes upon the road. The actual running time was 10 hours and 40 minutes. The coal consumed on the trip was 30,070 lbs., being 67.33 lbs. per train mile, a small amount for the work done. The average steam pressure was 195 lbs. When time occupied in stops is deducted, the average speed was 41.8 miles per hour.

This wonderful record shows what can be done by careful manipulation of an engine by the engineer and fireman. This performance, in all probability, is the most remarkable ever made in this or any other country, by an engine hauling a heavy train on schedule time. The total amount of coal used between Buffalo and Jersey City was 15 tons and 70 lbs., while the amount of coal consumed on this run usually is between 25 and 30 tons.

It seems only fair to state that the predominant influence in promoting this unparalelled run was Vice-President Middleton, to whom we are indebted for the data published.



ENGINE THAT PULLED HEAVY TRAIN 446.6 MILES WITHOUT LAYING UP.

F. N. Hibbits, Superintendent Motive Power. Built in Lehigh Valley Shops at Sayre, Pa.

Mechanical Stokers.

If it may be regarded as a sound principle of progress to make haste slowly the development of mechanical stokers is moving forward upon a most substantial basis. Ten years ago the indications were, judging from the tone of the Railway Master Mechanics' Association, that within five years the mechanical stoker would perform the whole duty of firing locomotives with very small supervision from the man in the cab. There seemed to be every reason why the mechanical stoker should be applied without delay. It was reported to be an excellent saver of coal, that it prevented smoke was generally believed, and relieved the fireman of the terrifically hard work that was beyond human endurance when a heavy locomotive had to be kept hot while performing maximum duty.

During the last few years these popular impressions were subjected to the ordeal of practice and the mechanical stoker is not so popular as it was. The apparatus worked almost as well as was expected, but failures happened occasionally, and little patience was displayed with failures that caused delay to trains. The stoker could not be developed without the failures that all other new mechanism had underground and it could not be developed without being in actual train service.

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Editorial Change.

Owing to impaired health Mr. George S. Hodgins, for the last nine years managing editor of RAILWAY AND LOCOMOTIVE ENGINEERING, has resigned and gone abroad to recuperate. Mr. Hodgins made a host of warm friends while editing this paper and they all hope that he will return from his travels entirely restored in health.

Exact Measurement.

A great deal of abuse was heaped upon Mayor Gaynor, of New York, because he expressed the opinion that there were no correct weights or measures used among the tradesmen of New York. If the Mayor meant absolutely correct weights and measures, such as are used in chemical laboratories, he was no doubt making a true statement, for it is very doubtful if any of the weights and measures or any measuring implements made by common workmen are more than approximately accurate and many of them are so far from recording the exact weight or measure represented that the makers and users may fairly be accused of using them for their own advantage.

The machine shops of this country, aided by tool makers, noted for the accuracy of their productions, may be depended upon to measure their work with exactness; but that has come about through long training and the use of parts that will bear no loose measurement. It was not always thus however.

We are constantly hearing of agitations being carried on to change our standards of measurement, and many people unreflectingly conclude that it would be a fine thing to introduce the French system of measurement with the meter, which is 39.3704 inches in length, as a basis. Those people seldom have learned anything about the difficulties there were encountered in establishing an exact inch as the basis of our measurements. Every boy who carries a well made steel scale now has in his pocket an inch that is the same length as the inch measured by instruments made especially to secure accuracy. The inch of every well regulated shop is of precisely the same length as the inch of any other shop of similar character. It is within the memory of men still young when a very different condition of affairs existed. The inch marked on the rules of different makers was seldom approximately the same, and the best of measuring scales rarely made the inch the same length and 1-32 inch difference on the foot was not considered out of the way. In fact there was no accurate unit of measurement on this continent till a comparatively recent date.

Railroad engineering men are entitled to a great share of the credit due for reforming the prevailing confusion in measurements. A committee of the Franklin Institute of Philadelphia made the first important move toward getting a standard system of screw threads introduced, and it was in connection with this that the need for an accurate inch came to be recognized. When the famous engineer, O. B. Chanute, was in charge of the mechanical department of the Erie Railroad in the early '70's, he decided to have interchangeable screw threads used in a large number of cars to be ordered. When he entered into details the first difficulty encountered was finding the correct length of an inch. He applied to the various Government arsenals and shipbuilding yards and obtained scales giving the standard inch they were working to. On a comparison being made it was discovered that none of the reputed accurate inches were exactly the same length. Mr. Chanute was a highly influential railroad officer and a leading member of the principal engineering society of the day, and he had good opportunities for making the anomalous condition of American measurements well known to the engineering world. He hied hither and thither seeking for a true inch like the ancient philosopher searching for an honest man, and his quest was equally fruitless.

The agitation, however, brought about the necessary reform. The question was taken up by the Master Car Builders' Association, and a committee was appointed to select a firm to make gauges for standard screw threads. The choice fell upon the Pratt & Whitney Co., Hartford, Conn., and that company displayed wonderful enterprise in providing the country with a correct standard unit of measurement.

The labor performed was enormous, and the expense incurred was not less than $25,000. The first thing to be done was to ascertain the length of the standard British yard, which was the original gauge of our measuring rules. This yard was made with great care, in 1760, and was deposited for safe-keeping in a strong room in the Houses of Parliament in London. It was supposed that this would provide the means of restoring the exact yard should the standard bar be lost or destroyed. The Houses of Parliament were burned in 1834, and the standard yard was destroyed. When scientists undertook to restore the standard yard from the natural unit, they found that the vibrations of the pendulum were susceptible to influences that induced errors. After a most laborious and painstaking investigation, it was determined to restore the standard yard by measurements taken from various yards that had been made with great care, and compared with the standard yard of 1760. This yard, then constructed, is known as Bronze No. 1, and is the British national standard yard. It is kept in the strong room of the old Palace Yard, Westminster, London.

To obtain an accurate transfer of this yard was the first work undertaken by the Pratt & Whitney Co. They engaged the services of Professor Rogers, of Harvard College Observatory, Cambridge, Mass., who was probably the first authority in the world on measurements and measuring instruments. The work was successfully performed, and very few connected with the vast interests that are enjoying the benefit of the accurate system of measurements established realize the great importance of the work that was accomplished.

The details of designing gauges and measuring appliances to introduce the accuracy of science into shop practice were carried out to a great extent by Mr. George M. Bond, of the Pratt & Whitney Co. This was done in such a practical manner that, within a few months after the standard measurement was established in this country, numerous shops were working to gauges that gave absolutely correct divisions of the yard. Although the yard is the standard of reference, the inch is the real standard of the machine shop.

Deserve Promotion.

"There is no chance for a man along a good position on a railroad unless he has some influential friend to help him climb the official ladder," wrote a correspondent, who added that he took no stock in the poppycock we were in the habit of publishing about the science of the business and studying the technical part of a railroad man's work. He had gone through the experience of machinist apprentice, fireman and engineer and was now working at the machinist trade, where a man could show a little independence. Working in a machine shop at the beck and call of an insolent boss was not entirely to his liking and he did not expect any favor there, for shop foremen and master mechanics were like all other railroad snobs, ever ready to snub and suppress men of ability. Railroad officials, he added, are the worst tyrants to be found and no class is so envious and hateful towards men who could give them points in ability every day of the week.

Some people devise peculiar consolation from emptying the vials of their wrath and the venom of their discontent and bitterness upon the devoted head of a helpless and unoffending editor and the communication quoted is representative of its class. Very often such complaints are carried into the editorial sanctum and pounded forth there, which is worse than sending in a scurillous letter. We have great sympathy with men aspiring to rise above the rank of our ordinary workman and therefore we listen as patiently as we can with those who feel constrained to complain about obstacles being thrown in their way. It is sad to tell, however, that the greater number of the men with grievances, are themselves the greatest obstacles to their own success in life. Most of the men complaining about not getting on do nothing whatever to recommend themselves for being taken out of the ranks, and they frequently display good cause why they should remain workmen.

In the mechanical department of railroads the first upward move that a man receives is usually to be appointed a foreman or a traveling engineer. If the officer making these appointments is wise and has the interests of his employers at heart, he will select men who have striven by acquiring knowledge to a equip themselves for higher positions. It is not enough that a man is a first-class machinist or carpenter or engineer that he should be selected for promotion. If he has worked for promotion he has acquired all the knowledge within his reach of the science of his business. These are the kind of men who have led the armies in the industrial campaign that has reared the great industries of this country, and it is only such men who will continue to come to the front. A man who is the best machinist in a shop, but has no conception of how to speed a shaft or how to figure on the strength of a belt, has no right to expect to be made a foreman. Ignorant and inefficient men are sometimes selected for promotion, but it is not the rule, and their employers are to be commiserated. To the ignorant grumbler and complainer that we are best acquainted with we could say: "You are receiving the treatment you have earned. If you have sound ambition you will try to do something to prove that you are more worthy of promotion than the others around you. Those who have not the stamina to quality themselves as leaders have the right to remain followers."

Doctoring Coal.

A report emanating from Boston says that Philip O. Levitt, an engineer on the Boston & Albany Railroad, has perfected a process by which he can reduce by one-third the amount of coal burned by locomotives. The inventor or discoverer of this process says: "My plan consists in part of spraying the coal with my secret solution. And I also save a great deal of coal in building fires. I have devised methods to offset almost wholly the waste by the fire caretakers in the roundhouse before the locomotive is sent out on its run."

In 1892 great claims were made in New England for the use of a mixture called Kom Kom, which was reported to convert inferior coal into a fine steam-making combustible. The scheme was promoted by a man named Howard. That man seemed to deceive the president of the New York & New England Railroad concerning the value of the mixture, but the mechanical officials were not taken in. A new president was elected for the road, and after an investigation he reported:

"We have found out that Howard, entirely unknown to the company, had contracted with a Boston firm to have all the coal used by the company sprinkled with some patent stuff called 'Kom Kom,' which was supposed to improve it in some way. The 'Kom Kom' cost four cents a gallon, and it took three gallons to sprinkle a ton of coal. Thus the company paid twelve cents on every ton of coal for stuff that was worthless. For this purpose alone Howard spent between $40,000 and $50,000. There is not a drop of 'Kom Kom' used by the New York & New England road.

"An inspection of the coal in the bins showed that it was the poorest quality and resulted in the rejection of several thousand tons that were ready for delivery. Yet the company was paying for good coal. The annual report showed that the cost of fuel had been 26 cents per train mile, whereas the average for about fifty roads was only 20 cents. Between 'Kom Kom' and poor coal, the New York & New England had a hard time of it."

The fuel value of coal depends upon the quantity of carbon and hydro-carbons it contains. When these are burned with the proper admixture of oxygen nothing more of heat value can be secured no matter what doctoring may be attempted.

Oil-Burning Locomotives.

Our recent article on locomotive running repairs embracing oil burning locomotives has brought to us some valuable data in regard to the comparative cost of coal and fuel oil locomotives. As may be expected there is a variety of opinion among railway men, but all agree that boiler repairs constitute the most important item in the running work. Leaking tubes continue in a more marked degree to be the chief cause of engine failures. With the oil burners the flues do not last as long as with coal burners, owing to the intenser heat being more rapidly developed. The turning off and on of the fuel supply when stopping and starting, with the consequent variations in temperature in the firebox, also accelerates the tendency to induce a constantly increasing leakage in the firebox end of the flues. Tubes with welded steel ends are in some cases replacing the older methods, thereby obviating the use of copper ferrules, which are more readily affected by rapid changes in temperature. Smaller holes in the flue sheet are also being experimented with, thereby extending the area of the heating surface and lessening the liability to small fractures.

There also seems to be a continuation of differences of opinion as to the methods of working a locomotive to obtain the best results with oil fuel. Whether should the throttle lever be fully opened and the reverse lever adjusted to a short stroke of the valve, or should the throttle lever be partially opened with a longer valve travel? This question is not new, the conviction being that at high rates of speed and running lightly, the lever should be "hooked up," giving the valve as short a stroke as will admit sufficient steam to maintain the high velocity.

The reports from many engineers in charge of oil burners is that engines running with throttle valves partially open and a fuller opening of slide valves are more economical in fuel, show less wear on the motion and show less condensation by carrying particles of water into the steam chests.

Successful Mallet Compounds.

The most successful Mallet compounds are those that have an intercepting valve for starting, and for working the engine simple. The intercepting valve automatically regulates the pressure of the live steam entering the receiver when starting, and when working simple keeps it at such a pressure that each of the four cylinders do practically the same amount of work.

With this appliance, when the engine is working simple the exhaust from the high pressure cylinders pass directly to the atmosphere, and the valve cuts off communication between the receiver and the exhaust side of the high pressure pistons, thus relieving them of back pressure—with the exception of the back pressure of the exhaust steam. Moreover, the low pressure pistons exert more power than when working compound, because the live steam admitted from the boiler is reduced to a pressure somewhat above the ordinary pressure in the receiver. The increased power thus obtained, and that secured in the high pressure cylinders due to the reduction of back pressure, gives a total increase of power, when working simple, of about 20 per cent.

When the intercepting valve is not used, a by-pass arrangement takes its place. This method has the advantage of being simple and reliable, but it does not materially increase the power of the locomotive. It is self-evident why this should be. When the engine is working simple live steam is necessarily admitted to both sides of the high pressure pistons, and consequently they will be nearly balanced, while, at the same time, the live steam which is admitted to the low pressure cylinders is reduced in pressure. The result is that the greater portion of the power is generated by the low pressure when the engine is working simple.

Liquid Fuel.

Oil or liquid fuels possess many advantages over other fuels. The mechanical firing of oil fuels is an important factor in considering the advantages.

Eight to ten boilers can be managed by one fireman, consequently producing economy in labor. Only four boilers, where hand-firing of coal is required, can be managed by one fireman.

As there is no ashes, the required labor and cost for handling same is eliminated. The other advantage over ash producing fuels are: No waste or fuel in banking fires; no waste of fuel in ashes and cleaning fires; no dust and ashes in fire room or another adjacent room.

Oil fuel fires have large range of control of consumption. The combination of the high calorific power of oil fuels and its controlled combustion would give a higher efficiency than a coal fuel. There is less smoke and unburned carbon with oil fuel than with any solid fuel. The fireroom has a lower temperature, consequently producing more comfort for the fireman. An oil fire can be very readily started. Oil fuels can be stored up and conveyed with less expense and labor than any solid fuel. The disadvantages are very few in comparison to the above advantage. The most important of the disadvantages is the liability of explosions caused by flames blowing out and igniting again with dangerous combinations of oil-vapor and air. It is interesting to note here that the total oil production of the world would supply but a portion of the demand for heat required, hence the price of oil would go up if there would be a large demand of oil for fuel purposes.

Every Little Bit Helps.

We are always glad to know when we have helped some one, and it is also very gratifying to know that our friends appreciate what things can be accomplished through the medium of Railway and Locomotive Engineering.

We quote from a letter just received from the Buker & Carr Mfg. Co., of Rochester, N. Y., who make an outfit for mounting and demounting air and steam hose.

"It may be of interest to you to know that a few days ago, in one mail, we received a request for lowest cash price for our Twentieth Century hose-mounting and demounting outfit, each inquiry referring to your publication and our standing advertisement therein. One of these inquiries was from Queensland, Australia, and the other from Winnipeg, Manitoba."

We are pleased but not surprised. Railway and Locomotive Engineering never publishes any but dependable matter, whether editorially or as advertising, and when one reads an advertisement in our columns, it is in reality an introduction of one friend to another.

Railway and Locomotive Engineering will be found on any news stand in this and foreign countries, upon the desks of railway officials all over the world and where there are yet no railroads and one is planned, there you will find this paper.

Learning Things About Air Brakes.

Our air brake department is operated with the expectation that it will keep trainmen informed concerning the latest development of air brakes and to keep them in touch with up-to-date air brake management. This department is not, however, intended as a treatise on care and management of the air brake. When a train man is studying air brakes we recommend that he secure Congers' Air Brake Catechism and study it thoroughly. Make its pages a faithful study. Some people think that by possessing themselves of a book they will absorb its contents without work, which is a mistake. Study the book systematically—a certain time every day—and you will make wonderful progress into useful knowledge.

To Revive Business.

Business is stagnant because many companies and individuals are delaying the placing of orders in hopes of seeing others take the initiative. There is plenty of money ready for investment in the purchase of goods, but the holders delay making purchases until they see others taking the lead. The substantial orders for cars and locomotives placed by the enterprising management of the Erie Railroad Company has stirred to some extent the prevailing tendency to delay ordering needed equipment, but the stirring needs to be followed by the active co-operation of many buyers. If a dozen or more railroad companies could be prevailed upon to place orders simultaneously, say on the first of October, the action would have the most stimulating effect upon business generally. That might be supplemented by the manufacturers of railroad supplies placing orders for sufficient material to last them a few months.

Meeting of Erie Freight Agents.

The Erie Railroad management encourage the forming and maintaining of various organizations formed to widen the knowledge of employees concerning their business to promote social intercourse and personal harmony. A very useful organization of this character is the Association of Freight Agents.

On July 20 this organization held a meeting at Buffalo, N. Y., and went through a hard day's work that could not fail to be beneficial to the individual taking part and to the company in whose interests the gathering was held. There were 42 members and 12 visitors present.

Early in the morning the party boarded a special car and were drawn from freight house to freight house all over the Erie lines within half a day's journey of the Union Station. The party stopped at every freight house, walked leisurely over it, commending some things and finding fault with others, as displaying intense curiosity to see the heart of every arrangement calculated to facilitate the handling of freight.

They were a zealous and energetic crowd. No stairs were too steep or numerous for them to climb and no freight shed too long to be thoroughly explored. When he had walked fifty miles, as near as he could guess, the scribe took refuge in a passing street car.

The party returned for early dinner and in the afternoon a meeting was held in the Prudential Building, where numerous topics of mutual interest were discussed. President Mahoney was in the chair and displayed great skill in persuading the different members to express their views on freight matters. "Free ash or shipments" was the subject which elicited most discussion. "Lost and Damage Claims" was another word producing subject. All the members were very earnest and a mass of information was brought up which could not fail to result in the clipping down of preventable waste.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Second Series.

(*Continued from page* 301.)

128. Why is the present brake called an automatic brake?

A. Because it is automatic in its action; that is, its normal condition is when it is held off, due to the maintenance of train line pressure, and anything which happens to reduce the train pipe pressure will cause the brake to apply of its own accord or automatically.

129. Where is the compressed air stored?

A. In the main reservoir on the engine, in the auxiliary reservoirs under each car, in the train line which extends throughout the train under the cars, and connects the brake valve with the triple valves connected with the auxiliary reservoirs.

130. What are the essential parts of the air brake system as applied to a locomotive?

A. The air compressor, the air compressor governor, the main air reservoirs and the engineer's valve, a duplex air pressure gauge, a plain triple valve, auxiliary reservoir, brake cylinder with its piston and the necessary piping with stop cocks and angle cocks.

131. Name the positions of the engineer's valve.

A. Release, running, lap, service application and emergency application.

132. How is the automatic brake applied and released?

A. First by putting the engineer's valve in the application position. To release the brake the handle is turned to the release position.

133. Where are the different pressures stored?

A. The highest pressure air is stored in the main reservoirs on the engine. The working pressure is in the brake pipe and in the auxiliary reservoirs under the cars.

134. What is excess pressure?

A. The amount of pressure contained in the main reservoir higher than that of the train line pressure.

135. What is the purpose of carrying excess air pressure?

A. It provides the means of releasing and recharging the brakes quickly.

136. Where do these pressures begin and end?

A. They begin with the air compressor and end with the release of brakes through the triple valves.

137. What is the use of the air compressor governor?

A. To shut off the flow of steam to the compressor when the desired main reservoir pressure has been attained.

138. What is the purpose of the main reservoirs?

A. The principal purpose of the main reservoirs is to hold a volume of air sufficient for operating the brakes on locomotives and cars. They supply the brake pipe and auxiliary reservoirs with the air required, as it tends to reduce the temperature of the air which is heated by compression of pumping.

139. Where are the main reservoirs located?

A. Generally between the frames of the engine behind the cylinder saddle or in any other convenient place.

140. What is the purpose of the auxiliary reservoir?

A. The auxiliary reservoir, which is located under each car, holds a storage of compressed air for supplying the brake cylinder with pressure to operate the piston in the brake cylinder which applies and releases the brakes.

141. What is the purpose of the brake pipe?

A.—The brake pipe is the circulating medium for air between the main reservoir and the auxiliary reservoirs. It conveys the required pressure throughout the train, and any accident that breaks it leads to the application of all the brakes.

142. What is a triple valve?

A.—The triple valve is an apparatus consisting of pistons and slide valves that apply and release the brakes, acting on the difference of pressure in train pipe and auxiliary reservoir. The triple valve performs a three-fold function. When the engineer's valve is in release position the triple valve permits air to pass from the train pipe into the auxiliary reservoir. In application position of the engineer's valve, the triple valve permits air pressure to pass from the auxiliary into the brake cylinder, thereby applying the brakes. When the engineer's valve is put into release position, the triple valve permits the air to escape from the brake cylinder to the atmosphere.

143. What is the brake cylinder and what is its use?

A.—The brake cylinder is provided with a piston which connects the brake actuating mechanism. When air is admitted to the brake cylinder through the action of the triple valve, the piston is pushed out, moving a lever that operates and applies the brake.

144. How should the air compressor be started?

A.—Very slowly with all drain pipes wide open. After the compressor is heated and the water drained off and when a pressure of 35 to 40 lbs. has accumulated in the main reservoir, the compressor throttle should be opened sufficiently to run the pump at a speed which will maintain the required pressure and perform the brake work satisfactorily. The steam end of the compressor should be lubricated freely during starting just after the drain cocks are closed.

145. What kind of oil should be used in the cylinders of an air pump?

A.—Good valve oil.

146. How often should the air end of the pump be oiled?

A.—Often enough to prevent the pump from groaning.

147. Where does the pump deliver air?

A.—To the main reservoir on the engine.

148. How can a disabled brake be cut out?

A.—By turning the stop cock on the branch or cross-over pipe.

149. How should the handle of cut-out cock stand when closed?

A.—Parallel with pipe.

150. How should handle of angle cock stand when closed?

A.—At right angles with the pipe.

151. What does the line or mark at end of plug cock indicate, regardless of position of handle?

A.—This line or mark indicates the direction of the passage way through the plug cock and by it may be known if the cock is open, regardless of the handle itself.

152.—How should a brake be bled off?

A.—The release valve in the auxiliary reservoir should be sharply opened for an instant, then quickly closed. This operation may be repeated until the triple valve begins to discharge air, which can be heard at the retaining valve or exhaust port of the triple, then no farther opening of this valve should be made.

153. What do the red and black pointers on the air gauge indicate?

A.—The red indicates main reservoir pressure; the black indicates brake pipe pressure.

Iron or steel may be made rustproof by boiling in 1 gal. of water to which is added 4 oz. of phosphoric acid and 1 oz. of iron filings. A black non-corroding coating is produced.

Be Cheerful and Work Faithfully.

Lord Strathcona, the famous Canadian, who left Scotland 73 years ago bearing the name of Donald Alexander Smith, holds peculiar views about the qualities necessary to promote success in life. During a recent speech he said: "Do not despise what you are. Be satisfied for the time, not grumbling and finding fault. Do the work yourself; don't wait for friends to use their influence on your behalf; don't depend on the help of others. Apart from what we call genius, I believe one man is able to do as well as any other, provided the opportunity presents itself, and he is blessed with good health. Much of what I would advise young men to do is contained in the old counsel, 'Trust in God and keep your powder dry.'"

Had Lord Strathcona been inclined to fret or worry over disappointments he certainly would not have lived to the old age of 91 years which he has attained. He performed the principal labor of having the Canadian Pacific Railway built, and had to endure many defeats and much reviling before that part of his great services to Canada was accomplished.

Product of Prison Labor.

The sentiment in nearly all our states is opposed to cheap prison labor being permitted to compete with properly paid skilled labor, but the thieving politicians in numerous cases succeed in eluding the law. The State of Ohio has been notorious for producing unscrupulous politicians, many of whom hace succeeded in making fortunes from cheap prison labor.

In a recent number of the *American Magazine* appears an article by Julian Leavitt, under the title, "How a great manufactury gets its goods made by convicts in five States for thirty-four cents a day." This manufactory, according to the writer, is the Ford-Johnson Company, of Cincinnati, in which, it is stated, Mr. George B. Cox, the Cincinnati political boss, has long had an important interest. The Ford-Johnson Company is engaged in "manufacturing, buying, selling and dealing in chairs, chair frames, settees, furniture, lumber and other kindred substances." "For many years this company," the article goes on to state, "either in its own name or that of one of its many subsidiaries, has controlled the labor of convicts in several prisons from Connecticut to Kentucky." In the Indiana State Prison it employs 200 men at 65 cents a day, the State of Indiana furnishing the buildings rent free; in Kentucky, 250 men at about 75 cents a day; in the House of Correction at Chicago, 100 men at about 40 cents a day; in the county jail at Hartford, Connecticut, 200 men at ten cents a day; in the county jail at New Haven, Connecticut, 200 men at an average price of eight cents a day. These contracts are taken in the name of different companies, said by the writer to be all connected with, or subsidiary to, the Ford-Johnson Company of Cincinnati. The publication of these statements in a reputable magazine, and over the name of its author, certainly justifies an investigation by the National Prison Reform Association. It ought to have no serious difficulty in getting and giving to the public authoritatively the facts and figures.—*The Outlook.*

Happy Canada.

There are no loud-mouthed politicians going about in Canada howling "prosecute" every person or organization that appears to be prosperous, and so "hard times" has dropped out of the vocabulary of that country. Result—a spirit of enterprise everywhere, especially among the railways, the interests that for the last ten years have been the *bete noir* of American calamity producers.

In Winnipeg improvements are projected this season that will involve the expenditure of $45,000,000, and the continuous employment of 30,000 men and 10,000 teams to accomplish the construction of 2,800 miles of new track.

The Canadian Northern announces that it will spend about $14,000,000 in construction work this year, laying 1,000 miles of new track and employing about 12,000 men.

The Grand Trunk Pacific is spending $17,000,000 this year in constructing some thousand miles of new track. It is stated that 10,000 men and 4,000 teams have been employed. The company contemplates many other extensions and improvements, the details of which have not yet been made public.

The Canadian Pacific people contemplate adding 1,023 miles of main track this season. It is understood that the company will spend in the neighborhood of $12,000,000 in improvements and construction of new lines in Western Canada this season.

Telephone Train Dispatching Rules.

The United States Electric Company has issued in its Bulletin No. 502 some suggested rules for telephone train dispatching. These rules are a compilation of the requirements which have been generally adopted by the majority of American railways which have installed telephone train dispatching. As reflecting the consensus of judgment of users, these rules are of interest to roads contemplating the change to telephone dispatching. Some general instructions governing the use of the telephone in railroad service follow and it is believed that, as simple as some of these appear, they have an important bearing on the efficient operation of a railway telephone installation.

Story of the Thistle.

The national badge of Scotland is the thistle, with the motto, *ne me impune lacessit;* translated, "touch me not with impunity," and more freely as "wha daur meddle wi' me." The origin of badge and motto form a romantic story. For centuries Scotland suffered deplorably from the inroads of pillaging Danish pirates. On one occasion a great array of Danish galleys sailed up the River Tay, spreading destruction on their route. The fleet was arested by the Scottish army, led by King Kenneth, at Lancarty, near Perth. The Scottish army was posted on a rising ground overlooking the river. The Danes attempted a night surprise upon the Scots and to avoid making noise marched bare-footed. When they were near the defending host, one of the Danes stepped upon a Scotch thistle and its sting was so vigorous that the man howled with the pain, which spread a timely alarm. The fight then began on even terms and a terrible conflict ensued, in which the Danes were routed and driven out of the country. Out of gratitude the thistle was then adopted as the national emblem of the Scots.

The main line of the Caledonian Railway traverses the scene of that battle. When the line was under construction many arrow heads and parts of spears were discovered after being 900 years in the ground. This find, made by the railway builders, settled a historical dispute as to whether a battle had ever been fought at Lancarty.

The Way They Do It.

The scientists are finding out many things about ancient nations, some of which may be true and some not. Inference is often advanced as fact. Guesses grow into possibilities, and possibilities into probabilities and probabilities into certainty. Dr. M. G. Kyle tells a story which illustrates one method of argument. An Assyriologist boasted to an Egyptologist that "the Assyrians understood electric telegraphy because we have found wire in Assyria." "Oh," said the other, "we have not found a scrap of wire in Egypt, therefore we know the Egyptians understood wireless telegraphy."—*Home Herald.*

Steam derricks are such useful appliances that it is difficult to imagine that the industrial world ever got along without them. Yet, according to John Carson Wait, the steam derrick was first employed by James J. Smith in 1870, in building the New York Post Office foundations.

Air Brake Department

Conducted by G. W. Kiehm

Slid Flat Wheels.

About the most difficult problem the air-brake man is compelled to deal with is the slid flat wheel, and, while doing so, air-brake men have corrected many erroneous impressions that have existed in the minds of many railroad men.

In attempting a brief and comprehensive analysis of the air-brake man's discoveries while investigating this trouble, and the causes thereof, it must be admitted that the subject is broad enough to fill volumes, and it is contributed to by a multitude of causes, but only the most prominent ones will be mentioned, and, contrary to the opinions sometimes countenanced by those who do not follow the subject closely, the trouble lies not in discovering the actual cause of wheel sliding, but in applying the remedy. Even when recognized, the remedy cannot be applied by any individual, and the only possible way in which it can be applied is by the hearty and honest co-operation of every individual who is in any way connected with the maintenance and operation of air and hand brakes, and even if these men have done their duty, there still remains the possibility of slid flat wheels, due to track conditions and make-up of trains.

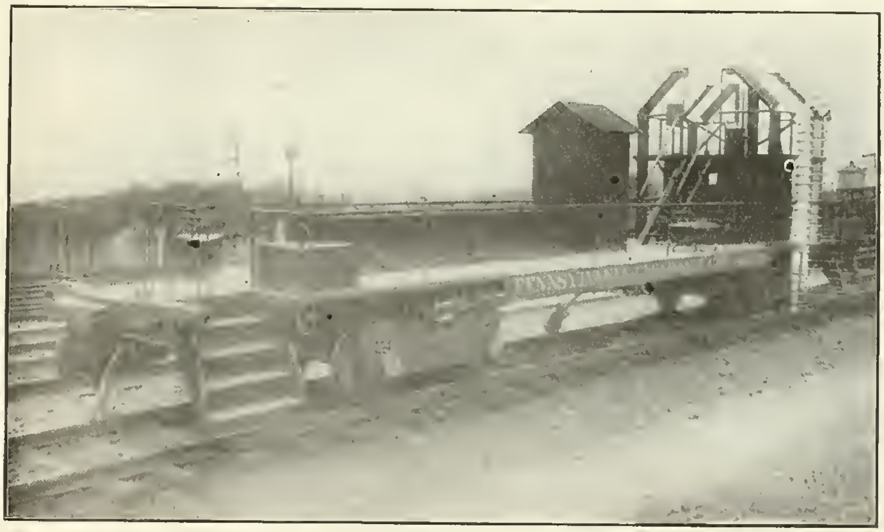
Before mentioning any of the causes that contribute to wheel sliding, it may be well to say that the majority of slid flat wheels are the result of starting cars to move when the brakes are applied, rather than the result of stopping the car with the air-brake. This statement is made by men who are in position to appreciate to just what extent defective apparatus, improper manipulation and slack action in trains contributes toward wheel sliding during a stop, and the statement becomes plausible when we consider several self-evident facts in this connection.

In the first place the air-brake manufacturers recognize the fact that the amount of braking power that can be applied to a car wheel without causing it to slide depends upon the frictional force developed between the brake-shoe and the wheel as well as the frictional force that exists between the wheel and the rail, and as a car brake is designed in a manner that the maximum pull of all the shoes on the wheels cannot exceed 70, 85 or 90 per cent. (as the case may be) of the weight resting on the wheels when the car is empty, and it naturally follows that if the retarding force between the shoe and wheel is not increased thereafter, and if the frictional force between the wheel and the rail is not reduced, it is impossible to slide the wheels on this car by the application of the air-brake.

Again, if the braking power of the car does not exceed the maximum force intended, and if the condition of the rail does not change, with one car alone the relation of these forces cannot become changed enough to result in wheel sliding, or, rather, if the car is running alone and not influenced by the action of other cars in the train, it can be stopped from any speed with any kind of an application of the air-brake without the slightest danger of injuring the wheel, and it follows that if 25 or 100 cars are coupled together and stopped with each car furnishing its own share of the braking power they will all come to a stop without any material assistance from each other, and under such conditions it would be just as impossible to slide wheels during a stop as though each car was running alone. If these statements were not reasonable, how could a freight car, braked at 70 per cent., based on 60 lbs. cylinder pressure, have wheels slid flat when loaded to its capacity and without any change in brake apparatus show no indication of wheel sliding when empty, or how could the application of high-speed brakes reduce the number of slid flat wheels when its fundamental principles are an increase of brake-shoe pressure, and while this pressure was reduced during the progress of a stop the reduction required a certain amount of time, so that emergency stops from low speeds brought the train to a stop with an abnormal cylinder pressure; and, furthermore, during air-brake tests this nominal percentage of braking power has been increased to 150 per cent. and 180 per cent. of the light weight of the car without resulting in any injury to the car wheels?

Firmly believing that but a very small per cent. of the flat wheels are the result of sliding during a stop with the air-brake, we have arranged a chart intended to show the principal causes of, and those that contribute to, slid flat wheels.

While some of the causes or contributing causes may have been overlooked in preparing the chart, it is safe to say that the trouble will be considerably reduced if but two or three of the causes mentioned are removed.



PENNSYLVANIA RAILROAD CLEARANCE CAR.

Undoubtedly the most prolific cause is "starting cars with brakes applied," "unequal piston travel," "stopped up retaining valves," and an injudicious "clubbing" of the hand brake.

As to starting trains before the brakes on the rear end have had time to release, it is obvious that nothing can be gained, as the speed cannot be accelerated until the brakes have released, and if but one or two remain applied, the rest having leaked off, it may result in the slid wheels. In this connection it may be noted that the car with the flat wheel has a good brake, that is, 90 per cent. of the cars with slid wheels have no defect in their brake apparatus, and in practically all cases the triple valve has a tight check valve which makes it evident that while the other brakes may have leaked off this one did not. Unequal piston travel, creating unequal breaking power, results in many of the shocks in the train that cause slid flat wheels, and sometimes this is not altogether clear to the student, but no matter how rapidly the wheel revolves, it is stationary in its relation to the rail, and the adhesion of the wheel to the rail is constant at all speeds varying only with the condition of the rail, then should this static friction be changed to a dynamic friction by the wheels rotation being checked, the resultant friction, owing to several causes, would be but a small per cent. of that previously existing as the result of static friction, and practically all of the brake-shoe pressure must be withdrawn in order to again start the wheel revolving.

As to checking the rotation of the wheel the static friction keeps the wheel revolving, and the brake-shoe friction, termed dynamic, acts to check the rotation of the wheel, and the nearer the latter force approaches the former without exceeding it the more efficient the brake.

Assuming, then, that at a moderate rate of speed, considerable retarding force is obtained, and while the two forces are opposing each other, a shock of momentary duration accelerates the movement of the car, then the speed of the wheel must increase directly and instantly with the speed of the car, otherwise the "contact" between the wheel and rail will be broken and the wheel will slide along on the rail.

In this event of a sudden shock as of cars running in the slack, the increase in the speed of the car is instantaneous, and the only force tending to increase the speed of the wheel is the difference between the static and dynamic friction then existing, and, as stated, this force necessary to keep the wheel in motion may not be available, and will not be if the shock is heavy and the brake is doing a considerable amount of work. Roughly speaking, the car body starts to moving faster than the brake wheel can turn, and, consequently, it is dragged along on the rail in the same effect that a man running faster than a boy overtakes him, and, in passing him, reaches out his hand and pulls the boy off his feet, and the expression "bumping the car off its feet" is aptly taken.

As the wheel does pick up and slide the dynamic friction between the shoe and wheel is changed to static, and the friction between the wheel and rail is changed from static to dynamic, and a contemplation of the difference in the surfaces of metal in contact will convey an idea as to the amount of frictional force that would be required to dislodge the shoe without removing the pressure from the brake-shoe.

Frictional force between the shoe and wheel exceeds the adhesion of the wheel to the rail due to	Defective wheels and trucks	Wheels not bored centrally. Improperly mounted on axle. Wheels not perfectly round. Wheels warped. Unevenly chilled. Improperly hung brake beams. Hangers of improper length.
	Defects of car brakes	Unequal piston travel. Brake pipe leakage. Stopped up retaining valve. Wrongly used triple valve. Imperfect triple valve repair work. Leaky emergency valve or check case gasket. Wrongly used triple piston. Leaky triple piston packing ring.
	Defective engine brake	Defective triple valve. Leaky brake cylinders. Defective feed valve. No excess pressure. Main reservoir full of water.
	Improper manipulation	Too long in release position. Allowing insufficient time for release of brakes. Failure to kick off brakes after re-application. Failure to apply brake in a manner to conform with slack conditions and make up of train.
	Lack of inspection or observation	Starting trains with brakes applied. Retaining valve turned up. Switching cars with brakes set. Ice frozen in brake rigging. Brake beams wedged with shoes against wheels. Clubbing hand brakes down too hard when air brakes are applied.
	Slack action in trains	Resulting in cars being pushed ahead faster than wheels can revolve.

Under the heading of faulty manipulation of the brake valve is the expression "too long a time in release position," and if the pumps and reservoirs are of large capacity, 7 or 8 seconds in release position is sufficient for the longest train. A longer time may be necessary to keep the pumps in operation when charging a train, but during any ordinary train brake release a gauge located 25 cars back in the train will not indicate whether the valve handle is in running or release position. Therefore the high main reservoir pressure can be started into the brake pipe in 7 or 8 seconds' time, and the feed valve should be in a fit condition to maintain a flow of air to the brake pipe thereafter, and if the re-application occurs a second rapid movement to release position sholud release all brakes.

Insufficient time for release of brakes requires but very little comment. If it takes 45 or 50 seconds' time to release brakes on the rear cars of long trains, even under the most favorable conditions of pump and main reservoir capacity, it is useless to attempt to get away until a release is accomplished unless the brakes have leaked off. Therefore it would be good policy to leave the throttle alone for at least one minute after the movement to release, regardless of the remarks of the train crew.

Excessive brake cylinder leakage on the locomotive holds good even if the engine is equipped with the "E. T." brake, as a volume of the compressed air that should be going to the brake pipe may be escaping through the brake cylinders.

The triple valve test racks will remove the trouble caused by imperfect repair work, but the wrongly used triple valve is still in evidence, and it is very liable to cause the slid flat wheel when the "P 1" valve is used instead of the "H 1," as the feed groove in the larger triple valve will charge the freight reservoid in approximately one-half the time required by the smaller triple, and if a high brake pipe pressure enables the triple valve to charge faster than the other valves it will also charge to the higher pressure, consequently this triple valve in the front portion of a train on a descending grade is liable to start enough auxiliary reservoir pressure to slide the wheels.

That the slid flat wheel is a serious problem cannot be denied, and there can be but one solution, and that is, each vehicle doing its own share of the braking power; every wheel in the train braked; intelligent manipulation, and accurate repair work.

Along this line we recall the remarks of an air-brake man who recently said that he had honestly tried to better air-brake conditions for the railroad company that employed him by paying particular attention to brake cylinder leakage, piston travel, lubricating and testing triple valves which resulted in an astonishing increase in the number of slid flat wheels.

In extenuation he gave the causes as defective brakes or unbraked weight of other cars in the train crowding the cars with the repaired brakes, or, rather, stated that the repaired cars were doing the brake work for the entire train, whereupon he was advised to get back to former conditions, and let someone else repair the brakes and take care of the flat wheels.

This is, of course, an exceptional case, but many air-brake men can testify that a closer attention and increase in air-brake efficiency has invariably resulted in an increase in the number of slid flat wheels, and that larger air pumps and larger main reservoirs, higher main reservoirs and improved feed valves, had apparently aggravated the trouble.

Questions Answered

on Air Brake Subjects:

CHANGE OF DISTRIBUTING VALVES.

70. J. M., Ft. Wayne, asks: On an engine equipped with the No. 6 E. T. brake the brake would work all right with the independent brake, but after a service application of the automatic brake the engine brake would release. In a hurry we changed distributing valves with another engine, and without any cleaning or repairs both distributing valves then worked all right in the service, emergency or independent application. What could have been wrong in the first place? A.—This would indicate that you had a leaky graduating valve in the distributing valve and a leak in the release pipe branch between the brake valves on the first engine, thus after a service application the leaky graduating valve in reducing pressure chamber pressure allowed the equalizing valve to be forced to release position after the application, and application cylinder pressure could escape through the leaky branch of the release pipe. After the other distributing valve was obtained it is evident that its equalizing valve did not move to release position under the circumstances mentioned, while the first distributing valve's leaky graduating valve could not release the brake on the engine on which it was placed because this release pipe was no doubt free from leakage.

DEFECTIVE E. T. BRAKE.

71. A. B., Youngstown, asks: On an engine equipped with the No. 6 brake the black hand slowly creeps up equal to the red hand, and when the brake valve handle is returned to lap position after an application the driver brake releases. What causes this? A.—The rising of brake pipe pressure and the release of the brakes are due to two entirely different causes. The increase in brake pipe pressure is due to main reservoir pressure leaking into it, whether the leakage is through the brake valve, the dead engine fixture or through a patent brake valve cut-out cock. The release of the engine brake is due to application cylinder pressure leaking away. It may be in either the application cylinder or release pipe or in either of the branches of those pipes. The leakage may be from the application cylinder cover gasket, from the reservoir studs, or possibly from the safety valve through a combination of graduating or slide valve leakage. In this particular case, however, we must assume that the independent brake would remain applied, otherwise you should have stated that it did not, and as the increase of brake pipe pressure, with the automatic brake valve on lap position no doubt moved the equalizing valve to release position, it indicates that the leakage which released the brake was either through the release pipe branch between the brake valves or due to a leaky safety valve which would be connected with the application cylinder as soon as the equalizing valve was moved to release position.

"BACKWARD FLOW OF AIR."

72. A. B., Youngstown, writes: I have heard of a case where the application of the independent brake of the No. 6 Westinghouse equipment resulted in an automatic application of the brake, and in case of an obstruction at some point in the reservoir pipe between the main reservoir and the distributing valve supply connection, a sudden drop in main reservoir pressure surrounding the brake valve, as a result of an independent application, would give an opportunity for brake pipe air to flow backward through the feed valve and cause a brake pipe reduction and an automatic movement of the distributing valve. Now there has been some controversy over the question as to whether the backward flow of pressure can pass the regulating valve or lift a neatly fitted supply valve off its seat far enough to cause the automatic application. Can this happen, and how fast can the pressure flow backward through a feed valve? A.—The pressure can flow backward through the feed valve about as fast as it can flow through in the proper direction. You can note the time that will be required to charge a certain sized reservoir through a feed valve on a G-6 brake valve, then bolt the feed valve on upside down and you will find that there will be very little difference. If you will close the reservoir cut-out cock on a locomotive or on a test rack and then open it just enough to slowly charge the equipment, then make an independent application and note the results, which will be a drop in brake pipe pressure and a movement of the lower portion of the distributing valve.

Inconvenient Cinder Pits.

The writer was going about a large roundhouse recently with a master mechanic, noting the appearance of the engines and of the facilities provided for carrying on running repairs which were up to date in every respect. Our walk brought us to a long cinder pit, and the spectacle there brought us back from modern methods to the practices that prevailed during the first decade of locomotive operating. The fact that a pit had been excavated for the convenience of the men who had to clean out ash pans showed that some progress had been made from the time when cinders were raked upon the level track, but the advance was hardly worth mentioning. The fires of thirty to forty engines a day had to be cleaned over these pits, and no labor-saving appliances had been provided, not even a depressed pit for the car track.

On talking to the master mechanic about the saving that might be affected by putting in modern pits and a migratory hoist, he said that improvements of that kind belonged to the engineering departments. It is a little too bad to find money wasted and inconveniences endured because the active men in one department fail to be as enterprising as the same class of men in the other departments.

FREIGHT AGENTS OF ERIE INSPECTING BUFFALO FREIGHT HOUSES.

Defective Organization.

In speaking on shop organization at the General Foreman's Convention, Mr. F. C. Pickard spoke about finding a tinsmith putting in a point and, in another shop, the boiler makers put them in at about 25 per cent. increased cost of labor.

That reminds us of a visit paid to a railroad shop in Ohio, where we found the master mechanic inside of a smokebox adjusting the lift-pipe, while a boiler maker and helper looked on. That, we concluded, to be defective organization under a man who preferred doing the work himself, instead of directing his men how to do it. One man cannot do two men's work as it should be done.

Overcoming Difficulties in Pioneer Railroad Shop.

Years ago Mr. Samuel L. Moore, the first master mechanic of what is now the Central Railroad of New Jersey, gave reminiscences of his early experience and difficulties overcome that ought to be edifying reading for modern mechanics.

In 1847 Mr. Moore accepted the position of master mechanic of the Elizabeth & Somerville Railroad. His headquarters were first at Somerville, but within a year were moved to Elizabethport, where the repair shop had been established. At that time the car equipment consisted of about fifteen cars. The motive power consisted of four Baldwin engines with 10 x 16 in. cylinders, single pair of driving wheels, located behind a haystack, firebox and a four-wheel truck in front. The length of track in operation was 26 miles.

When Mr. Moore took charge of the repair shop, the only tools in the place that had a rotation motion were a grindstone and a blacksmith's crank drill. He soon secured a lathe for turning driving wheel tires, and a smaller one for general work, but there was nothing to give them motion. A steam engine for driving the tools was out of the question. He had lathes, but unless they could be made to revolve they were useless. He again made good the rule that necessity is the mother of invention. He put a set of rollers in the track, so that the drivers of a locomotive would revolve them, reversing the modern practice of making rollers revolve the driving wheels, as is done in valve cutting operations. To these rollers he secured attachments that transmitted the motion to the shop tools. This practice was followed for seven or eight years.

When an engine came in from the run to Somerville she was put to the treadmill duty of providing power to turn the tires of some other engine, much the same as some farmers use a dog for a churn motor.

Fishing For Blankets.

In one of our back numbers, James H. Hevey, who contributed "Reminiscences of a War Time Engineer" to our columns, tells an amusing incident of how a soldier got the best of a conductor.

Blankets were scarce and ingenuous schemes were worked to get possession of good ones. One of the slickest schemes was to procure a musket ramrod, sharpen the small end and turn a hook on it. The big end was lashed to a strong piece of cord. With this rig a wily schemer would make successful fishing of blankets. The fisherman would station himself in an empty car at a station where trains did not stop. As a train passed loaded with recruits wrapped in new blankets, the trick was to throw the hook and hold on to the cord.

While lying at Kingston one night I saw the tables turned. Stevenson, one of our conductors, had a Mexican "serape"—a thick blanket. During the evening he had been showing it to visitors to the caboose and boasting about its comforting qualities. About ten o'clock the conductor went to bed, spreading his serape over him. I was on the station platform, close to his car, when I saw a soldier sitting between the tracks, immediately under the caboose door. As there was nothing unusual in this, I paid no attention to the soldier until a passing train came along, when the man stood up and prepared to board the train, which could easily be done. About the time the soldier slipped between two of the moving cars, I saw something flutter out of the door of the caboose and start up the track after the train. It was Stevenson's serape hooked to the end of a cord. The owner jumped up and fired two or three shots, uttering a string of cuss words, but the serape had gone for good.

Flange Cutting.

When the report on flange wear, submitted by H. H. Haig, of the Santa Fe, was under discussion, Dr. Angus Sinclair remarked:

"A long time ago I was running a locomotive on a very crooked road. I was responsible for the condition of the engine and had to keep it going. It quickly developed a great deal of trouble from cutting out flanges. I never had any experience to guide me as to what was to be done, but I tried oiled swabs—a very crude way of oiling the flanges, and then I had trouble from the wheels slipping and, consequently, I had to give that up. It did prevent the cutting of the flanges, however. Then I used a tallow. I first tried blocks of tallow and it worked fairly well. Then I mixed it with Dixon graphite and made blocks just as hard as I could get the tallow and the graphite to hold together, and I had very good results from that. With the crude oil appliances mentioned in the report, I should imagine there should be more or less trouble with slipping. This is a subject that deserves more consideration than it has hitherto received, and the excellent manner in which Mr. Haig has gotten up this report seems to me a splendid introduction to further study of the subject."

Atlantic Locomotives for British Railway.

The North Eastern Railway of England has ordered a group of "Atlantic" locomotives from the North British Locomotive Company of Glasgow, to be used on the East Coast Scottish express trains. They have been designed by Mr. Wilson Worsdell, the consulting mechanical engineer of the North Eastern Railway.

Ten of these engines will be fitted with Schmidt's superheaters, and all of them with Wakefield mechanical lubricators. They will also rank as the heaviest railway locomotives adopted by the North-Eastern Railway Company. The four bogie wheels are 3 ft. 7 ins., and the four coupled wheels 7 ft. 10 ins. in diameter, whilst each of the engine trailing wheels is 4 ft. in diameter. The bogie wheel base is 6 ft. 6 ins., and the fixed engine wheel base 15 ft. 7 ins. The boiler, which is almost of the maximum dimensions permitted by the British railway loading gauge, is 15 ft. 10½ ins. in length, and 5 ft. 6 in. in diameter, and its centre line is "pitched" 8 ft. 11 ins. from rail level. The three cylinders are 15½ ins. diameter by 26 ins. stroke, and the total heating surface amounts to 2,340 sq. ft., to which the tubes (254 in number, and each 2 ins. diameter) contribute 2,160 sq. ft., and the firebox the remaining 180 sq. ft. The fire-grate area is 27 sq. ft., the distance from rail level to top of chimney stack is 13 ft. 3 ins. The tender is carried on six 3 ft. 9¼ ins. diameter wheels, and carries 4,125 gals. of water, with a space for five tons of coal. As each engine weighs 77 tons, and the tender an additional 45 tons 6 cwt., the total weight on rails is 122 tons 6 cwt.

Good News From Canada.

A new publication made its bow to the world with July and *The Railway Journal of Canada* has become an esteemed contemporary.

This new paper, which is published at Toronto, has upon its staff those who well know how to run a trade journal, and the present should be an auspicious time to launch such an enterprise.

The *Eagle* extends a friendly wing to the *Beaver* and wishes everything Canadian God-speed.

Canada, the right hand of the British western arm, is progressive, friendly solid and with financially substantial methods, is a great power. Her railways are among the best in the world and we are proud to call her our beloved neighbor.

O, toiling hands of mortals, O, unwearied feet, traveling you know not whither. Soon, soon, it seems to you, you must come forth on some conspicuous hill-top, and but a little way further, against the setting sun, descry the spires of Eldorado. Little do you know your own blessedness; for to travel hopefully is a better thing than to arrive, and the true success is to labor.—*Stevenson.*

Who heareth the eternal voice is delivered from many an opinion.

Brake Rigging for Six-Wheel Truck.

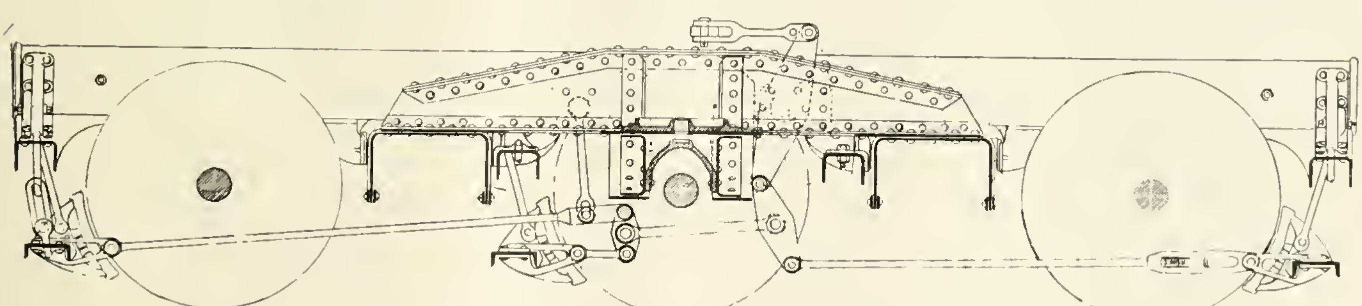
In connection with recent new car equipment on the Pennsylvania Railroad, the re-designing of the truck received careful consideration, and it was necessary to construct a new system of brake rigging, and a method was devised embodying the principle of an independent set of triple brakes for each side of the six-wheeled truck which apply their braking force to the brake beams adjacent to the brake heads, thereby avoiding heavy bending strains usually present in brake beams.

The brakes of each truck, as shown in the accompanying illustrations, are connected to the ends of horizontal equalizers by links. Application of the brakes moves the link to the left, thereby working a lever about its center and transmitting motion to a lever which pulls a rod with twice the force of the rod attached to the larger end of the lever, which acts upon a brake beam. Through an equalizer, the pull of the rod is divided equally between the rods which act directly upon their respective brake beams. The combination forms a brake rigging of great power and efficiency and is the most successful method in use in braking the six-wheel truck of any kind of railroad car that has yet been in use of similar weight.

NEW PENNSYLVANIA STEEL CAR, SIX-WHEELED TRUCK.

No Spot Safe from Lightning.

A widespread belief is that during a thunder storm safety may be found under a beech tree, and that the danger from lightning is fifteen times as great under a resinous tree and fifty times as great under an oak. Dr. A. W. Borthwick, the British naturalist, finds this view to be entirely without foundation. The beech is not avoided by lightning, which strikes one species as readily as another, but the taller trees in a neighborhood appear to be the ones liable to be struck. The effects of lightning also are commonly misunderstood. The cells of a tree are not ruptured or torn by the formation of steam, as so often stated, but collapse or shrink without tearing. The roots seem to escape damage.



BRAKE RIGGING FOR SIX-WHEEL TRUCK. PENNSYLVANIA RAILROAD.

To Make Commuters Fly.

A somewhat troublesome class of people doing business in cities and living in the country are known as commuters. No kind of transportation has come within sight of satisfying the commuters, who travel for a fraction of the regular fare. Mr. Hudson Maxim proposes a radical change.

"I predict," he has written recently, "that in the near future—assuredly within the next decade—the commuting aeroplane will be a common sight. The aeroplane will be a great time-saver. The tiresome hours of the commuter spent on trains and trolley cars are always so many hours added to the day's work. The flying machine will change the weary coming and going to invigorating recreation and sport."

We also venture the prediction that judging from past performances the flying machine, if brought into general use, will greatly reduce the troublesome people who complain about railway trains being too slow.

Agitators' Theories Dead.

The agitation that was exerted by Louis D. Brandeis' loudly reiterated assertion that railroads could save $1,000,000 a day by scientific management has entirely died down, and many people are wondering that the extravagant talk of that supreme agitator ever created a ripple of excitement. Mr. Morrissey, the well-known Railroad Brotherhood chief, made the strongest answer to Brandeis that we have seen. Concerning the extra burden to be put upon the working railroad men, he said: They decline to bear the additional burdens such a system would impose. If there should be a saving of a million dollars a day by the more economical operation for the benefit of the shipper it would come largely from labor. The suggestion contemplates the reduction of the operating force by thousands of men. The exploitation of such a system would tend to plunge the country into industrial warfare, the result of which could not be foretold, but would certainly be a brutal step towards the coarsest kind of barbarism, from which we are happily getting away from.

Prussia Going Ahead.

A locomotive of 1,000 horse-power driven by a Diesel engine has just been set to work on the Prussian State Railways. The drive is direct to the axles, and the outward appearance is similar to that of an electric locomotive. Nearly £12,000 have been spent in experimenting with this engine. The results are not yet published, but some philosophers tell us that trial is better than triumph.

Give to mankind the example of a people always guided by an exalted justice and benevolence.—*Washington.*

Electrical Department

The Development of the Electric Motor.

By A. J. Manson.

(*Continued from page 355.*)

In the previous articles we have described in detail the development of the electric motor and the work done by Davidson, Page, Siemens, Edison, Field and Daft. There are two other systems which should be described in order to make this early history complete. The first is that of J. Van Depoele and the other is the Bentley-Knight.

Van Depoele did much in the development of the electric railway. As early as 1874 he had commenced to transmit power from a dynamo electric machine for lights, and by 1882-3 he was experimenting with, and operating a railway in Chicago, using an overhead wire. In 1884 he was operating a railway at the Toronto Exposition, Canada, carrying people to the fair grounds. Instead of an overhead wire two flat copper strips were laid on the sleepers for 2,000 ft., and current was collected from these strips by brushes mounted on the locomotive. One of these strips was made the positive, the other the negative. The locomotive was nothing but a regular box-car, in which was mounted one of Van Depoele's generators used for arc lighting and equivalent to 30 h. p. Three cars made up the train, each weighing three tons and having a seating capacity of sixty persons.

The next Summer, 1885, he was operating another railway at the Toronto Exposition, and on a much larger scale. This railway connected the fair grounds wtih the station, a distance of one mile. An overhead trolley was used for the positive and the track rails as the negative; current was collected from the wire by a wheel held by spring pressure against same and connected by cable to the main switch and then to the motor. The first trip was made September 5, when a speed as high as 30 m. p. h. was reached.

The same year, on November 14, 1885, an electric road at South Bend, Indiana, was put into operation with Van Depoele apparatus. Four street cars, one with a 10 h. p. motor and three with 5 h. p. motors comprised the equipment. In order to reduce loss and drop of voltage the running rails had copper plates, placed under each joint with the rail spiked down hard. An overhead wire, ¼ in. in diameter, was used for the positive, placed centrally over the track, and current was collected by means of a carriage which ran on this wire and which was connected to the car by a cable. The cable conducted the current to the motor and also pulled this collecting device or carriage along the wire. The motors were mounted under the cars and were connected to the axles by a link belting.

The electrical equipment, installed by Van Depoele on the roads, had worked nicely and in the early Fall of 1886 he was operating the heaviest service he had yet undertaken. The trains on the Minneapolis Elevated Railroad, which were operating by steam, were handled by electric locomotives from a point on the outskirts of the city to the terminal, thus eliminating the smoke nuisance. Nearly fifty trains were run each way daily, with an average load of 91 tons. The overhead wire system was used on this installation.

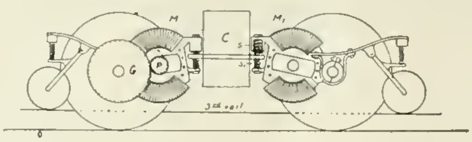


FIG. 7—SPRAGUE'S MOTOR TRUCK—1886.

By the end of the year 1886, there were several roads in operation using Van Depoele apparatus, as follows:

Port Huron, Michigan, 4 miles, single track and 8 motor cars; Detroit, Michigan, 1¾ mile, single track and 4 motor cars; Appleton, Wisconsin, 4½ miles, single and double track and 8 motor cars; Scranton, Pennsylvania, 3¼ miles, single track and 3 motor cars; Montgomery, Alabama, 11 miles, single and double track and 18 motor cars.

The Bentley-Knight system was the first to make use of the conduit for carrying the positive and negative wire underground. The conduit system is that now in use in New York City for all surface cars. The postive and negative are rails or strips of iron laid a few inches apart about one foot under ground. A surface opening about ¾ in., is provided in the center of the track. Current is collected by two contactors which are fastened on a thin, flat "plow," as it is called, and which in turn is carried along by the car. Flat leads connect the motor to the contactors which rub on the power rails. The first mile of road using this system was built in Cleveland in 1883, with plans for 1½-mile extension. The single motor car stood all tests and was in operation during all kinds of weather. The motor, weighing 1,000 lbs., was mounted between the wheels of a two-ton horse-car, and was connected to the driving axle by friction gears and link belts. This system was a success and it was not long before other roads adopted it.

At the time Daft commenced to electrify the Ninth Avenue Elevated, New York, for his experiments with the "Benjamin Franklin," the Electric Railway Company of America, which had built the "Judge," got out plans, which they said would be feasible, for electrifying 14½ miles of the New York Elevated Railroad from Harlem River to the Battery. These plans were not carried out, but later the company operated a locomotive on a branch line of the elevated, which we will describe in the proper sequence of events.

We come now to describe the work of the man, whose foresight and courage to carry through what he knew to be the solution of the railway problem, brought electric traction where it is today. This man is Frank J. Sprague. As shown in our past articles, the electric locomotive and electric railway, although showing wonderful growth, were far removed from our present-day practice. The great step in the development of the electric motor was made by Sprague.

Little was known of him until the Fall of 1884, when he exhibited a number of small electric machines at the Electrical Exhibition in Philadelphia. In December, 1885, he delivered a lecture before the Society of Arts, Boston, Mass., on the elevated railroads of New York, which were then operating with steam locomotives. Due to the growth of the city and indications of what the population would be, it was necessary to increase the carrying capacity. He outlined in his lecture the work required of the steam locomotives and stated that the number of trains could not be increased. The weight of the steam locomotive could not be increased, owing to the extra strain which would be put on the steel work. Increasing the length of the train would not endanger the structure, however, due to the weight being properly distributed, and he stated that to solve the problem it would be necesary to turn to the electric system. His recommendations were to distribute the power under the cars, controlling the same simultaneously, and in this manner any length of train could be operated. As the power would be under each car a large weight would be made use of for traction and this would be at least six times that of the steam locomotive. With this increased traction the acceleration of the train would be increased and in turn, the capacity of the road.

The next year, 1886, Sprague was experimenting with a full-sized elevated railroad car, which had been put at his disposal and on which he had mounted two motors, on the north track of the Thirty-fourth street branch of the Manhattan Railroad. The voltage chosen for these experiments was 600 volts, a voltage which was higher than ever used before for railway work, and which is that used mostly today. The reason for choosing such a high voltage, compared with what had been used, was to obtain a voltage which would be most satisfactory if the whole elevated road was electrified. A very large amount of power would be required to move and accelerate all of the trains. Power is the product of volts by amperes or current, so that the higher the voltage or pressure, the less the current for the same power, and the less the amount of copper in wires, etc., for transmitting this current to the trains. The greater the current the larger the copper wire necessary in order that the resistance against the flow of current will not be too great. The flow of current along or through a wire is analogous to water flowing through a pipe. The size of pipe must be increased to allow the water to flow without excessive drop in pressure.

A third rail located centrally between the track, and three to four inches higher, was laid for the positive, while the running rails were grounded and connected to the iron structure at intervals.

The car was equipped with two motors on one truck, as shown by Fig. 7, each occupying the space between the axle and the center cross-piece. This method of mounting motors was entirely novel and different from any other arrangement. Here was a radical departure and the method of mounting these two motors on one truck is practically the same as the method made use of today. Referring to Fig. 7, *C* is the center cross-piece with center plate. One end of each motor, *M* and M_1 are fastened to this cross-piece, but not solidly. Springs, *S* and S_1, are placed on top and bottom, to take up the shocks which would result if the motor was bolted directly to the center-piece, and also to provide a flexible and cushioning effect on the gears, *G*, and pinions, *P*, when the motor is transmitting power to the driving axles. The other end of each motor was supported on the axle and a split bearing was used so that same could be easily replaced. The pinions, one on each end of the armature shafts, were made of forged steel and were of 3-in. face and contained 13 teeth. The gears of 66 teeth were split gears mounted close to the hub of the wheels. One gear on each axle was adjustable so that the teeth on both pinions on one motor amature shaft could be made to mesh properly with the gears and not have all of the work taken by one gear. The motors were extremely light for the power they developed.

The motors were wound with two sets of field windings. One coil was connected in shunt, and the other in series, with the armature. The former remained constant for constant voltage, while the latter varied as the load on the motor. The field coils were such that the field was very strong at start, which would give a large starting torque, or turning power. At the start a resistance was placed in series with the armature. Increased speed was obtained by cutting this resistance out step by step, and then inserting same in the shunt-field circuit, thus weakening the field and increasing the speed. Due to the design of the motor, only one set of brushes was needed for both directions of rotations, and the reversal was obtained not by means of brushes as heretofore, but by changing the direction of flow of the current

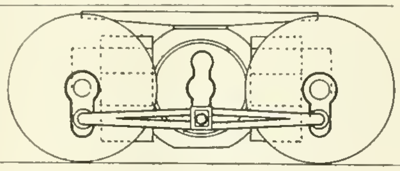


FIG. 8—DRIVING TRUCK FIELDS LOCOMOTIVE—1887.

through the armature. The two motors were connected in parallel with each other and controlled from one source, which was the first time that two motors were simultaneously controlled.

The car was controlled by means of four rods leading to the platform. The first was used for operating a switch to open and close the main circuit; the second was used for reversing the connections to the brushes so that reverse motion could be obtained; the third was used for disconnecting the armature from the circuit, leaving the shunt field still energized, and connecting same to the resistance, which was used when starting up, through the regulating apparatus operated by the fourth rod. This fourth rod, resembling a brake wheel, regulated the amount of resistance in the armature circuit and thus the rate of braking of the train. This was the only method of braking used and is explained as follows:

When the armature is disconnected from the circuit, with the fields still energized, it is still revolving due to the movement or coasting of the car. Here is an armature revolving in a field and instead of a motor we have a generator. When the armature is connected to the resistance a current flows and the amount depends on the value of the resistance. It takes power to generate this current and same is done at the expense of tne movement of the car and the result is braking. The experiments were discontinued at the end of the year. During the whole time no air brakes were used and the car was under perfect control.

In May, 1887, Sprague signed a contract for installing an electric railway in Richmond, Virginia. This was a remarkable contract, for it called for eleven miles of road to be built and electrified, and forty cars to be equipped, all within ninety days. The road was made up of 29 curves, and grades as high as eight per cent. with one curve and grade combined equal to a twelve per cent. grade. At that time the system Sprague used was only on paper, and the only results as to the reliability of his motor, which he had obtained, were the results from his tests carried on with the car on the 34th street branch of the Manhattan Railway. It took courage and enthusiasm to accept a contract of this nature, especially at that time when electric apparatus was not developed, but the road was a grand success and it was the beginning of the modern development.

An overhead conductor was used, held up by poles mounted side of the track. The cars used were single truck cars. The motors were similar to those on Sprague's test car and due to the non-use of a cross piece on these single truck cars, one end of the motor was suspended from the car body, springs being provided on top and bottom of this suspension so as to take up the shocks. The motors weighed 800 lbs., and were of 7½ h. p. each, normal rating, and capable of giving 30 h. p. for short periods. Each armature shaft was fitted with a three-inch pinion in either end meshing with 22 in. split gears.

The success of this road was wonderful. Eighty to one hundred and ten miles were made per car per day with loads fifty per cent. above normal. The cars ran 6,000 to 8,000 miles without going to the car barns for repairs and stood outdoors in all kinds of weather without any appreciable damage.

As mentioned above the Electric Railway Company, of which Stephen D. Field, was the head, had gotten out plans for electrifying the elevated railroad. By the Fall of 1887 they had built a locomotive and had operated it on the 34th street branch. The locomotive had the motor mounted between the driving wheels and connected to same by crank and side rod. The motors were series wound and the speed was regulated by means of a water rheostat. This rheostat consisted of tank partially filled with water to which had been added a very small quantity of acid. Two plates, one connected to the power and the other connected to the motor, were placed in the water. Current would then flow, the amount depending on the depth the plates were dipped into the water. Fig. 8 is the outline of the driving truck of this locomotive, showing the location of the motor and side rods. Following is some data on the locomotive:

Weight of motor	9 tons.
Weight of armature	1 ton.
Total weight locomotive	13 tons.
Diameter drivers	3 ft.
Driving wheel base	5 ft.

(*To be continued.*)

Simple Test of Coal.

There is a very simple test for coal that ought to be known to every person interested in fuel, more especially the fuel agents of railways. It is based on the quantity of pure lead that will be released from its oxide by a given weight of carbon. Litharge is oxide of lead, and contains 34.5 units of lead to one of oxygen. When finely powdered coal mixed with oxide of lead is heated to the combing temperature, the oxygen of the compound unites with the carbon and leaves the metallic lead. The quantity of lead precipitated gives the means of determining how much carbon there was in the coal.

Let a sample of coal under examination be heated with forty times its weight of pure litharge. The weight of the lead formed will give a basis for ascertaining the percentage of carbon in the coal. The weight of the lead will vary from twenty to thirty times the weight of the coal. If the weight of lead is twenty-five times the weight of the coal employed the percentage of carbon in the coal will be about $\frac{25}{34.5}$.

Any one inclined to make the litharge-coal experiment should take a piece of inch iron tube about two feet long, put a threaded cap on one end and a reducer at the other, to which is fastened a piece of ¼-in. gas pipe about 3 ft. long and open at the end. One ounce of finely powdered coal mixed with forty times its weight of pure litharge is placed in the tube. This is pushed into a hot fire with the gas pipe slanting outward. The mixture will boil quickly, giving off a stream of gas which can be felt by the finger. When the gas ceases to flow the tube should be removed from the fire. A sharp rap will send the button of lead to the bottom of the tube. The weight of the lead button will, by the calculation given, show the percentage of pure carbon in the coal.

Product of the Dead Sea.

The awful desolation of the Dead Sea, which lies nearly 1,300 feet below the level of the Mediterranean, is broken here and there by the salt divers, whose work is probably as ancient as the human race itself.

From remotest antiquity the salt of the Dead Sea has been collected and brought to the Jerusalem market, where it is used for curing hides and for domestic purposes. Dead Sea water contains over 25 per cent. of solid substances, of which 7 per cent. is chloride of sodium, or common salt.

The Dead Sea contains no living creature. Sea fish put into its waters speedily die. Not a single boat navigates its strange waters, nor is there any sign of life, save the isolated parties of salt divers, who scrape and slowly amass their glistening heaps of crystal near the mouth of the Jordan.

When a sufficient cargo is made ready, a long string of camels crosses the desert, and the salt is loaded up into panniers, or "shwerries," and taken into Jerusalem, where it finds a ready market.

Salt, as is well known, has been used as currency from time immemorial, just as bricks of tea are used today in central Asia, especially in the borderland of China and Siberia.

When Steel Forced Itself Into Favor.

Steel came into use for industrial purposes through the short-sighted policy of iron makers who fell into the habit of making their products of such unreliable character that it could not be depended upon. Iron had a wonderful hold on popular favor and was only brought into disrepute through the mistaken policy of the makers who were not satisfied with a fair profit.

When Krupp, of Essen, Germany, in 1847, made his first cannon of steel military engineers ridiculed the metallurgist and protested that he would be offering them glass guns next. That sentiment extended to all the early attempts to introduce steel for engineering purposes; but ridicule prejudice and interest in other material all failed to delay the progress of steel into favor. Some of the early steel makers were inclined to follow the iron masters in offering inferior products unsuitable for high-class purposes, but that inclination was soon checked. The worst practice tried was filling orders with Bessemer steel when open hearth steel was absolutely necessary. That practice has not yet entirely ceased, but reputable concerns are above that mean species of stealing.

Water Purification.

When the subject of water purification was under discussion at the Master Mechanics' Convention, Dr. Sinclair said:

"I have had considerable experience in my time in trying to eliminate impurities from feed water. I had the pleasure of acting as a railway chemist at one time, with special attention to the prevention of scale and other impurities in boilers due to bad water. That made me pay a great deal of attention to what different railroads were doing to eliminate scale-making impurities from their feed water. I might say that the prevailing practices reminds me of a story told in the Highlands of Scotland. It was a district where there were few inhabitants and no doctors, and a traveler wanted to know what they did when anybody got sick. A native answered, 'Give them a drink of whiskey.' 'But,' said the traveler, 'if that did not help the patient, what would you do then?' 'Give him another drink,' was the reply. 'Suppose the second drink didn't do him any good, then what would you do?' was the next question. 'Well,' said the native, 'if a man is so bad that he can't be helped by whiskey, when he isn't worth helping.' (laughter).

"So it seems to me that nearly the same process is followed with the treatment of feed water. There are certain waters that contain elements that cause encrustation, and they are not the same in all waters. Yet the officials of many railroads take the same dose and apply it to all kinds of water and, if the dose they give doesn't remedy the evil, they think the case isn't worth curing.

"The fact of the matter is that all bad feed waters should be under the supervision of a chemist who is able to tell by analysis what should be done and what elements will put the bad encrusting matter out of solution. That is something that is not understood by every man connected with a feed-water station, and it ought to be systematically attended to if any remedy it attempted at all. I think the greatest disappointments in connection with water purification, or the preventing of the bad effects of hard water, have been ignorance in the treatment."

Efficiency—Works or Faith.

In an ideal state, practice and theory would go hand in hand, like twin brothers. In the present condition of things, however, there is perpetual rivalry between them. Their relative value may be best explained by an illustration borrowed from the well-worn theological controversy respecting faith and works. A couple of belligerent Divines—so runs the story—were in the habit of renewing their discussions concerning the relative merits of faith and works every time they crossed a river. One day they found their old friend, the waterman, had scrawled "faith" on one oar and "works" on the other. They smiled at his whim, but soon found out what he meant, for, when in the middle of the stream, he dropped "works" and pulled only with "faith," getting on never a rod. Then, taking "works" alone, he had no better success. Finally, with "faith" in one hand and "works" in the other, he shot across to the shore. Now, substitute "theory" for "faith," and "practice" for "works," and the moral of the story will be evident.

Mikado Type Locomotives for the Illinois Central Railroad.

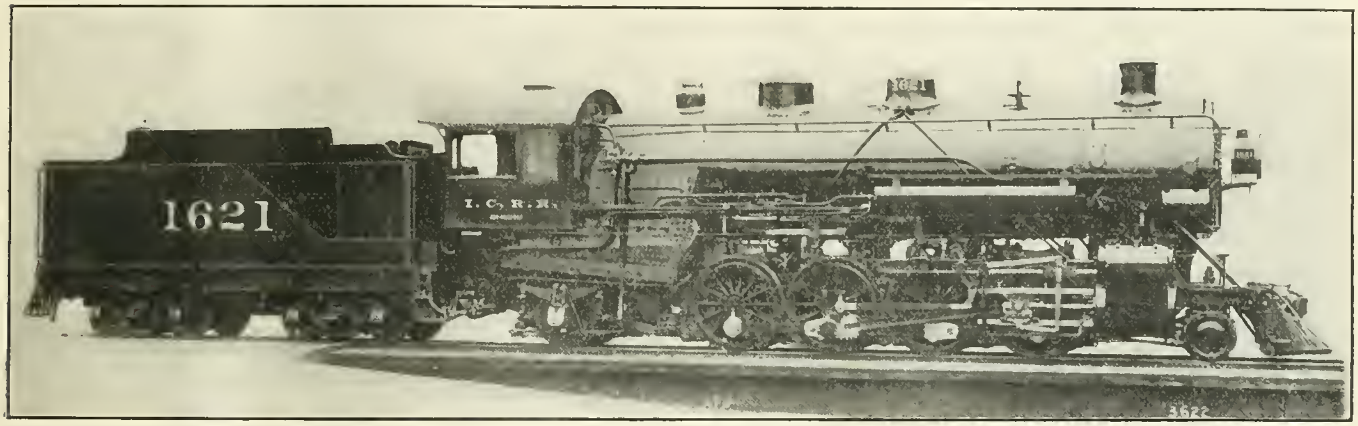
The Baldwin Locomotive Works has recently completed, for the Illinois Central Railroad, 50 Mikado type locomotives which are of special interest because of their design and capacity, and also because of the increasing use of this type of engine in heavy freight service. The principal business of the new engines will be to handle coal traffic between Centralia and Chicago, and Freeport and East St. Louis. These locomotives can exert about 30 per cent. more tractive force than the Consolidation type engines heretofore used in this service, and it is expected that they will be fully capable of meeting requirements on this road for some time to come. Superheated steam is used in single expansion cylinders, and the tractive force developed, with a mean effective pressure equal to 85 per cent. boiler pressure, is 51,700 pounds.

The boiler has a straight top and is built with "diamond" longitudinal seams. The fire-box crown is stayed by radial bolts, with two I-bars in front; and 400 flexible bolts are located in the sides, throat and back. No brick arch is used, but provision is made for blowing four steam jets into the furnace on each side, approximately on a level with the bottom row of tubes. The steam supply is drawn from the turret in the cab, and the nozzles are located in 2-in. tubes which are placed in the side water legs.

The superheater is of the top header, smoke-tube type, and is composed of 36 elements which are located in an equal number of 5⅜-in. tubes. The live steam pipes deliver steam directly into the top of the steam chests. A steel flange is bolted to the exterior of the smoke-box on each side, and to this flange is secured a malleable iron sleeve forming an air-tight joint with the steam pipe boss on the cylinder casting. The steam pipe passes through the flange and sleeve. With this arrangement of piping there is comparatively little obstruction in the smoke-box, and the superheater and tube ends are easily accessible.

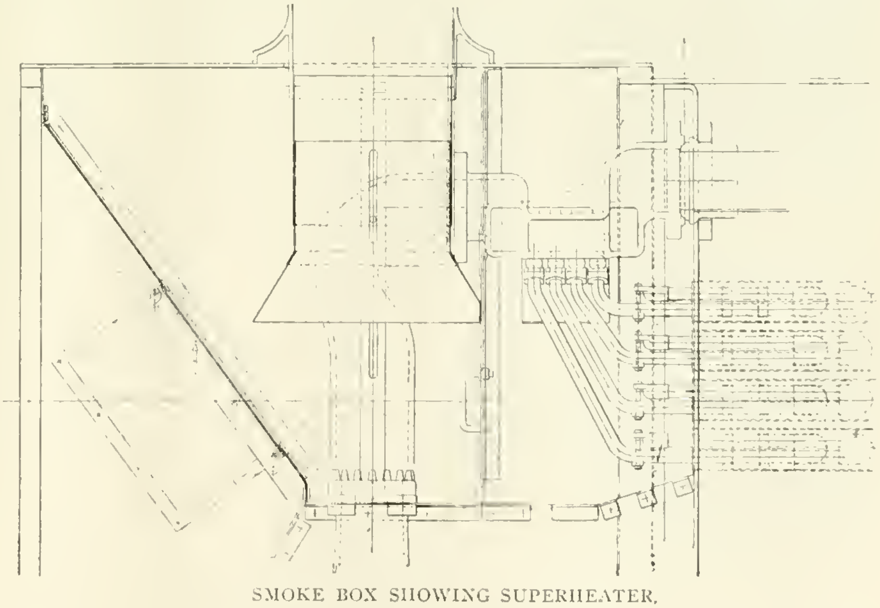
The cylinders are provided with bushings ¾-in. thick, which are inserted from the front and line the barrel as far back as the rear counterbore. The steam distribution is controlled by 15-in. piston valves. These are set with a maximum travel of 6½ ins., and a lead of ¼ in., and they have a steam lap of 1¼ ins., and are line-and-line on their exhaust edges. No circulating valves are used on these cylinders, but a vacuum relief valve is tapped into the outer wall of each steam chest above the live steam compartment. The valve motion is of the Walschaerts type, and the gear is controlled by the Baldwin power reverse mechanism.

The frames are of cast steel, 4½ ins. wide, with double front rails and separate rear sections. The frame bracing is most substantial. The guide yoke is bolted to a steel casting which is placed between the first and second pairs of driving-wheels, and has a long bearing on the top frame rails. A second casting, located ahead of the main drivers, supports the link bearings. These are placed outside the wheels, and are bolted in front to the guide yoke. In this way, those structural parts which support the motion work also assist in bracing the frames. The front pedestal legs at the main and rear pedestals, are braced by deep steel castings, and mid-way between the main and rear pairs of wheels a broad casting braces the top frame rails and serves as a support for a waist sheet. A heavy cross-tie is also located under the front end of the firebox, where the rear frames are spliced to the main sections. The front and back deck plates are of cast steel, and the front bumper is of the same material.



MIKADO TYPE LOCOMOTIVES FOR THE ILLINOIS CENTRAL RAILROAD.
M. K. Barnum, General Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The equalization system is divided between the second and third pairs of driving wheels. The rear truck is of the Hodges type, and it is fitted with a centering spring. The latter is mounted in pockets which are cast in one piece with the back transverse equalizer. The thrust-bar of the spring is mounted between lugs bolted to the truck frame. When the engine enters a curve, the thrust bar is displaced and the spring is thrown into compression, thus tending to restore the alinement.



SMOKE BOX SHOWING SUPERHEATER.

The main driving axle is of "Standard" heat treated steel, while the remaining axles are of open hearth forged steel. "Standard" rolled steel wheels are used in the front engine and tender trucks.

The tender frame is composed of 12-in. steel channels, weighing 40 lbs. per foot. The end sills are of cast steel. The tank has a water bottom and carries 9,000 gallons of water and 15 tons of coal.

This is a heavy locomotive of its type, and with comparatively large wheels and ample steaming capacity, aided in the present instance by a superheater, it should prove highly efficient in the service for which it has been designed. The principal dimensions are presented in the table.

Gauge, 4 ft. 8½ ins.

Cylinders, 27 ins. x 30 ins.

Valves, balanced piston.

Boiler.—Type, straight; material, steel; diameter, 82 ins.; thickness of sheets, ¾ in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 120⅝ ins.; width, 84 ins.; depth, front, 87¼ ins.; depth, back, 74 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water space.—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Diameter, 5⅜ ins. and 2 ins.; material, steel; thickness, 5⅜ ins., No. 9 W. G.; thickness, 2 ins., 0.125 ins.; number, 5⅜ ins., 36; 2 ins., 262; length, 20 ft. 6 ins.

Heating surface.—Firebox, 235 sq. ft.; tubes, 3833 sq. ft.; total, 4068 sq. ft; grate area, 70 sq. ft.

Driving wheels.—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, main, 11 ins. x 12 ins.; journals, others, 9 ins. x 12 ins.

Engine truck wheels.—Diameter, front, 30½ ins.; journals, 6 ins. x 10 ins.; diameter, back, 45 ins.; journals, 8 ins. x 14 ins.

Wheel base.—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins.; total engine, 35 ft. 2 ins.; total engine and tender, 65 ft. 1⅜ in.

Weight.—On driving wheels, 218,300 lbs.; on truck, front, 25,050 lbs.; on truck, back, 40,500 lbs.; total engine, 283,850 lbs.; total engine and tender about 455,000 lbs.

Tender.—Wheels, number, 8; wheels diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9,000 gals.; fuel capacity, 15 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 1,093 sq. ft.

Speed of Wood Working Machinery.

In spite of the prevailing ambition among mechanics to understand all details of their business, very few men know much about the speed of wood working tools. An iron working tool does its work by sheer slow force, but a wood working tool owes its efficiency to a succession of quick blows like the action of a properly wielded axe.

Great power is required to drive a wood working machine, and that is due to the enormous capacity of these machines for doing work. Wood is more easily cut that iron or other metals, but the material is cut so rapidly that it represents immense concentration of power.

A properly driven circular saw has a peripheral speed of 7,000 ft. per minute —nearly a mile and a half. A band saw is run at about the same speed. Planing machine cutters have a speed of about 6,000 ft. per minute, and the cutters of molding machines slice out material at about 4,000 ft. per minute. Augers 1½ in. diameter are run 900 revolutions per minute, and those half that size are run at 1,200 revolutions per minute. Mortising machine cutters make about 300 strokes per minute.

Persons interested in this subject should send for J. A. Fay & Egans' illustrated catalogue.

Large Transformers.

The Baltimore substation of the Pennsylvania Water and Power Company, which generates power from the Susquehanna River at McCall's Ferry and transmits it 40 miles to Baltimore, now contains four Westinghouse transformers, which are believed to be the largest ever built. They are employed to step down the 25-cycle current from 70,000 volts, which is the transmission voltage, to a potential of 13,200 volts, at which it is distributed to other substations around the city. Each transformer is rated at 10,000 k. v. a., and is of the water-cooled type. The tank which forms the shell is an ellipse, having an overall length of 15 ft. 11 in. and a width of 8 ft. 8 in. The height to the uppermost part of the terminals on the top of the transformer is over 16 ft., and the height from the floor to the joint between the tank and the cover is 11½ ft. from the floor line.

The Premium Apprentice.

In British workshops a practice originated many years ago of employing what was known as "premium apprentices." The youths who were employed under this title, instead of receiving pay for the work they performed, paid a premium to be permitted to learn the trade. This practice has been gradually falling into disrepute. The following note, taken from the London *Times*, indicates that the premium apprentice will soon be a thing of the past.

"The growing feeling of objection to the appointment of premium pupils, or apprentices without salary, in municipal undertakings, was manifested at the last meeting of the Chefffield City Council. In the past a number of pupils have been appointed on these terms, but when it was proposed to engage another, for the generating station at the electric light works, strong objection came from both the Labor and Conservative sides of the council. Alderman Marsh, head of the firm of Messrs. Marsh Bros., contended that it was a wrong principle to give articled pupils no salary, as they worked infinitely better if they were paid, even though they received only 2s. 6d. or 5s. per week. The Master Cutler (Alderman Senior) declared, from his experience in connection with the electric light undertaking when it belonged to a private company, that he had never known a premium pupil worth his salt.

"An amendment against the appointment was carried, and it is anticipated that the committee will now reconsider the whole question of premium pupils, of whom a good many are engaged in the works."

Telephone Train Dispatching.

The United States Electric Company, New York and Chicago, has received an order from the Bessemer & Lake Erie Railroad Company for thirty-six Gill selector equipments, bells to be rung by main-line battery; also the Gill calling keys and the telephone equipment necessary for the installation of the circuit. The same company is also furnishing for the Oregon-Washington Railway & Navigation Company twenty-five No. 502 Gill main-line selector outfits, including the United States Electric Company's universal resistance and calling keys to operate the circuit.

Knocking.

Should a considerable "knock" become apparent when running an engine, it should be the engineer's business to make a thorough examination of the motion at the earliest possible opportunity. There are many places in which the knock may have developed, and it is not always possible to locate it while the engine is moving, so that the following parts are those which should be investigated with a view to discovering the trouble:—all the guides and their bolts, the crosshead cotters, small and brasses and adjusting bolts, the big-end brasses, bolts and straps, and finally the axle box wedge bolts, which sometimes slack back and occasion a heavy knock. Climatic conditions have much to do with the liability to heating and consequent knocking.

Rank and rectitude alike are pleasant gifts; but the moment that one derives a sense of merit from the fortuitous possession of them, that moment one crosses the border-line of vulgarity, and is daubed with the malodorous slime.—*A. C. Benson.*

Questions Answered

FULCRUM OF DRIVING WHEELS.

73. R. L. B., Wheeling, W. Virginia, writes: We had a lively discussion in the roundhouse at noon one day last week about what point forms the fulcrum of driving wheels when a locomotive is working steam. I held that the axle boxes form the fulcrum of applied power, and others held that it was on the rail. What do you say?

A.—At the rail. A locomotive has the same principle of propulsion as a bicycle and it has no driving axle box.

CO-EFFICIENT OF FRICTION.

74. B. R. S., Cedar Rapids, Ia., writes: "Co-efficient of friction" is occasionally used in your paper, but no explanation is given of its meaning. Can you throw a little light upon the subject?

A.—As used in our pages, co-efficient of friction generally means the proportion of the weight of a body that is necessary to overcome the resistance to movement. Thus, if you put a block of iron weighing say 10 lbs., on a flat surface and attach a string to it, the amount of pull required to move the block will give the co-efficient of friction. If a pull of 2 pounds moves the block the co-efficient of friction will be 2/10 or 1/5. A similar expression very familiar to railway men is the co-efficient of adhesion. This is the proportion of weight on the driving wheels in relation to the power applied to cause slipping.

HEATED ELECTRIC STRAP.

75. W. T., Cedar Rapids, Ia., writes: The eccentric straps seem to be giving us more trouble than ever during the heated season. What is the best method of cooling or keeping cool?—A. When you have a chance of stopping the engine, slacken the bolts holding the two parts of the eccentric strap together. Put in an extra tin liner or two, which you should always have with you, but if not at hand, stiff paper will do. Tighten the bolts, and oil the eccentric thoroughly, added a supply of graphite. If the eccentric straps are of cast iron, they should not be cooled with water. When a strap persists in heating, it is safer with the shortest possible stroke of the valve, as the long valve stroke throws greater stress upon the valve straps.

HORSE POWER.

76. W. K., Omaha, Neb., writes: We had some discussion in regard to the horse power of a locomotive weighing 143,000 lbs., cylinders 22 x 28 ins., driving wheels 50 ins. in diameter, 160 lbs. pressure, 8 driving wheels.—A. A locomotive of these dimensions running at 20 miles an hour, making 135 revolutions per minute, would develop 960 horse power.

CROSSED ECCENTRIC RODS.

77. L. R. B., Escanaba, Michigan, writes: With crossed eccentric rods is it possible to make an adjustment in the valve motion to prevent a decrease of lead as the reverse lever is "hooked up"?

A.—There is no adjustment made to prevent the decrease or increase of lead in locomotives that are intended to run both backwards and forwards drawing load. Experiments have been made in the case of locomotives intended for pulling loads in one direction only looking towards the perfect adjustment of the forward motion by allowing the back eccentric and rod to be considerably out of their proper position, but an adjustment of this kind is not to be commended. The best practice is to adjust the entire valve gearing as correctly as possible at the point of cut-off where the locomotive is likely to perform the greatest amount of its work. Crossed rods have never come into popular favor, and are now almost entirely obsolete.

SAND VALVES.

78. J. L., Jersey City, writes: In regard to slippery rails during wet weather, is it best to keep a small stream of sand running all the time on the rails, or to open the sand valves now and then?—

A. Many locomotives are now fitted with pneumatic sanders, and by their use a fine stream of sand can be kept running without too much loss of sand, but with ordinary sand valves, such a fine flow is impossible, and fairly good results can be obtained by occasionally opening and shutting the valves. A certain amount of sand will in wet weather adhere to the wheels and aid the adhesion of the wheels to the rails, and an occasional opening of the sand valves, say three or four times in a mile, will help over the slippiest track. No exact rule can be laid down, and one must be guided largely by experience.

LEAKY THROTTLE VALVE.

79. R. U., Sheridan, Wyo., writes: I have had trouble with a leaking throttle valve. The night foreman says it must be the dry pipe joint, as the throttle valve has been carefully refitted. How can you tell without taking the pipes apart? —A. A leak in the throttle valve will always show dry steam, whereas a leak in the dry pipe will show more or less water, as it is near the water line. When an opportunity occurs the dry pipe can be entirely submerged in water, leaving the throttle pipe and valve dry, when a leak in the dry pipe will show water readily.

POSITION OF WAY CARS.

80. J. L. Low, engineer, Spokane, Wash, writes: I would like to have your opinion as to where would be the best place to put way cars in a train when handling trains over a hilly division.

A.—Way cars placed at the front of the train is perhaps more convenient for the engine and crew, in case the cars have to be set out on a side track. When they are put at the back of the train it is more convenient for the conductor, as it lets the train pull further ahead and brings the conductor and station agent together, thereby avoiding the trouble of the conductor having to walk the entire length of the train. The hilly division does not materially affect the general practice that way be found most convenient because the stations are not all on high points or in hollows. The general practice is that way cars are placed at the rear end of trains.

DISCONNECTING RODS.

81. J. D., East Somerville, Mass., writes: Would it be good practice in disconnecting an eight-wheel locomotive for a broken middle section side rod, to remove all side rods on disabled side and the main rod also, and run engine with all the rods up on the opposite side?

A.—If the rods are removed from one side of an engine they must in all cases be removed from the other side also. In the case referred to we presume it is a 2-8-0 type of locomotive, and if the main crank pin is uninjured, the main rod should be allowed to remain in place and also the rods on both sides connecting the front drivers, and the engine could be run similar to an Atlantic type of locomotive.

Hardening cracks are more often the result of uneven heating than of any defect in the steel. Do not determine the quality of any steel by the appearance of the fracture of a piece. The grain, whether fine or coarse, depends principally upon the heat at which it was finished by the hammer or rolls. Do not try to harden any bar of steel without first removing the scale from it.

A Swiss engineer who contributed a paper to an engineering society recently, made the statement that Switzerland has 120 steam locomotives and 45 electric locomotives arranged for working on rack gear lines. The first Swiss rack rail railway was made in imitation of Mount Washington Railroad. The longest is said to be the Mount Blanc scenic railway.

Items of Personal Interest

Mr. E. R. Lockhart has been appointed master mechanic of the Missouri Pacific at Hoisington, Kan.

Mr. J. T. Robinson has been appointed master mechanic of the Missouri Pacific, at Osawatomie, Kan.

Mr. G. L. Gay has been appointed chief dispatcher of the Missouri, Oklahoma & Gulf, at Calvin, Okla.

Mr. Albert Hoagland has been appointed tool foreman of the Missouri Pacific at Hoisington, Kan.

Mr. F. C. Moeller has been appointed night roundhouse foreman of the Rock Island lines at Silvis, Ill.

Mr. E. E. Bradley has been appointed signal engineer of the Western Maryland, with office at Baltimore, Md.

Mr. W. J. McGee has been appointed master mechanic of the Texas & Pacific, with office at Gouldsboro, La.

Mr. H. A. Witzig has been appointed master mechanic of the Missouri Southern, with office at Leeper, Mo.

Mr. W. O. Morton has been appointed night roundhouse foreman at Burr Oak, Ill., on the Rock Island Lines.

Mr. F. W. Brown is appointed superintendent of the Louisville Lines, with headquarters at Louisville, Ky.

Mr. W. H. Donley has been appointed master mechanic of the Illinois Central, with office at East St. Louis, Ill.

Mr. Don E. Irvine has been appointed traveling engineer of the Panama Railroad in place of A. C. Stone, resigned.

Mr. J. W. Thomson has been appointed chief electrician of the Chicago & Alton, with headquarters at Bloomington, Ill.

Mr. D. W. Cross, has been appointed master mechanic of the Toledo, St. Louis & Western, with office at Frankfort, Ind.

Mr. W. H. Gunzelman has been appointed dispatcher of the first and second districts of the Monon, at Lafayette, Ind.

Mr. T. H. Williams has been appointed master mechanic of the International & Great Northern, with office at Mart, Tex.

Mr. A. C. Stone, traveling engineer Panama Railroad, has resigned to engage in real estate business in Rochester, N. Y.

Mr. W. W. Morrow has been appointed general foreman of the Santa Fe at Prescott, Ariz., in place of Mr. C. F. Ryer, resigned.

Mr. F. E. Smith has been appointed road foreman of engines, Cincinnati division, in place of Mr. W. D. Cooper, promoted.

Mr. A. W. Davis has been appointed to the position of locomotive foreman on the G. T. R. system, with headquarters at Stratford, Ont.

Mr. R. H. Collins has been appointed inspector of roundhouse and shop efficiency of the 'Frisco system, with office at Springfield, Mo.

Mr. D. W. Cross has been appointed acting master mechanic of the Toledo, St. Louis & Western, with headquarters at Frankfort, Ind.

Mr. W. H. Sample has been appointed master mechanic of the Grand Trunk, at Ottawa, Ont., in place of Mr. R. Cowan, assigned to other duties.

Mr. P. H. Reeves, motive power inspector of the Baltimore & Ohio Southwestern, at Cincinnati, Ohio, has been appointed master mechanic.

Mr. J. D. Maupin, master mechanic of the Trinity & Brazos Valley, has been appointed superintendent of motive power, with office at League, Tex.

Mr. P. Laden, superintendent of the Illinois Central, has been appointed general manager of the Missouri, Oklahoma & Gulf, at Muskogee, Okla.

Mr. F. M. Kerwin has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific at Silvis, Ill., in place of Mr. T. Kilpatrick, promoted.

Mr. A. B. Barker, formerly roundhouse foreman at the Missouri Pacific shops, Nevada City, has been transferred to Joplin, Mo., as division foreman.

Mr. F. S. Rodger has been appointed assistant district master mechanic of the Superior division of the Chicago, Milwaukee & St. Paul, at Marion, Iowa.

Mr. G. W. French, master mechanic of the Missouri Pacific, with office at Ferriday, La., has been transferred to Paragould, Ark., as master mechanic.

Mr. George Verner, air brake foreman at the G. T. R. shops, Stratford, Canada, has accepted the position of master mechanic of the C. N. R. at Kamsack, Sask.

Mr. A. A. McGregor has been appointed assistant master mechanic of the Louisville & Nashville, with office at Evansville, Ind., succeeding the late Mr. J. B. Huff.

Mr. W. D. Cooper, for several years road foreman of engines, Cincinnati division of the Erie, has been appointed supervisor of locomotive operation in the same district.

Mr. H. D. Voohees, assistant to President Daniel Willard of the Baltimore & Ohio, has been appointed general superintendent of transportation of the Baltimore & Ohio.

Mr. J. W. McKee, master mechanic of the International & Great Northern, at Mart, Texas, has been appointed master mechanic of the Texas & Pacific at Gouldsboro, La

Mr. M. Marea, master mechanic of the Toledo, St. Louis & Western at Frankfort, Ind., has been appointed master mechanic on the Troy & Easton, with office at Madison, Ill.

Mr. J. F. Gannoway, chief dispatcher of the Spokane, Portland & Seattle, has been appointed trainmaster and chief dispatcher of the Spokane & Inland Empire, at Spokane, Wash.

Mr. R. Tamman has been appointed master mechanic of the Virginia Railway and Power Company, of Richmond, Va., and will have charge of the Richmond, Interurban and Petersburg divisions.

Mr. F. G. Colwell has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western, with office at East Buffalo, N. Y., in place of Mr. B. H. Hawkins, resigned.

Mr. W. A. Curley, general foreman of the Missouri Pacific shops at Poplar Bluff, Mo., has been appointed master mechanic, with office at Ferriday, La., in place of Mr. G. W. French, transferred.

Mr. C. H. Dallow has been appointed purchasing agent of the Louisville & Northern Railway & Lighting Company, New Albany, Ind. Mr. Dallow has been in the employ of the company for a number of years.

Mr. F. J. Macleod, Cambridge, Mass., has been appointed chairman of the Massachusetts Railroad Commission. He is a native of Prince Edward Island, and is an expert on railroad laws and regulations.

Mr. N. S. Reeder, vice-president of the Western Steel Car & Foundry Company, Chicago, Ill., has been elected second vice-president of the Pressed Steel Car Company. Mr. Reeder will continue his Chicago location.

Mr. John P. Sykes, assistant general superintendent of the Baldwin Locomotive Works, Philadelphia, Pa., has been made general superintendent, in place of Mr. S. M. Vauclain, who has been elected vice-president.

Mr. W. A. Sterns has resigned his position as mechanical engineer with the Louisville & Nashville Railroad Company, and has been appointed chief mechanical engineer of the American Steel Foundries at St. Louis, Mo.

Mr. R. B. Seymour having resigned the office of chief engineer of the Chicago, Indiana & Southern, the office is abolished, and Mr. M. C. Cleveland is appointed engineer maintenance of way, with headquarters at Gibson, Ind.

Mr. James R. Shea, an engineer on the Duluth & Iron Range Railroad, has been promoted to the position of traveling engineer, with headquarters at Two Harbors, Minn. Mr. Shea has been 22 years in the employment of the company.

Mr. Wm. Owens, who has been for many years a locomotive engineer on the Lehigh Valley Railroad, has been appointed general manager of the Western district of the New York Air Brake Company, with headquarters at Denver, Colo.

Mr. F. A. Linderman, supervisor of boilers of the New York Central & Hudson River, at West Albany, N. Y., has been appointed district superintendent of motive power of the Ontario & St. Lawrence division, with office at Oswego, N. Y.

Mr. D. S. Smith has been appointed general manager of the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company, Minneapolis, Minn. Mr. Smith was for several years general superintendent of the Brooklyn, N. Y., Rapid Transit Company.

Additional shop superintendents have been appointed on the Missouri Pacific. These include Mr. W. C. Smith, Kansas City, Kan.; Mr. E. F. Stroch, Hoisington, Kan.; Mr. B. J. Peasley, De Soto, Mo.; Mr. B. E. Stevens, Argenta, Ark., and Mr. M. J. McGraw, at Sedalia, Mo.

Mr. J. F. Long has been appointed master mechanic, southwestern division of the St. Louis & San Francisco, with headquarters at Sapulpa, Okla. Mr. Long has been acting general foreman at the Sapulpa shops, and is eminently qualified for the higher position.

Mr. A. S. Abbott, master mechanic of the St. Louis & San Francisco, at Sapulpa, Okla., has been appointed mechanical superintendent of the first district, and Mr. J. Foster master mechanic at Kansas City, Mo., has been appointed mechanical superintendent of the second district, both with offices at Springfield.

Mr. George W. Bennett, general foreman of the boiler department of the West Albany shops of the New York Central & Hudson River, has been appointed a district boiler inspector of the Interstate Commerce Commission. Mr. Bennett is president of Master Boiler Makers' Association.

Mr. G. F. Hess has been appointed superintendent of machinery of the Kansas City Southern and the Arkansas Western, with headquarters at Pittsburgh, Kan. Mr. Hess is still a young man, having been born at Ft Wayne, Ind., in 1872. He entered railroad service as an officer in the master mechanic's office of the Pa. Railroad, and afterwards served his time as an apprentice in the shops. He worked as a machinist in various shops, then was made roundhouse foreman, rising by degrees to his present position.

Mr. H. Marsh, general car foreman of the Baltimore & Ohio at Washington, Ind., has been appointed general car foreman of the Iowa Central, with office at Marshalltown, Ia.

Mr. M. Dailey has been appointed master mechanic of the Bellingham Bay & British Columbia Railroad, with office at Bellingham, Wash., in place of Mr. W. J. McLean, resigned.

Mr. A. W. Wheately, general manager of the Brooks plant of the American Locomotive Company, has resigned to accept the position of manager of the Canadian Locomotive Company, with headquarters at Kingston, Ont. Mr. Wheately had been manager of the Montreal Locomotive Works before assuming the position of general manager of the Brooks works.

Mr. Henry Swoyer, manager of the Richmond plant of the American Locomotive Company, has been transferred to the Brooks plant at Dunkirk, N. Y., where he takes the place of Mr. Wheately, who has been appointed general manager of the Canadian Locomotive Works. Mr. Swoyer was connected for a number of years in various positions with the Louisville & Nashville Railroad, and was superintendent of the Rogers Locomotive works in 1905 when that company was acquired by the American Locomotive Company. Mr. Swoyer was later appointed as superintendent of the Cookes plant, and early in the present year was appointed manager of the Richmond plant, from which position he has been transferred to Dunkirk.

Edwin M. Herr.

Edwin M. Herr, who was elected president of the Westinghouse Electric &

EDWIN M. HERR,
President Westinghouse Electric & Mfg. Co.

Manufacturing Company at a meeting of the Board of Directors, held in New York August 1, has been the first vice-president of this company and in charge of operation of same at East Pittsburg since June 1, 1905.

Mr. Herr was born in Lancaster, Pa., May 3, 1860. Upon completion of a common school course, he was given the position of telegraph operator on the Kansas Pacific Railroad, with which company he remained for two years. He was promoted from the construction train service to the position of station agent.

In 1881 he entered the Sheffield Scientific School of Yale, graduating in the Class of 1884, and worked as an apprentice in the shops of the Pennsylvania Railroad Company at Altoona, Pa., during the two summer vacations.

From 1884 to 1885 he was an apprentice at the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railroad. He then went to the Chicago, Burlington & Quincy Railroad Company as a draughtsman in the mechanical engineers' office, and afterwards became assistant engineer of tests, and was promoted from this position to engineer of tests on this road at Aurora, Ill.

From 1887 to 1889 he was superintendent of telegraphy, and from 1889 to 1890 was division superintendent of this road.

From 1890 to 1892 he was division master mechanic of the Chicago, Milwaukee & St. Paul Railroad at West Milwaukee. From 1892 to 1894 he was superintendent of the Grant Locomotive Works at Chicago.

From 1895 to 1897 he was superintendent of motive power and machinery of the Chicago & Northwestern Railroad. From June 1, 1897, to September 10, 1898, he held the same position with the Northern Pacific Railroad.

On September 10, 1898, he became assistant general manager of the Westinghouse Air Brake Company at Wilmerding, Pa. He was promoted to the position of general manager on November 1, 1899, which position he held until June 1, 1905, when he was elected first vice-president of the Westinghouse Electric & Manufacturing Company.

Obituary.

Mr. Joseph Francis Tucker, chairman of the Central Freight Association, died at Chicago, July 25. He was in his seventy-sixth year. He was for many years general freight agent of the Illinois Central. In 1884 he acted as arbitrator of the Transcontinental Association and of the California, Colorado & Utah Pool. Latterly he acted as manager of the Chicago, Fort Madison & Des Moines, now the Chicago, Burlington & Quincy. He became chairman of the Central Traffic Association in 1896. He was a native of Maine and went to Chicago in 1856. He was an able executive officer, an accomplished and genial gentleman, and among the best types of railway men.

Westinghouse Electric Co. Officers.

At a meeting of the Board of Directors of the Westinghouse Electric & Manufacturing Company, held in New York on August 1, the following officers were elected:

Chairman of the Board of Directors, Robert Mather; president, Edwin M. Herr; vice-presidents, Loyall A. Osborne, Charles A. Terry, Harry P. Davis; acting vice-presidents, Henry D. Shuts, George P. Hebard; comptroller and secretary, James C. Bennett; treasurer, T. W. Siemon; auditor, F. E. Craig.

Mr. E. M. Herr is elected to succeed Mr. Edwin F. Atkins, who has been president of the company since June, 1910, and who declined re-election.

Mr. Herr has been first vice-president of the company since 1905. He has announced the appointment of Calvert Townley as assistant to the president.

Mr. Calvert Townley was for many years connected with the Westinghouse Electric & Manufacturing Company, at first in Pittsburg, and later, as manager of its Boston office, and as special representative in New York City. He comes to the company directly from the New York, New Haven & Hartford Railroad Company, where, for the past five years, he has been closely identified with the electrification of this road.

Mr. Harry P. Davis has been with the Westinghouse Company for twenty years, and for the last few years has held the position of assistant to first vice-president and manager of engineering at the East Pittsburg works.

By the Wayside of the Grand Trunk Pacific.

There has always been features of romance about the surveying and construction of our transcontinental railways, and the latest line to surmount the mountain chains has given us many opportunities for high human endeavor among engineers as anything that ever invited men to dare and to do.

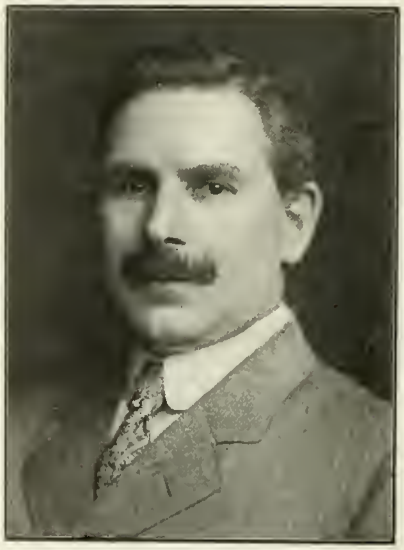
The enterprise of the Grand Trunk Pacific Railway Company will open to civilization some of the most fertile lands that have ever been reached by the axe and the plow. Where solitude now reigns, broken at rare intervals by the screams and conflict of wild animals, prosperous farms and happy homes will soon follow the sinews of steel rails.

All along the Fraser River the primeval forest will be turned in the next ten years into an immense garden. Further west the Nechaco valley will be a great mixed farming country, the potentialities of which it is impossible to fathom. Even now, before the railway has arrived, hay and oats enable the farmer to recoup his outlay upon land within a year or two. Even wild hay grows to a height of five feet, and land that is pre-empted at one dollar an acre increases in value ten or twenty fold directly the settler begins to improve it.

When the planning to push the Grand Trunk Pacific route through British Columbia; the commission given to Van Arsdoll, the pathfinder, to discover a feasible track through the Rockies; his disappearance for many months in the wilderness, during which time he nearly died of starvation; his eventual reappearance with a favorable report of the Yellowhead Pass, so called from a gigantic Iroquois who carried furs that way, a pass only 3,720 feet high, so that the gradient of the line need only be 1 in 225, a different obstacle, if obstacle it can be called, to the Kicking Horse Pass, by which the Canadian Pacific toils over the mountain.

W. V. Turner.

We take pleasure in reproducing a photograph of Mr. W. V. Turner, Chief



W. V. TURNER.

Engineer of the Westinghouse Air Brake Co., who was recently awarded a medal by the Franklin Institute of Philadelphia in recognition of a lecture delivered before that body, which is composed of some of the most scientific men of America.

Mr. Turner's address was of a technical nature and is on record in the Westinghouse Air Brake Co.'s publication No. 9016, entitled "The Air Brake as related to progress in locomotion."

Mr. Turner's name frequently appears in these columns and as many of our readers, especially those in foreign countries, have never had the pleasure of seeing or hearing him, we are sure they will be interested in the likeness of the man who has designed and perfected such air brake equipments as the E. T., the L. N., and the P. C. Mr. Turner is still in the prime of life and much good work may still be expected from him.

Australia to Omaha.

Through the consular service, McKeen motor cars in use on the various railroads of the United States were investigated, and an inspector representing the Australian Government railways commissioners visited Omaha for the purpose of investigating gasoline motor cars built by the McKeen Motor Car Company. The Australian Government special committee visited the McKeen Motor Car Company's works at Omaha, and the report of its investigation to the Australian Government was so uniformly favorable that the Victorian railways, of the province of Victoria, placed a formal order for two standard 70-ft. gasoline motor cars, to be delivered in January, 1912. The cars, however, are to be designed to conform to the track gauge of five feet and three inches used in that country. The government has been particular not to specify any changes in the fundamental principles of the engine and car design of the motor car as developed and perfected by the McKeen Motor Car Company. The cars will be equipped with the same style of buffers as used on English roads, and will have their standard hook and link coupling device. The cars, to be of steel, will be provided with first and second-class passenger and smoking compartments and a baggage compartment.

Andrew Carnegie's Latest Pensioner.

Andy Toth was locked up in jail for the best twenty years of his life for a murder he did not commit. When his innocence was discovered, the State begged his pardon for the mistake and turned him loose, a broken-spirited pauper. This was the extent of the community's reparation for unjustly wrecking his life.

States, like kings, can do no wrong, or at least feel under no obligaton to right any they may do. Andy was quite helpless as an independent living-maker; had come, in fact, to look upon the penitentiary as his home, and wanted to stay there. But that was out of the question and the State of Pennsylvania authorities were willing to allow this broken-down victim of injustice to starve.

By good fortune Andrew Carnegie learned about the case and at once placed Andy Toth upon his list of private pensioners, to draw a fair income for the remainder of his life.

Mr. Carnegie has done many generous deeds of this kind and it would please us very much to publish even part of the list, but that is a form of publicity forbidden. It seems a singular circumstance that it should be left to a private individual to make reparation for a great public wrong.

Erie Wants Baldwin Locomotive Works.

Every year or two we notice announcements that the Baldwin Locomotive Works are about to be moved, from their inconvenient location in the heart of Philadelphia, to some other place where the huge works could be arranged in the shape that would facilitate the handling of material. The latest news concerning the removal of the Baldwin Locomotive Works appears in an Erie, Pa., paper which says:

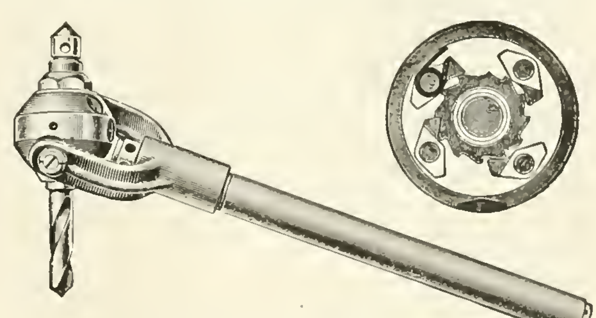
"Representatives of the Baldwin Locomotive Works have signed options on a tract of 700 acres of land in the section southwest of the city limits, and plan the removal of its shops from Philadelphia to this city, according to information given out last night. When the proposed removal will take place has not been announced, as company representatives in Philadelphia say they do not expect to leave that city.

"The reasons for leaving Philadelphia are that the plant now occupies property valued at twenty millions in the heart of the city, only five minutes from the Broad street station, and that cheaper transportation and as good shipping facilities in Erie cause them to turn to this city."

There are good reasons why the Baldwin people should wish to get their works out of Philadelphia, but we think they would not be likely to jump over the whole length of Pennsylvania, when there is plenty of open space with good water and rail transportation facilities between Philadelphia and Baltimore.

Universal Ratchet.

Among the tools that have sprung rapidly into popular favor, Armstrong's Universal ratchet drill has won an enviable place. As is shown in the accompanying ilustration the handle or lever has a wide range of adjustability, and by tightening a screw the handle of the ratchet will remain fixed. The construction of the tool has all the substantial qualities that distinguish the fine products of this firm. The pawls and center are tool steel hardened, the other parts, with the exception of the ratchet handle, which is of the best tubing, are made of steel drop forged, or machined from bar. Those who are familiar with the difficulties that often arise in drilling in narrow or irregular spaces will appreciate the advantages of the adaptibility of this fine ratchet to unusually difficult work.



ARMSTRONG'S UNIVERSAL RATCHET.

Annual Report of the Buffalo, Rochester & Pittsburgh.

Through the courtesy of Mr. William T. Noonan, president of the road, we have received a copy of the 26th Annual Report of the Buffalo, Rochester & Pittsburgh Railway Company. The report indicates that the company is in a prosperoous condition, and we feel certain that a material share of the prosperity is due to the judicious management of the president. Mr. Noonan presents a good example of how prosperity may be cultivated by fair dealing towards the employees of a railway company and toward its patrons. His policy is the fair play that pays. It seems only a few years ago since we had to acknowledge warm kindnesses from Mr. Noonan at Minneapolis, Minn., when he was chief clerk to the general superintendent of the Minneapolis and St. Louis Railway. From that position his rise has been rapid, but every step climbed has been reached by the force of merit.

The H. W. Johns-Manville Co., Cleveland, Ohio, the well-known manufacturers of asbestos, high-pressure, steam packings, are meeting with marked success in their new cement department. From reports it appears that fire-brick troubles are literally eradicated. As is generally known among railway men as well as stationary engineers, the most annoying items of expense in boiler maintenance are the upkeep of fire-brick walls and arches, and the cost of delay in cooling down a boiler for repairs. This is largely due to the inefficiency of fire-clay, which heretofore has been the only available bond for setting up fire-brick.

Fire-clay readily fuses and runs, opening up the joints between the bricks. In addition to this, refractory bricks are porous. Hot gases of combustion enter into the pores of the bricks and into the joints when the fire-clay has fused out, weakening the bricks and eventually causing the whole wall to break down.

The advent of the Johns-Manville temperature cements has put an end to all these difficulties. These cements will resist a far greater heat than fire-clay and make a perfect, permanent bond that actually increases in strength when vitrified.

Railway Turn-Table With Motor Drive

Economy of time and of operating cost are the most important considerations in the operation of railway turntables. The relative importance of these two features depends on the amount of traffic to be handled. At a very busy yard the saving of time becomes the first consideration, and any device that will lessen the time required to handle engines and cars is welcomed. The greatly increased amount of traffic that can be handled in a given time is of more importance than the saving in operating expense. At the same time, the careful and efficient management of modern railway systems demands that no unnecessary expense be incurred either in the first cost of apparatus or in its operating expense.

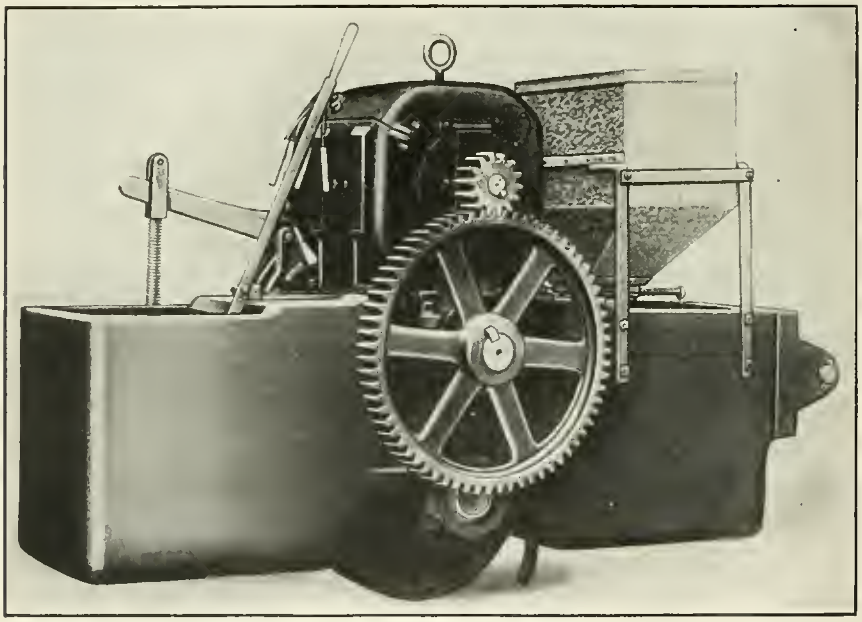
The increasing frequency with which turn-tables are used, as well as the increased weight of rolling stock in many cases, have compelled many roads to install power drive. Engines operated by air, steam, gas or gasoline have been used for this purpose, and have resulted in a saving both of time and operating expenses. However, the constantly increasing use of electricity in railroad service is causing these devices to be replaced by electric motors, since an available source of power is often at hand without the installation of additional generating equipment. The motor consumes no fuel while idle, it is always ready for instant service, and it is under perfect control in the hands of a single and comparatively unskilled operator.

Simply closing a switch and moving a controller handle starts the table, and an effcient brake enables accurate stops to be made. The motors are designed and built to develop the high torque necessary for rapid acceleration; under average conditions the heaviest locomotive can be turned completely around in two minutes, and the table stopped accurately at the right point. The motor equipment can be installed in the small space which could not be economically utilized for any other purpose.

Power is available at almost every important railway yard or terminal, and the expense of installing and maintaining electric conductors is very small compared with similar expense for steam or compressed air pipes. Moreover, the losses by radiation and leakage in steam and air pipes are considerable and continuous. There are no corresponding losses for electrically-driven tables, and the efficiency of electric equipment is much higher than steam, air, or gas-engine drive.

Safety devices can be installed to insure full protection from injury in case of accident or careless operation. By the use of electric tractors, delays in handling locomotives can be avoided and schedules can be more easily maintained. The work is of an intermittent character and usually is rushing for a short period and then at a standstill. Especially is this true of turntables at terminals, where many locomotives often come in at about the same hour. The much shorter time required by the electrical equipment to turn the table expedites the movement of the locomotive and relieves the congestion.

The turntable equipment consists of a complete tractor, including frame, motor, brake and sander, also a controller, resistor, fuses and current col-



ELECTRIC MOTOR DRIVE FOR TURN-TABLE.

lector. The controller and fuses, together with levers for operating the brake, sander and locking device are contained in a cab located in the center of the table.

The controller is of a design which provides for operating at several different speeds, forward and reverse, and is arranged to obtain very slow speed just before stopping, in order to facilitate lining up the track. To further assist in this, a hand-operated shoe-brake is provided, the wheel being mounted on the end of the counter-shaft outside the tractor frame. Powerful leverage is thus provided and the heavily-loaded table can be stopped within a short space and with the required accuracy.

For supplying power to the motor, the conductors may be brought up through the turntable center-pin and connected to slip-rings, from which the current is transmitted through brushes

TURN-TABLE WITH ELECTRIC MOTOR DRIVE.

to the motor leads. In the case of a new turntable this is undoubtedly the best arrangement, but it usually involves considerable expense where an old table is to be adapted for motor drive. In the latter case wires are sometimes run around the turntable pit and the current collected by trolleys. This is, of course, more or less of a makeshift. A much better scheme is to bring the wires overhead to a collector.

The collector consists of rotating and stationary parts and is mounted on a framework erected at the center of the table. The rotating part is bolted to the framework and revolves with the table; guy wires prevent the rotation of the stationary part.

Two important points to be considered in the location of the cab are the convenience and the comfort of the operator. It should be so situated that the jolts to which he is subjected will be reduced to a minimum and yet be near enough to the radiating tracks to enable him to make accurate alignment promptly. This is especially true where a large number of engines are to be turned, as otherwise time will be lost in lining up the tracks, thus defeating to a certain extent the purpose for which electric drive was installed.

Briefly stated, the advantages resulting from the use of electric tractor are: Great saving of time with consequent promptness of service; low cost of installation, operation and maintenance; ease of power transmission; absence of all energy loss while motors are idle; simplicity and accuracy of control, and reliability and high efficiency of operation.

Joseph T. Ryerson Scholarship.

Secretary Taylor, of the Railway Master Mechanics' Association, has issued a circular intimating that the Joseph T. Ryerson Scholarship is open to candidates. This valuable scholarship in Purdue University was established by Joseph T. Ryerson & Co., Chicago, in 1903, and entitles the recipient to $500 a year for four years.

To be eligible for candidacy for this scholarship, applicants must have had at least twelve months' practical experience with the motive-power department or car department of a railroad, and must be in the enjoyment of good health. The Ryerson Scholarship will not be awarded to any person who has already completed a year's work in Purdue University or any other institution of like standing.

Applicants for this scholarship must file with the Registrar of Purdue University, Lafayette, Ind., a statement over his own signature that he is an applicant for the scholarship; a certificate from a member of the Master Mechanics' Association covering his practical experience, and a certificate of a reputable physician that he is in possession of good health and a strong body.

Raising Tax Assessment.

A misfortune that many manufacturing concerns located in small towns have to endure is excessive taxation. The towns will frequently offer all sorts of inducements to prevail upon concerns employing many people to locate within their jurisdiction, and after a few years impose taxes that are ruinous. A case in point is that the assessors of Dunkirk, N. Y., have increased the assessed valuation of the Brooks Locomotive Works $500.000.

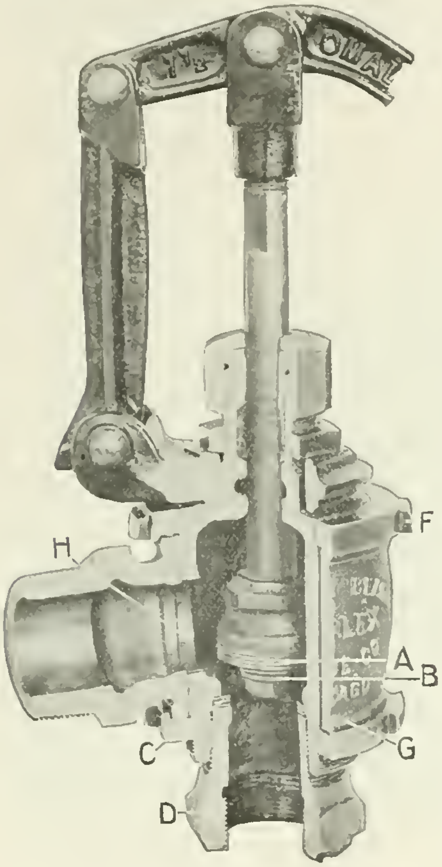
A patent has been granted to a Connecticut inventor for a coin operating device for unlocking reversing car seats. There are now coin in the slot for nearly all purposes connected with railroad travel movements, but some of them ought to be prohibited.

I have conquered adversity, but it remains to be seen whether I can conquer prosperity.—*Holden.*

Improved Blow-Out Valve.

The O'Malley-Beare Valve Company, 23 South Jefferson street, Chicago, Ill., has recently placed on the market a duplex locomotive blow-out valve which possesses some new and interesting features.

The head and seat of this valve are composed of a multiplicity of this durable metal plate, the same as is used in all of their other classes of valves. Instead of refacing and regrinding when the head and seat become cut or damaged in service, the worn or damaged plate is easily removable, and when it has been discarded the next plates form a new seating surface. In addition to the "Multiplate" head and seat in this blow-out



IMPROVED BLOW-OUT VALVE.

valve, it may be seen from the cut that the head and seat are in a hollow rotatable plug. When it is desired to remove damaged head and seat plate, or make other repairs on the inside of the valve, this inner rotatable plug may be turned in its casing, thus cutting off the inner part of the valve from the boiler pressure. In this position full repairs may be made with the boiler under full boiler pressure. By disconnecting the lever handle from the stem and swinging it over into a horizontal position it forms a wrench for turning the inner rotatable plug. This duplex shut-off feature avoids the necessity of blowing down the boiler in the round house when it is necessary to make repairs to the blow-out valves.

This duplex shut-off may also be used by the engineman on the road in case of leaky blow-out valves of inability to close his blow-out valves after operating them, thus preventing an engine failure.

By means of the adjusting rings at top and bottom of the inner plug, the plug may be raised or lowered in its outer casing, thus tightening or loosening it, as may be desired.

A positive shut-off being assured when using this valve, the usual uncertainties of blowing out boilers is done away with. No special tools are necessary to handle this valve or make repairs.

Mr. O'Malley, the inventor of this valve, was for a number of years a practical railroad and roundhouse machinist and general foreman.

This company is also making a duplex gauge cock which operates in the same way as this blow-out valve.

Exhibits at the General Foremen's Convention.

The exhibits this year were not only attractive but showed improved machines, appliances and methods which could not fail to benefit those who inspected them. The Garlock Packing Co. showed packings and gaskets, etc., in a variety of forms, but the name "Garlock" made one sure that all were good.

E. S. Jackman & Co., Chicago, had the Blue Chip tool steel of the Firth-Sterling Steel Co.

The Independent Pneumatic Tool Co., of Aurora, Ill., displayed "Thor" pneumatic tools.

The National Machinery Co., of Tiffin, Ohio, were there to boom their Semi-Automatic Nut Tapper, and showed some bolts, etc. made on their machines.

The Crucible Steel Co., of America, had an exhibit showing their usual line.

Fairbanks, Morse & Co., presented Duff-Bethlehem forged steel goods.

Manning, Maxwell & Moore, with the Hancock Inspirator Co., The Consolidated Safety Valve Co., The Ashcroft Mfg. Co., etc., displayed the various articles made by these concerns and their exhibit attracted the usual amount of well-merited attention.

Green, Tweed & Co., of New York, showed "Palmetto" packing.

Pratt and Letchworth exhibited samples of the "Buffalo" Journal Box.

The Detroit Lubricator Co., had quite an elaborate display of lubricators.

Marshall & Huschart Machinery Co., of Chicago, occupied a booth where they conversed upon the merits of The Lodge & Shipley and the Landis tools, as well as others. Their large machinery display at their warerooms in Chicago proved an interesting place to many.

The U. S. Metal Mfg. Co, called attention to Railway supplies.

The Geometric Tool Co., of New Haven, Conn., presented a variety of work done upon their machines and had one machine in operation.

Hoskins Mfg. Co., Chicago, exhibited Electric Furnaces and Pyrometers for steel treating.

McCrosky Reamer Co., Meadville, Pa., showed adjustable reamers.

The Emery Pneumatic Lubricator Co., of St. Louis, presented their Automatic Lubrication device for air brakes and pneumatic multiple control systems. Their method is a departure from the ordinary and, in brief, consists in using compressed air to automatically distribute the lubricant at the right time and in the right quantity. Their pamphlet is well worth having and can be had for the asking.

Armstrong Bros. Tool Co., Chicago, showed ratchet drills, lathe dogs and tool holders, and one was much interested in the many improvements brought out by this company. It is sufficient in itself to say of a tool that it was made by Armstrong, but those who have not seen their recent products will do well to write for descriptive matter.

Carpenter Steel Co., of Reading, Pa., showed a big chip cut by a tool made from their tool steel.

The Loco Improvement Co., of Clinton, Iowa, displayed Markel's Removable Driving box brasses and solid back-end main rod.

The O'Malley-Beare Valve Co., Chicago, introduced a new line of valves, the principal feature of which was a multiple head and seat. The bearing surfaces of both head and seat are the outside layers or disc plates of a nest or magazine of plates, and instead of grinding a valve, it is merely necessary to remove a plate and a fresh wearing surface is presented.

Chicago Pneumatic Tool Co., made its usual display.

The Anchor Packing Co. showed fibrous and metal packings.

Joseph T. Ryerson & Son also made a creditable showing.

The Carborundum Co., of Niagara Falls, N. Y., exhibited carborundum wheels, etc., in wide variety of standard and special shapes.

The Goldschmidt Thermit Co., of New York, had the usual attractive exhibit, with moving pictures and illuminated display. This company publishes a free technical quarterly devoted to quick repair work and welding. Any mechanic who has not already seen this company's literature will do well to ask for it at once.

Hunt-Spiller Mfg. Co., Boston, as everybody knows, makes the celebrated Hunt-Spiller gun iron and they also had a space near the convention hall.

American Steel Foundries—Simplex Railway Appliance Co. had an elaborate exhibit—showing Davis' steel wheel, Simplex couplers, cast steel bolsters, Andrews' side frames, Janney couplers, Susemihl side bearings, brake beams, springs, Simplex bolsters, etc.

The Celfer Tool Co., of Buchanan, Mich, displayed drills, lathe tools and bridge reamers.

The National Boiler Washing Co., Chicago, exhibited large photos and maps showing their installations, and their rapidly growing business is indicative of a very meritorious system of boiler washing.

Jenkins Bros. showed valves—just valves, and it is probably superflous to even mention the word valves, as when one hears the name Jenkins, he thinks of valves anyway.

The Pilliod Co. had their little locomotive out with the Baker valve gear, and it was "turning over," just fast enough that the operation could be easily comprehended.

Horace L. Winslow Co., of Chicago, represented the Okadee Co.'s reflex water glass and the Clark blow-off system.

The Marshall Ventilated Mattress Co. exhibited a vented cab seat cushion.

U. S. Metallic Packing Co., Philadelphia, Pa., showed "King type" packing for piston rods, air pumps, etc.

McCord & Co. exhibited their journal box.

The Franklin Railway Supply Co., of New York, were present with their "Devices that make for economy," showing their flexible conduit driving box lubricants, pneumatic fire door operating device and shaking grate.

The Nathan Mfg. Co., of New York, showed their various products, and especially gave preference to their 7 feed lubricator. This lubricator has sufficient capacity for the largest engine, including the superheaters.

S. F. Bowser & Co., of Fort Wayne, Ind., displayed their systems for the automatic measuring and registering of oil, as it flows through pipe lines where predetermined quantities are discharged.

The McMaster-Carr Supply Co., Chicago, made a very creditable showing of railway supplies.

The Ashton Valve Co., of Boston, exhibited pop safety valves and gauges, dead weight gauge testing apparatus and other appliances of their manufacture. Particularly noticeable as new was their protection device for glasses on air gauges.

The Adreon Mfg. Co., Chicago., displayed their Campbell graphite lubricator and other specialties. The many points of merit to be found in the appliances made by this company are best described in their circular, which every railroad man should have.

The Locomotive Superheater Co., of

New York, had their miniature boiler on exhibition, showing the locomotive superheater in its most approved form. This exhibit was especially interesting at this time in view of the present general interest in superheaters.

Chicago Railway Equipment Co. showed brake beams, roller side bearings and slack adjusters.

Barrett Mfg. Co., Chicago, made a display of coal tar products, with especial emphasis upon the "Barrett Specification" roof.

The Otley Mfg. Co., Chicago, had paints, enamels and cements in variety.

Crane Co., displayed valves, etc.

The Storrs Mica Co., of Owego, N. Y., had an interesting showing of mica lantern globes and mica headlight chimneys. These goods have come to stay, and the Storrs Mica Co. is well known as an authority on this class of material.

The Jos. Dixon Crucible Co., of Jersey City, was well represented, and displayed a variety of graphite products. In this connection we are reminded that one of our staff who some years ago was actively engaged in manufacturing, made a test of crucibles under usual brass foundry conditions and ran a No. 18 Dixon crucible seventy-two heats.

Safety Car Heating & Lighting Co. occupied a booth where a well posted representative merely had to mention the points of merit of their systems, which were readily confirmed by some listener.

Templeton, Kenly & Co., Chicago, showed Simplex jacks.

Last, but not least, RAILWAY AND LOCOMOTIVE ENGINEERING occupied a corner of the convention hall, where they received their many friends, and where to the best of their ability they made welcome all from far and near, and the friendly hand shake and pleasant word from all were a fitting tribute to the official organ of the International General Foremen's Association.

Pocket List.

The Railway Equipment & Publication Company, of New York, are now located in their new quarters at 75 Church street, where Vesey makes a corner.

The fifteenth floor of the Underwood Building is beautifully equipped for the publication of the Official Guide and the Pocket List of Railway Officials.

In 1895 Edition No. 1 was reviewed by RAILWAY AND LOCOMOTIVE ENGINEERING and the editor at that time jokingly said that it required a "jimmy" to open the book. The present methods of binding show marked improvement over the old style as latter day signs of the times show the march of progress. The indexing and classification are models perfection, and are fine samples of correct editorial work.

New Catalogues.

VULCAN LOCOMOTIVES.

Vulcan locomotives are beautifully illustrated and finely described in one of the most handsome publications that we have ever seen, and which has been recently published by the Vulcan Iron Works, Wilkes-Barre, Pa. Edition "K," as it is styled, extends to 144 pages and contains nearly 100 illustrations. The types of locomotives illustrated represent almost every kind in general use at the present time, designed for the widest range of service and every variety of track. The company has long enjoyed an enviable reputation for locomotive construction, especially those locomotives that are best adapted to meet the varying needs of contractors, steel, mining and industrial plants; and for plantation, logging, freight, switching and passenger service, operated by steam or compressed air, and ranging from seven to seventy tons on drivers. The company's works has developed into four separate establishments, all located in the anthracite district of Pennsylvania, and at present employing over 1,200 men.

In addition to fine representations of the various types of locomotives constructed at the company's works, there are a variety of interesting views of the Vulcan locomotives at work in mining, lumbering and logging districts, and also views of the compressed-air mine locomotives, many of which are in use in the coal regions.

In addition to the letter-press descriptions that accompany the illustrations, there is a considerable portion of the publication devoted to instructions on the subjects of tractive force, hauling capacity, grades and curves, with interesting data on the speed and horsepower of locomotives, with tables on the approximate cost of railroad tracks, to which is superadded a miscellaneous mass of information that is well for engineers, and all in any way engaged in engineering work generally, or locomotive work particularly, to know. Copies may be had on application.

HYDRAULIC PUMPS.

"Hydraulic Pumps," Catalogue No 81, is the title of a new 120-page publication, descriptive of many standard and several new types of hydraulic pumps. This catalogue is issued by the Watson-Stillman Company, 50 Church street, New York, and contains much valuable information for hydraulic engineers and users of hydraulic machinery.

It may be added that among their recent improvements is a fibrous packing which has shown perfect efficiency where the water pressure is of less than 2,000 lbs. to the square inch. The friction is less than that of their celebrated leather packings, which are indestructible.

Some time in August, 1780, Oliver Evans, the real inventor of the steam engine, introduced the use of chain pots for flour mills to elevate grain and flour. The Egyptians had used the same device for raising water more than twenty centuries earlier, but Evans was the first to apply the invention to modern industries.

RINGS, SHELLS AND RING DIES.

The Standard Steel Works Company, Philadelphia, Pa., have just issued a new catalogue on Rings, Shells and Ring Dies. This very interesting publication contains illustrations of the various types of this class of material such as are used in the Chilean, Huntingdon, Griffin or Bradley, Kent and Bryan Mills, as well as cuts of rolled steel rings which are used for various other purposes. The catalogue also contains cuts showing gear rims and blanks for built-up gears for heavy electric service, built-up wheels for Bascule bridges and wheels for mining service. On the last few pages it contains tables of dimensions of peened, screw, welding and plain pipe flanges, as well as fac-simile of dimension blanks used in the ordering of wheels. They are to be congratulated on this very creditable addition to their catalogue list. Copies may be had on application.

ASHTON VALVES AND MACHINE WORK.

The Ashton Valve Company, Boston, Mass., has a neat method of advertising their products by issuing an occasional blotter presenting a fine view of the Company's works at East Cambridge, Mass. They also set forth briefly a list of their principal products, including their pop and relief valves, pressure and vacuum gages, pattern work, brass castings, steel springs and general machine works. Their growing popularity for thirty years is the best guarantee of their high standard quality. Send for a specimen of their handy blotter.

SMALL TOOLS.

"Small Tools" is the subject of Catalogue No. 6, just issued by the Pratt & Whitney Co., Hartford, Conn. It is a substantial publication of 250 pages, profusely illustrated with descriptive letterpress and attached price lists. The carefully prepared catalogue is classified into eight sections, presenting details in regard to taps, dies, milling cutters, reamers, punches, drills, miscellaneous tools, with attached tables and a complete index. It need hardly be stated that in their threaded tools this company has adopted the standard for all government work, which is now the standard for all railroad work both in America and Europe. A special advantage in the standard thread is the fact that it is practically impossible to mutilate a thread with these taps.

Among the new features is an adjustable tap wrench, which is sure to meet with popular favor, and also a flue-beading tool for forming the inside bead in boiler tubes, which is already a marked favorite among boiler makers. Copies of this catalogue will be furnished on application to the company's office at Hartford, Conn.

PLANING MACHINES.

Niles - Bement - Pond Company, 111 Broadway, New York, have just issued a 32-page catalogue descriptive of their high-class planers. There are fourteen illustrations of the various types of Standard planers, all built to conform with the requirements of modern machine-tool practice. The most notable feature is the direct-connected variable speed-reversing motor which has been recently applied to the planing machine, and has resulted in a tool which is not approached for economy in operation and ease in handling. The company has applied this new type of drive to every size and type of reversing planer.

The gain made by the adoption is evident by the marked reduction of moving parts, and the increase in the variation in speed, with a degree of stability and accuracy hitherto unobtainable in the loose-joined, vibrating machines of the older type. The application of the drive, and the fine planers to which they are attached, are fully described and illustrated in the catalogue, and it is gratifying to observe that there is a rugged simplicity about these machines that betokens a step in the right direction. The capacity of the planers illustrated, range from 30 ins. to 168 ins., and the larger seem the simpler. All interested should send for a copy of this interesting publication.

DIXON'S GRAPHITE.

Graphite, for August, ably sustains the high character which this 12-page publication has earned in presenting fully and freely the merits of Dixon's graphite productions, and always finds room for items of a historical, scientific and also of a humorous kind, that gives the publication a character peculiarly its own. In the issue before us Dixon's American graphite pencils form a feature that should be a lesson to advertising men. A fine article by Mr. L. H. Snyder shows very clearly that graphite plays a very important part in the electrical field because of its high electrical conductivity, which combined with its softness makes an ideal combination for graphite brushes.

It is, however, as a lubricant that graphite has gained its world-wide reputation and this feature is never lost sight of in the spirited publication. Very frequently it has to be explained to the inexperienced that graphite is not a competing product with oils or greases. It has been distinctly proved, however, that either oil or grease gives far better results when the correct proportion of flake graphite has been added to it. Dixon's graphite greases contain the proportion and the ingredients are thoroughly mixed. Dixon's products are cheap, and copies of the publication referred to are free. Copies may be had from the head office of the Joseph Dixon Crucible Company, Jersey City, N. J.

RATCHET DRILLS.

Booklet No. 4, issued last month by the Armstrong Bros. Tool Company, Chicago, Ill., is of much interest. Of several marked improvements in their variety of ratchet drills, these embrace four varieties, including the Packer, for hard, rough service; the Standard, for general service; the Universal, for awkward corners and confined spaces, and the Short, for use where a short head and long feed are essential. As is well known these excellent tools are made entirely of the most durable steel, including the taper sleeves and drill sockets.

In another column we present a brief description and illustration of their Universal ratchet drill, which has already met with much popular favor on account of its applicability to the most difficult situations where the use of an ordinary ratchet would be impossible. In sending for particulars ask for a copy of the complete catalogue.

VANADIUM FACTS.

Amercian Vanadium Facts appears this month with a new feature illustrating the peculiar merits of Vanadium steel in resisting the transmission of 50 horsepower through a tubular shell ⅛ in. in thickness, leaving a factor of safety of 38 per cent. to meet any hazard in action. It has not been demonstrated to our knowledge that any other material with which we are acquainted, could resist this strain. It is as if an ordinary flue could serve as a driving shaft in an ordinary machine shop. The tests described and illustrated show the metal to have a tensile strength of 104,400 lbs., and it is not to be wondered at that the merits of the American Vanadium Company's fine products are rapidly bringing them into popular favor. Copies of their monthly journal may be had free on application at their office, Frick Building, Pittsburgh, Pa.

THROTTLE VALVE.

"The best throttle valve that can be put into any locomotive," is the title of a folder just issued by the Watson-Stillman Company, 50 Church street, New York, in which are summed up briefly and clearly illustrated the principal arguments in favor of the "Chambers' throttle valve." No less than 170 of these throttle valves were recently ordered in less than one month by the leading railroads. A glance at this interesting folder will convince any engineer of its advantages, and it may be added that it has stood the test of several years' trial on the leading railroads and has everywhere met the approval of those capable of judging of its merits. It is entirely free from the weaknesses of other throttle valves.

BOILER SCALE.

One of the most interesting booklets that have come to our notice is "Scale Removal Made Easy," published by the Wm. B. Pierce Company, of Buffalo, N. Y. It is pocket size and is full of valuable information about boiler scale, what it does and some fallacies about its removal. If you want something worth reading on a very important subject write the Wm. B. Pierce Company for a copy.

As the train approached Preston, and the open spread of river valley came in sight, a lady passenger called her friend's attention to the view.

"Lovely," admitted the other lady; "quite a postcard, isn't it?"

"Gentlemen of the jury," exclaimed the attorney for the plaintiff, addressing the twelve men who were sitting in judgment and on their respective shoulder-blades, in a damage suit against an American corporation for killing a cow:

"If the train had been running as slow as it should have been ran, if the bell had been rung as it ort to have been rang, or the whistle had been blown as it should have been blew, none of which was did, the cow would not have been injured when she was killed!"

"How often does your road kill a man?" asked a facetious traveling salesman of a Central Branch conductor the other day.

"Just once," replied the conductor.

The story is told of the times of the old Manchester Locomotive Works, that a student came and wanted to study the business of locomotive building in his vacation days. The student came well recommended, and they sent him down to the boiler shop and placed him in charge of the old foreman. The old man took the "tech" man around, and in the course of the inspection of the shop they came across one boiler on the inside of which was a man at work.

"How does that man get out?" inquired the "tech" man.

"Oh," said the venerable pilot, "he doesn't get out. We always count upon losing at least one man in building a boiler."

At the station on the hill top looking out of his cab, the engineer saw the new brakeman and said, with a sigh of relief:

"I tell you what, we had a job to get up there, didn't we?"

"We certainly did," said the new brakeman, "and if I hadn't put the brake on we'd have slipped back."

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, October, 1911. No. 10

Crossing the Canyon Diablo on the Santa Fe Railroad in Arizona.

The eastern traveler moving toward the setting sun on the Santa Fé Railroad passes through a wonderland that burns itself into the memory forever. While there may be an absence of "the palaces and piles stupendous, of which the ruins are tremendous," that add to the scenic splendors of European travel, there is a glow and glory of coloring in the phenomena of

SANTA FE TRAIN CROSSING THE CANYON DIABLO.

From Stereograph, Copyright by Underwood & Underwood, New York.

nature in her beauty and solitude in the west that is without a parallel. Through New Mexico and Arizona the far stretching flower-spangled prairies reveal ever-changing fantasies in azure, purple, emerald and gold, but it is not until one reaches the appalling canyons of the Rocky Mountains, that rise in their colossal magnificence, that the amazed beholder comes face to face with the sublime and terrible scenery of the western world. Pictorial illustrations, such as the one that we reproduce this month, fall far short of giving one a just conception of these scenic wonders. The camera can, at best, only grasp one little detail of the ever-changing panorama of the wild and wierd sublimity of the wondrous wealth of gorgeous grandeur revealed in this vast wilderness.

In passing one cannot fail to be struck with the substantial nature of the construction work of the great railway. Steel bridges, monuments of engineering, concrete culverts, massive as granite, come at intervals, while the general equipment, if possible, surpasses the polished elegance of the eastern railways. Intelligent activity, heightened by the assurance of a revival of industrial growth, is manifest on every hand.

The scene of the accompanying illustration is located a few miles east of Flagstaff, Arizona. The view is from the north side of the railroad. The nearest station—Canyon Diablo—is a quarter of a mile to the left. The train has just come from the station, and is heading for Southern California. The traveler who has time to stop here has the opportunity of seeing the Navajo Indians living in picturesque contentment. There is a little village near the canyon, and at first glance one would marvel how the Indians could find a living among the rocky canyons. Every Indian, however, is the possessor of a few sheep, and the neighborhood of water encourages a scanty growth of grass here and there. The wool is spun by the women on crude, but effective, home-made spindles, and woven by the men on rough looms constructed of the boughs of trees. The decorative figures woven into the blankets all have some symbolic meanings. They signify such things as winds and rains, mountain heights, and flashes of midsummer lightnings.

It is a notable fact, however, that with all their stoical indifference to eastern civilization, their vanity is easily appealed to—the older figure shown in the picture shows with great pride to visitors an impressive looking document signed by the managers of the local trading post, appointing him as "Mayor" of the village. The blankets worn by the "Mayor" and the boy who acts as an attendant on his Honor have extra symbols woven into their blanket-like mantles, and an air of importance sits upon their dark brows, like a rising storm.

It is also noted that the Indians never seem to weary of gazing wonderingly at the great locomotives and shining train of cars as they sweep high overhead. A kind of awe overcomes them as the vision of the moving train crowned with a pillar of cloud by day and a pillar of fire by night, comes thundering at intervals, waking the echoes of the Canyon Diablo.

Old Line Railroad Reminiscences.

By S. J. Kidder.

So far as the writer can recall, there never was a phrase used in connection with railroad parlance that established a standing more quickly or was utilized more frequently, when occasion presented itself, than "the brakes failed to work." In the early days of the air brake it was looked upon as a contrivance difficult to understand as well as susceptible of playing all sorts of pranks at the most inopportune moment, which the layman could not unravel. For a score or more of years following its advent, no matter what the cause of an accident, whether a tail end or crossing collision, side swipe, running off or through a switch, or any serious disarrangement of the rolling stock, as well as failure to stop at a designated point, the usual report to the superintendents' office was, "The brakes failed to work." Among the rank and file of engine and train men this statement was recognized as a very clever and convenient one to cover up many sins of omission and commission, and that the excuse generally went was largely a result of the brake mechanism and its operation being very imperfectly understood by railway officers; hence, with such conditions existing there could be no going behind the returns to question the statement of men most directly interested. In time, however, with the gradually increased knowledge of brake mechanism, from which methods of analyzing alleged brake failures could be instituted, such excuse slowly but surely lost its significance and finally to an extent that during these later years the term "air brake failure" has been nearly or quite eradicated from the railroad man's nomenclature. In all my years of running a locomotive, with both the straight air and automatic brakes, I never experienced at a critical time an air brake failure, but the assertion was so common after I got into the brake business that among my numerous duties was that of investigating these alleged failures, whether in case of accident or at other times when it was stated that the brakes failed to work properly, and while I can recall many instances, not one occurs to me where the brakes failed to perform their intended mission unless from a contributory cause by some of the employees connected with the making up or operation of the train. The two instances I propose to relate were the result of such contributory causes; in one instance the brakes failed to stop the train within a reasonable distance; the other, a mysterious application of the brakes and stoppage of the train from no apparent cause, though on both occasions the men responsible did not at the time realize their responsibility. What is said will also indicate that these mysterious cases can usually be run down to a conclusion if the investigator is on the ground or has an opportunity to gather the actual facts.

One morning while in my office the general manager of a big trunk line telephoned asking me to come to his office. Arriving there my attention was called to several reports from engine and train men of a brake failure to the extent that the train had passed a station some half mile before being brought to a stop. After coming to a stop the trainmen alighted to investigate, and while so doing the brakes released, one here, another there, until all were off. Following this the brakes applied and released properly; then the train was backed up to the station and, shortly after, proceeded on its journey, the brakes continuing to work all right. The reports gave no intimation of what had been wrong, and after discussing the matter for a time I was asked to be present at the investigation to take place a few days later when all concerned were to be "brought on the carpet." Leaving the office I started on a quiet tour of investigation with a view of acquiring any knowledge which might have a bearing on the subject. Going to the roundhouse, the engine which pulled the train was found, and a critical examination disclosed nothing wrong with the brake equipment other than the absence of a handle spring from the D8 brake valve. From the air brake repair man it was learned the spring had been absent several weeks, it having been removed by the engineer, who had instructed the repair man that he did not wish it replaced. This gave a possible clue to the lack of maximum braking power at the time of the alleged brake failure. The train hauled by this engine regularly picked up a dining car at a station some forty miles from the terminal, so I next repaired to that outside point where, upon examining the brake on the car everything was found normal excepting that the auxiliary reservoir bleed cock was open.

Upon questioning the car inspector he stated it was his practice to bleed the brake on this car as soon as it was placed on the siding, the object being to prevent boys from applying the brake by opening an angle cock, which a number of times had been the cause of foreign matter lodging on the emergency valve seat and which could not be discovered until the car was again picked up, the leakage incident to the unseated valve causing a delay to the train. Further questioning revealed the fact that the inspector did not make a practice of closing the cock, neither did he know who did perform that important duty.

With this information of the missing handle spring and open bleed cock I later attended the hearing with a belief that the cause of that failure to stop at the station could be accounted for. On the day of the examination the general manager, general superintendent and myself constituted the examining board, and before the hearing began I intimated that I would question none other than the engineer and flagman. The first to enter the office was the engineer, a man who had been many years in the service of the road, with a fine record and was also n old and valued friend of mine. He was questioned and cross-questioned by the officers, but nothing significant being brought out he was turned over to me.

"William," said I, "how long has that handle spring been gone from your brake valve?"

"Oh, I took that off two or three months ago," he replied.

"What was your object in removing it?"

"Well, you see, the handle works much smoother when there is no spring to lift over the notches."

"Do you ever discover your brake pipe pressure getting low when making long runs between stops?"

"Yes, once in a while."

"What do you do at such times?"

"I throw the brake valve handle to release, then back to running position."

"Will your brake pipe pressure then be maintained?"

"Yes, most always; though sometimes after a while if the pressure don't stay up I move the handle to release again."

"How can you tell, particularly in the night, if the brake valve is in running position?"

"Oh, I can tell pretty near by the feeling."

From the above my reader will understand that the times when the brake pipe pressure dropped was the result of moving the handle a little too far and lapping the running position ports.

One after another the conductor, brakemen and baggage master were catechised, but nothing of value was brought out. In the final roundup in came the flagman, whose replies to questions were on similar lines to the others until I began questioning him.

"Where were you while the train was stopping?" I inquired.

"On the tail end platform," he said.

"What did you do when the train stopped?"

"I jumped down and looked under the car to see if anything was wrong."

"What did you find?"

"Nothing."

"Didn't you find the bleed cock in the auxiliary reservoir open?"

"Oh, yes, that was open and I shut it up, but it wasn't leaking enough to amount to anything."

"That's all," said I, and he was excused.

As he passed out of the door the general manager turned in his chair and said, "Well, what do you make out of this investigation after all?"

"A clear case," said I, "of what caused that train to pass the station; no mystery about that brake failure."

"There ain't—eh? Seems to me it shows your brakes do fail once in a while, then they turn right round and work all right again, which is a very dangerous thing on a railroad."

"If they fail to work right once they should continue the same way, for under a similar condition in another locality a serious accident might result." Another twist in his chair, then the G. M. asked, "How do *you* account for that brake failure?"

"Well," said I, "the absence of the brake valve handle spring and the open bleed cock under the dining car tells the whole story. The brake valve handle had been inadvertently placed in a position to lap the brake pipe feed port, after picking up the dining car and pulling out with the bleed cock open there was no braking power in the car. The leak which the flagman did not think amounted to anything was a gradual leakage of air from the brake pipe and auxiliary reservoir throughout the train, though not sufficiently rapid to automatically apply the brakes. When the engineer applied the brakes, after running some twenty miles, it was with a greatly reduced force, a result of the depleted air pressure in the reservoirs, and which gave insufficient braking power to stop the train in the distance contemplated, and which could have been done had the brakes been charged to the maximum."

"I see it," exclaimed the General Manager, "and I also see that, while the air brake is pretty nearly indefatigable, a little of the human equation is necessary as well as anything else connected with railroad operation."

In the case of the mysterious application of the brakes subsequent events proved it was brought about by the proverbial "colored gentleman in the woodpile." On several occasions an express train had been stopped by an apparantly unexplainable application of the brakes, the brakes releasing after the stop and giving no further trouble during the trip. Three times this had occurred on the same railroad and train before it had come to my attention, and I at once started out on a still hunt during which it was learned that Pullman car "Wyoming" had been in the train each time the trouble was experienced and with the same porter accompanying the car.

This was in the early days of employing the water raising system on Pullmans, the air for the system being taken direct from the brake pipe, the control of the air passing from the brake pipe to the large air reservoir being governed by a globe valve located in the washroom, under the basin. To avoid possible interference with the air brakes a notice addressed to porters was posted in the room, this notice being to the effect that the water system should never be charged, except when the train was making a long stop, such as at a station where the passengers were taking a meal. Believing I was on the right trail, I accompanied the "Wyoming" on its next trip. Getting along quite late in the night others deserted the smoking room, leaving me the sole occupant, and after a time the porter came in with his shoe-shining outfit, when I began making inquiries regarding the water system. What made the water flow from the faucets so freely, etc., all of which the porter explained, and, among other things, he stated if the water did not come out fast enough he just opened up the valve and filled everything with air.

"Don't you porters ever have that hungry feeling when the train is standing at an eating station, as well as the passengers," I asked.

"Sure, I does, boss; I always carries my appetite along with me," he replied.

"I should think you would want to reach the lunch counter when meals are being served as well as the others."

"I don't go without my feed, no Sar. I just sneaks out here when there ain't no smoking gentlemen, and turn that wheel, and no one don't know anything about it. I has just done been in this business too long to lose my fodder."

"If no one knows anything about your fixing up the water outfit, why is it that the train sometimes stops when you open that valve?"

"That's the funny thing about it, boss. When the train stopped, I done shet up that wheel and got off, and while we was hunting for the trouble the hrakes all blowed off."

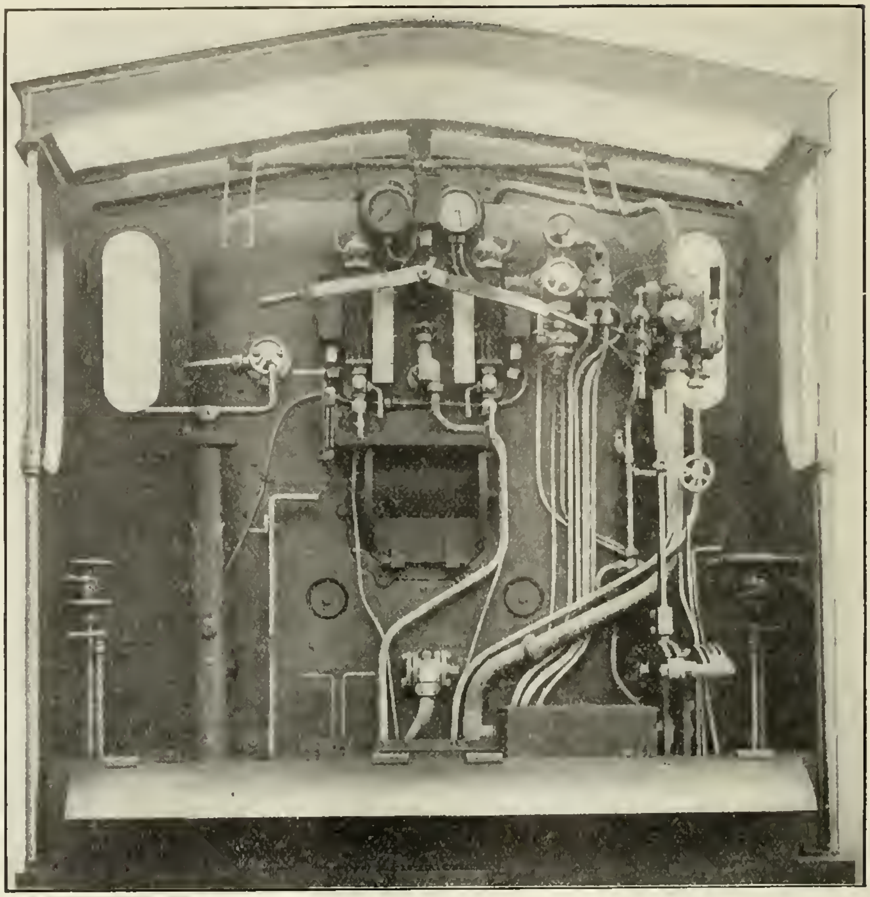
I then called his attention to the notice, explaining to him that the opening of the valve was the cause of the train stopping and, of course, would have to make out a report to that effect.

Upon making this statement his eyes bulged, and, throwing up his hands, he exclaimed "For the goodness sake Was that me making that train stop?" Then he began supplicating that he would lose his job, saying if I would not report him he never again would disobey the rules governing the manipulation of that globe valve, a promise I gave with the proviso that he should explain to the other porters the danger of charging the water raising system when the train was in motion, a promise he faithfully carried out.

In conclusion, it may be said, for reasons such as the one recited, the development of valves to automatically maintain the desired pressure in the water distributing system resulted, thus removing any liability of interfering with the air brakes from this source.

0-6-6-0 Mallet Articulated Compound Locomotive.

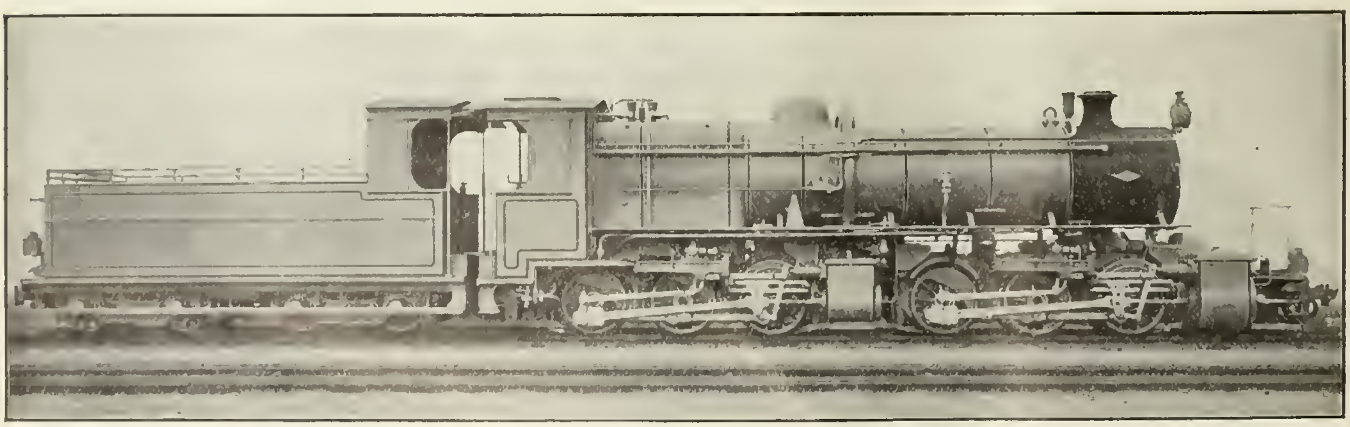
The Burma Railway operate nearly 1,530 miles of metre gauge track connecting the different centers of the country and terminating at Rangoon. Although Rangoon is strictly not a terminus, as the line extends to Moulmein, the station is operated as one and trains start from there for the different districts served.



INTERIOR OF CAB OF MALLET ARTICULATED COMPOUND LOCOMOTIVE FOR THE BURMA RAILWAY.

The engine illustrated is destined for working over the hilly districts served by the Burma Railways. The engine and tender is 62 ft. 2½ ins. over buffers. Total weight, empty—engine, 52.5 tons; tender, 15.6 tons; engine and tender, 68.1 tons. Total weight in working order—engine, 58.2 tons; tender, 31.3 tons; engine and tender, 89.5 tons. Diameter of engine wheels, 3 ft. 3 ins.; diameter of tender wheels, 2 ft. 4½ ins. Cylinders—high-pressure, 15½ ins. diameter by 20 in. stroke; low-pressure, 24¼ ins. diameter by 20 in. stroke. The boiler contains 178 steel tubes 2 ins. external diameter, and is 15 ft. between tube plates. The steam pressure is 180 lbs. per sq. in. Heating surface—tubes, 1,398 sq. ft.; firebox, 115 sq. ft.; total, 1,513 sq. ft. Area of fire grate, 33 sq. ft. The boiler center is 7 ft. 3 ins. above rail level. Tender—fuel capacity, 6 tons coal; tank capacity, 2,000 gallons. The tractive force of the engine for starting purposes equals 28,386 lbs.; the tractive force for working conditions equals 24,394 lbs.

The design is very neat considering the large amount of gear in this type of engine. From the photographs it will be observed that the boiler rests on three saddles or supports, the middle one of which slides on a bronze liner, and the front one controls the side movement of the flexible portion of the engine, and is not supposed to take any weight. The whole of the engine bearing springs are compensated. The engine is reversed by a lever, assisted by a steam and oil-controlling cylinder, and the valve gear is of the Walschaert type. Pump lubricators are fitted, one for the high-pressure, and one for the low-pressure engine, each worked from the valve of its own engine. Steam brakes are on the engine and tender, and vacuum brakes on the tender. In addition there are hand brakes on the six wheels of the fixed portion of the engine and on the tender, and the Meyer counter-pressure brake on the engine, the muffler for which is seen on the boiler behind the chimney.



MALLET ARTICULATED COMPOUND LOCOMOTIVE FOR THE BURMA RAILWAY.

General Correspondence

Flange Cutting.

Editor:

We notice a communication in your September issue on "flange cutting," in which our lubricating stick is mentioned.

The writer of the article in question seems friendly to our methods, but is quite at sea regarding the composition of our lubricating stick, as applied to the Collins Wheel Flange Lubricator.

We have spent considerable time and money to develop this very important composition and while it is a secret formula with us and one which we jealously guard, still we may say the prime ingredient is graphite.

The one point in the article referred to and which we consider the most important is that regarding the confining of the lubricant to the flange. Our lubricant does not fly off nor get on to the wheel tread.

THE COLLINS METALLIC PACKING CO.
Philadelphia, Pa.

Gantry Crane and Air Lift.

Editor:

Enclosed snapshoot marked No. 1 is a home-made air-lift and crane, which is

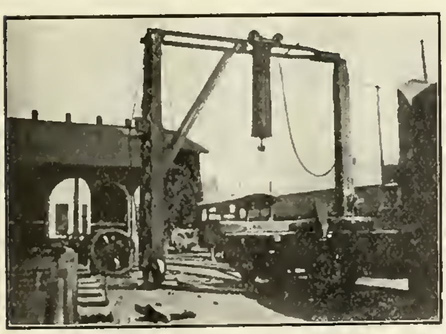


FIG. 1. HOME MADE AIR LIFT.

used at the Clinton, Ia., shop of the C. & N. W. Ry. to load and unload driving wheels and other heavy material from flat cars. This snapshot shows the crane in position to load or unload the flat car. You will note that the air-lift travels in and out on the rails, which are pivoted to top of post on one end and the other end of rails are bolted to girdered upright, which upright has two flanged wheels bolted to bottom of upright. These wheels revolve on circular rail, which circle is 60 ft., allowing the lift to be moved to any part of the car. When lift is not in use it is rolled around on circular track, out of the way, leaving the loading track free. This position is shown by snapshot No. 2. We consider this a very handy crane, as it is equipped with a 15-in. air-lift it will handle a very heavy load. Snapshot No. 3 shows a home-made cleaning vat crane made from old bridge timbers. On the top timbers of this crane are laid old rails which

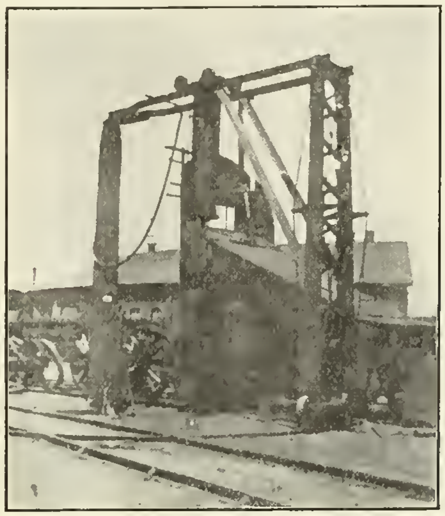


FIG. 2. LIFT ROLLED OUT OF THE WAY.

carry the carriage and 15-in. air-lift, which carriage is pulled in and out by crank and wood drum fastened to each side of the uprights. The load to be cleaned is brought to vat on dump car by

FIG. 3. HOME MADE CLEANING VAT UNDER CRANE.

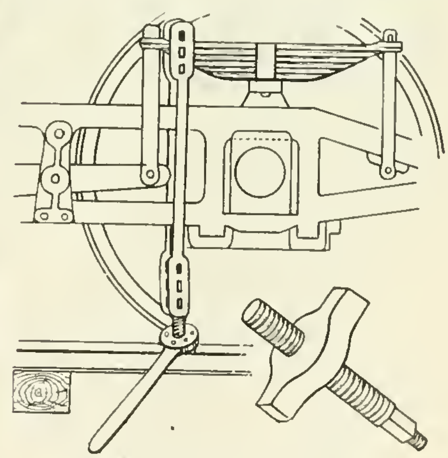
track which runs parallel with the vat. This lift and crane will lift our heaviest engine trucks, which are put in and cleaned before dismantling. The cover to this vat, you will note, is counter-balanced by chain and weight. This vat has been in use two years and has given every satisfaction. Trusting that this will be of interest to your readers, I send it on.

CHAS. MARKEL,
Shop Foreman, C. & N. W. Ry.
Clinton, Ia.

Locomotive Spring Puller.

Editor:

Springs, like everything else on the modern locomotive, are growing so great, that pulling them in place with ordinary screw bolts is no longer possible. We have a handy device in use here that pulls the heaviest springs to their places in a very short time. The enclosed sketch shows two slotted straps, one of which is placed on each side of the spring, and a gib with projecting lugs is placed through the upper slots of the straps and rests upon the spring, the projections on the ends of the gib keeping the straps in place. Another gib, so constructed that a



LOCOMOTIVE SPRING PULLER.

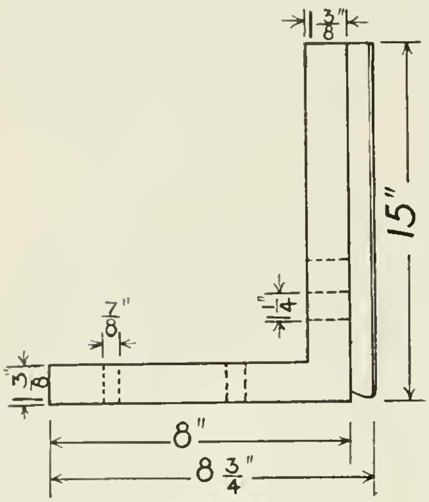
threaded bolt 1¼ ins. in diameter passes through it, reaches through slots in the lower end of the straps. This screw bolt may be turned by hand some distance, after which an adjustable ratchet may be readily applied to the lower squared end of the bolt and the spring drawn down to the required point where the spring-hanger gib can be placed in position and the straps removed. The tool is a prime favorite here, both in the machine shop and engine shop. It will be seen that the ratchet is held in place by having the lower end of the bolt reduced to ⅞ in. and threaded so that a nut and washer may be applied to keep the ratchet from sliding downward.

P. G. GREUSEL,
Wymore, Neb. C. B. & Q. R. R.

Adjustable Clamp For Holding Brasses.

Editor:

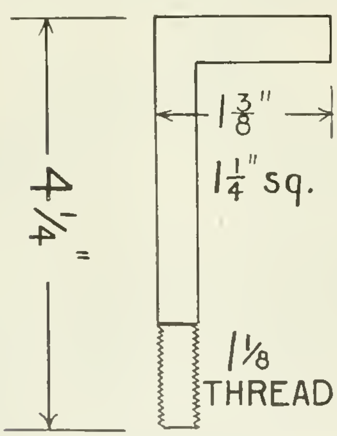
I enclose sketch of a simple clamping arrangement for holding driving box brasses on the slotting machine after they are turned. It is especially handy on account of the readiness with



ANGLE PLATE—SIDE VIEW.

which the brass may be set up, which is necessary at least twice for each brass when fitting new brasses on old cast iron driving boxes, the strength of which are doubtful, necessitating trying the brass into the box to see that it is snug without being tight enough to break the box.

The arrangement, it will be readily



HOOK BOLT FOR HOLDING BRASS.

noted consists of a cast iron angle plate, one side of which is adapted to bolt on slotter table. The perpendicular face has two projections cast on it, ¾ in. square, and 3¼ ins. apart, with their sharp edges slightly beveled to make bearing for brass. The slot, as shown, makes it adjustable for any length of brass, and with two hook bolts, as seen in sketch, it is an easy matter to clamp brass ready for cutting.

R. S. Booth.

Atlanta, Ga.

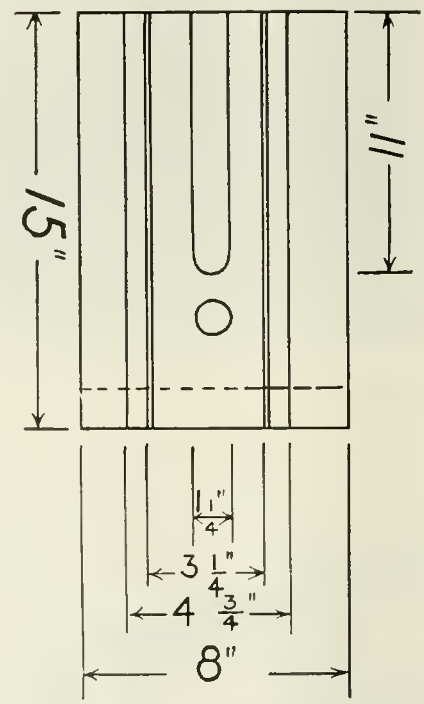
Waste of Bolts and Nuts.

Editor:

Why is it that railway companies do not specify in their orders for locomotives and cars, especially freight cars, that all nuts and bolts be cotter-pinned where possible? This would result not only in quite a large saving, but also in preventing accidents to a certain extent. One can pick up more bolts and nuts than could be carried along in a distance of four or five miles on one of our through trunk lines.

Wm. G. Landon.

Staatsburg, N. Y.



ANGLE PLATE SHOWING DIMENSIONS.

Rotary Steam Engine.

Editor:

In these days of marine turbines it may not be uninteresting to your readers to know that we have had in operation for some time a rotary steam engine directly connected to a 24 in. forge blower. Fig. 1 shows the turbine furnished with 19 blades. The steam nozzle will be noted on the upper right-hand corner. A short distance above the point where the steam enters a small angular protuberance will be observed preventing the steam from blowing in the wrong direction. The exhausted steam escapes at the shaft center after nearly completing a revolution. The blades are 1⅜ ins. apart. The shaft is packed with one strand of rope asbestos.

Fig. 2 shows turbine and blower. The device is simple, effective and economical. An admission valve regulates the flow of steam, and all that is necessary is a little oil to lubricate the bearings. There is no belting to repair, or spur wheels to break, and you

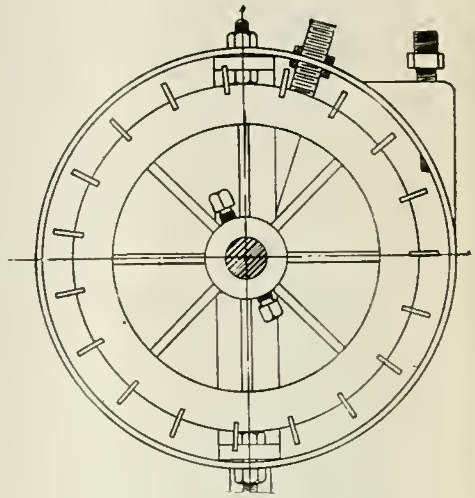


FIG. 1. STEAM TURBINE.

would not know it was there. Can you beat it?

The diameter of the turbine is 10 ins. and the width of the blades is 1⅛ ins.

It has been running for a number of months and has had no kind of repair, and from all appearance it will last

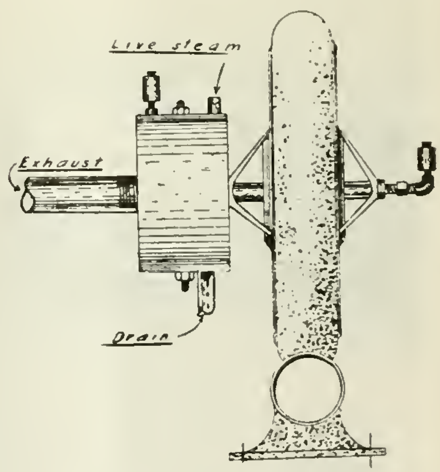


FIG. 2. TURBINE AND BLOWER.

for a long number of years. It is simple, very cheap and very effective. I may add that I have always looked upon your correspondence department as one of the best features in Railway and Locomotive Engineering. There is never a number but there are several things of real value to railroad men. We have a number of other contrivances here and particulars will be sent to you in the near future.

A. W. Nelson.
Div. Foreman.

Frisco Shops, Neodesha, Kan.

Krueger's Book.

Editor:

On page 380 of your September edition I noticed an inquiry for the address of the publisher of the so-called "Kruger" Book, the gentleman making the enquiry no doubt has reference to "Freight Car Equipment," published by Mr. F. J. Krueger, 679 Ferdinand avenue, Detroit, Mich., from whom he can secure copies at $1.50 per.

GEO. A. QUILLING,
M. C. B. Clerk,
A. & N. M. R. Co.

Clifton, Ariz.

R. J. Crane on Education of Industrial Leaders.

A copy of our article Heroes in Railway Life having been read by Mr. R. T. Crane, of Crane Company, Chicago, and the famous authority on higher education, brought from him the following article which is slightly condensed:

Before going into this subject, however, I would just mention that a number of years ago we instituted an employment bureau, at which time we took the hiring of the help for the factory entirely out of the jurisdiction of the superintendents and foremen and placed it in the hands of this bureau, and I am satisfied that this is a desirable thing to do in all large establishments, for reasons explained later.

MAKING OUR OWN HELP.

Until recently, however, we never made any systematic efforts to produce our own help; but now we have concluded to go into this question in a thorough and systematic manner, and in doing so have adopted the rule that we will take on only boys between the ages of 14 and 16 years.

In our city this means boys who have gone through the grammar school and completed the compulsory school age, but who, on account of being under 16 years of age, are not permitted by the labor laws to work more than eight hours a day.

Because of this restriction, such boys are not in what might be called satisfactory demand, and are knocked around in rather an indifferent sort of way; but the lower wages that they have to accept on account of working only eight hours a day of course compensates us for the disadvantage due to the shorter hours.

The hiring of these boys is a part of the employment bureau's work, and it is the duty of this department to select the boys with the greatest care and to keep a systematic record of them.

What we expect to gain by taking this class of boys is that they will form more industrious habits and also avoid the bad habits that boys usually get into when running on the streets; and we feel that they will learn a great deal between the years of 14 and 16 that will be useful to them when they are wanted for higher positions.

Furthermore, this preliminary work and experience gives us a better chance to know and judge of their merits when wanting boys for promotion, either to learn a trade or to go into some other department where they will have fixed occupations which they expect to follow.

It is our plan to make all of our help, both for shops and office, from this class of boys.

EDUCATION OF OUR HELP.

In connection with the making of our help, the question naturally arises as to whether or not a grammar school education is sufficient for making our office help, and we have concluded that it is. But in all probability these boys may not, in every case, be able to write a good, round, clear, business hand, or to do this with sufficient rapidity, or they may not be correct or sufficiently rapid in arithmetic, or they may not be able to read well—especially handwriting, and when such is the case they will be required to take up these studies at a public night school.

APPLYING OUR METHOD TO THE RAILROAD BUSINESS.

In the case of railroads, probably it is not possible to use fourteen-year-old boys to advantage, and therefore this particular feature of our scheme will not interest you, but I think that our general plan for making our help (and including the employment bureau) is more essential to a railroad than it is to us.

While it is impracticable in the railroad business to have the employment bureau hire all the help directly, I think the head of this department ought to do all the hiring in all the large centers.

Then in the next smaller places he should have a sub-agent who works in harmony with him.

And in places that are too small to have a sub-agent, the local agent in charge there can recommend persons for employment, but these persons should be passed upon by the head of the employment bureau before being engaged.

The object of having an employment bureau is manifest today, when we take into consideration the enormous number of "floaters" there are on the market, and the large amount of time and discretion required to investigate properly persons applying for work. This has now become so great that the superintendents and foremen cannot possibly spare the time for it. As a matter of fact we find, in our business that, even with all the care we take, we generally have to hire two men in order to get one, and that it is absolutely necessary to go into quite an investigation to get at the history of the men and learn something about them.

RECORD OF EMPLOYEES.

A record should be kept at headquarters of all employees above the laborers, this record to give the detailed history of each man, such as: Name, age, places where he was previously employed and length of time in each place, his qualifications, etc.

The purpose of these records is to make sure at headquarters that no slipshod or floating element is engaged.

REPORTS OF IMPORTANT MEN.

The employment bureau should receive annual reports from the heads of the various departments, showing how all their assistants are coming along (that is, the persons who naturally will work up to the higher positions), so that the head of this bureau will be satisfied that the right kind of material is coming along in every department, thus keeping the organization strong.

MEN OF DECIDEDLY UNUSUAL ABILITY.

The department heads are also to report to the employment bureau any men coming along that appear to have decidedly unusual ability and are of high character, stating in these reports all the particulars about such persons.

It will then be the duty of the head of the employment bureau, when such a man is reported, to send for him and look him over himself, after doing which, if he finds the report to be correct, he will determine for what particular branch of the work this man is naturally inclined.

His next step will be to see that this man is given a special course of training, something along the following lines:

Three years in the machine shop.

Two months in car-building shop.

Two months in foundry.

Two months in pattern shop.

Two months in blacksmith shop.

Three months in firing on locomotives.

Two months with track repairer.

Nine months in surveying, laying tracks, grading, etc.

Three months in testing department.

Six months in visiting all departments and inquiring about all the different kinds of material that the road uses and learning their peculiarities, in order to form some judgment as to all these various articles.

Three months at the smaller country stations.

Three months at a large freight station.

Three months in passenger department.

Six months in auditing and bookkeeping departments.

Two months in train despatcher's office.

Twelve months in division superintendent's office.

Making eight years in all.

While in the department last mentioned (the division superintendent's office) he would look into all kinds of accidents, landslides, washouts, snow blockades, wrecks, etc.; in other words, get a clear insight into all the difficulties with which a division superintendent has to contend.

A special record shrould be kept of such persons, showing what progress they are making and what the different heads of departments, under whom they are employed, think of them from time to time, in order to make sure that no mistake is made in the selection of men to be trained in this way for higher positions.

Now, suppose you take a man who has put in eight years in this way. He is still a young fellow in the neighborhood of twenty-four years of age, and if he is a particularly promising person he can then go on, say for four years more, dividing his time among the various departments in which it is decided it would be well for him to have more experience.

You can easily imagine how much more valuable to the railroad will be a person who has put in twelve years in this way, learning every detail of the business, than the men we frequently find at the head of a road, such as a lawyer, or a civil engineer, or a stock gambler. In the former, you have a real railroad man, one who has a pretty thorough knowledge of every detail of the business, whereas the latter class of men naturally have only a superficial knowledge of it and cannot possibly judge as to the value of any of their men or of the work they are doing, or know whether the road is being run correctly in every department.

THE RAILROAD PURCHASING AGENT.

A good illustration of the slip-shod, unbusiness-like methods of conducting the railroad business is found in their purchasing agents. We often see that for this position they select men who are mere clerks and know but little about the quality of any of the material they buy; in fact, they scarcely are fit to purchase a bunch of pencils, to say nothing of a locomotive. And what is the result?

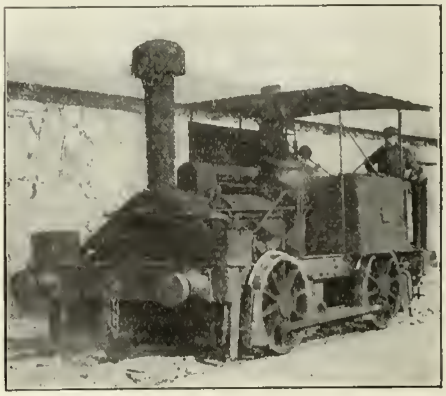
Naturally, it will be seen that the man who knows but little concerning the goods he purchases is easily imposed upon by any "smart aleck" of a salesman that comes along and offers the lowest price.

Since writing the foregoing I have been informed by a gentleman who manufactures one of the most important articles used by railroads, that recently he sold a quantity of this material to a man, who probably was a broker, at a price of 18 cents, and this man then turned around and sold it to a railroad at 35 cents. Of course, it would have been an easy matter for the purchasing agent of this road to go to headquarters and get this material for 18 cents, but instead of doing so, he allowed himself to be humbugged by this "slick" salesman, which conclusively proves my statement above in reference to the practice of railroads when selecting men for such positions.

An important article like the one just referred to should not, in the judgment of ordinary people, vary in value more than 5 per cent., and yet here was a case where the railroad paid 100 per cent. more than it was worth.

Another piece of stupidity on the part of the railroad is that there is no standard for this article.

To become a good purchasing agent a man should first put in a large amount of time in the various departments of the road for the purpose of becoming acquainted with the peculiarities of the various materials used by it. So extensive is the variety of goods used in the railroad business that it would take years for one to acquire sufficient knowledge of them to enable him to judge of them correctly and know what quality of goods is best for the road to use.



LAST OF THE 7 FT. GAUGE LOCOMOTIVES.

The Last Broad Gauge Locomotive in the World.

The broad gauge (7 feet) to which the Great Western Railway of England was originally built, was finally converted to the standard 4 feet 8½ inch gauge in May, 1892, and though one or two of the big single-driver engines were kept for a few years as curiosities, they too have now been scrapped. Therefore, the relic we illustrate herewith is of particular interest, for it is the last 7 foot gauge locomotive in the world, and is still doing useful work. It was built as long ago as 1852, by Messrs. R. B. Lomgridge & Co., of Bedlington, Northumberland, and is now used for conveying material from the Silica Works, on Holyhead Mountain, Isle of Anglesey, to a loading wharf for small vessels on the famous Holyhead breakwater. The line it runs on was part of the Holyhead Breakwater Railway, which was built to carry blocks of stone from the quarries on the mountain to the Breakwater works, which were commenced in the early "fifties." Built for this Breakwater Railway, the engine bears the maker's number plate, No. 309, and also a name plate, "Prince Albert," on the back of the bunker.

When the late Queen Victoria, with Prince Albert, were on the way to visit the Dublin Exhibition, they inspected the work in progress in connection with the formation of the National Harbor at Holyhead, this being the nearest port to the Irish coast, and Prince Albert rode on this engine, then just new. At the driver's request, he gave the name to the engine which it bears to this day. The engine was again used for a royal "special" when the late King Edward—then Prince of Wales—opened the breakwater, on August 19, 1873.

This curious old engine has inside cylinders sandwiched between the frame and the boiler, 12 inches in diameter, with a stroke of 16 inches, four driving wheels with steel tires, 3 ft. 2 ins. in diameter, and a boiler 3 ft. in diameter, with a working pressure of 110 lbs. It had a new boiler about nine years ago with several modern fittings, including gauge glass "protestors," etc. The corrugated iron shelter forming a roof and side sheet for the footplate, were fitted by the driver as some protection against the furious gales of the Irish Channel.

It will be noticed that a steam pipe runs from the raised firebox to a steam chest over the boiler, containing the regulator (or throttle), the rod for working the latter being seen below the steam pipe. At the time the photo was taken the wheel flanges were worn down to a "razor edge" so that it was not surprising to hear of frequent derailments, but low speeds prevail, so the results would hardly be disastrous. The sanding arrangements and the spark arrester are evidently contemporaneous with the date of the engine.

Apart from being the last of the "Broad Gauge brigade," this engine is surely one of the oldest in the British empire still at work.

First Bessemer Steel Made in America.

In 1865 Captain Ward, an enterprising American business man, conceived an idea that Bessemer steel could be made as cheaply and as good as it was made in Great Britain where its production was growing in magnitude. The first Bessemer steel plant had been started in Sheffield in 1858, and under the management of the inventor the product of the new process flashed into popularity.

Bessemer steel was selling in the United States for $150 a ton, which seemed to render its manufacture profitable without any government protection. Captain Ward induced capitalists to advance the wherewithal to build a Bessemer steel plant and a company was formed, called the American Steel Association. Works were built at Wyandotte, Mich.

New Type of Locomotive for the Chesapeake & Ohio

When the Mallet Compound appeared about the end of the last century it was thought that the limit in size and the diversity in design of the modern locomotive had been reached, but the present year marks another epoch in locomotive construction. The accompanying illustration shows a new type of passenger locomotive, the most powerful in the world. Two of this new class of locomotives have been built by the American Locomotive Company, and are doing excellent service on the Chesapeake & Ohio Railway. They are hauling 12 steel cars over a division of the road with grades extending to 14 miles rising as high as 80 feet to the mile, at average speeds of 26½ miles per hour, including as many as 13 stops. Both locomotives are exceeding the record of the 108-ton Pacific type, the limit of whose capacities are 6 cars. From the service for which they have been designed, and in which they are doing such remarkable work, Mr. J. F. Walsh, superintendent of motive power, has appropriately named them the "Mountain" type.

The design illustrated is equipped with superheater and brick arch, and the idea contemplated was that the engine would develop sufficient power to maintain a speed of at least 25 miles per hour on the grades referred to with a 600-ton train, or would haul a 10-car train over the division on the same schedule that the Pacific type of locomotive had been making with a 6-car train.

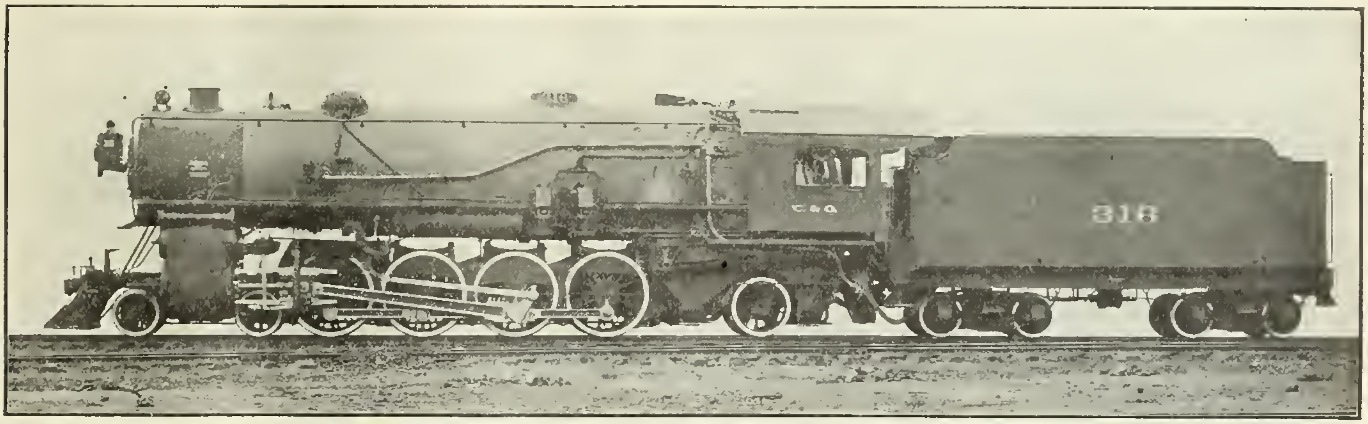
Both estimates have been surpassed by the new design of locomotives, so that the new type in all fairness may be said to surpass in efficiency two of the ordinary Pacific type of locomotive. Nor should it be imagined that the speed referred to in any way indicates the maximum speed of these powerful locomotives when running on a level track. Locomotive No. 316, which we illustrate, has repeatedly run over a level stretch measuring 2.4 miles in 2 minutes, making a speed of 72 miles per hour, and hauling 10 of the heaviest class of steel cars.

The best performance perhaps, from the standpoint of sustained horsepower, consists in taking a train of 4,200 tons over a sustained grade of 15 feet to the mile at an average speed of 23½ miles per hour. Calculating the resistance on a ratio of 3 lbs. per ton for the cars, the engine develops 2,480 horsepower, a record which is, probably, the highest ever attained by any locomotive.

As the accompanying details in construction show the total weight of the locomotive exceeds any other locomotive of rigid frame construction. The weight per axle of 60,000 lbs. is the greatest ever placed on four pairs of driving wheels on any engine built by the American Locomotive Company. The simple cylinders 29 ins. by 28 ins., are also the largest ever applied to a single expansion locomotive.

There are a number of new and interesting details on these locomotives, among which are the arrangement of outside steam pipes, a new design of self-centering guide for the valve stem crosshead of the Walschaerts valve gear with which the locomotives are equipped. This style of guide is so constructed that a perfect adjustment for any amount of wear can be easily made. The screw reversing gear has been adopted in place of the reversing lever. There is also a new design of a six hopper ash-pan, the slides of which are all operated by one gear. The ash-pan gearing is so arranged that the front and rear sections may be shaken independently or together. The fire-box is also equipped with a Street mechanical stoker.

The tests which the locomotives have already undergone give the most complete assurance that they have not only surpassed the expectations of the builders in point of power and speed, but they have also exceeded the expectations of the Ohio & Chesapeake Company in point of economy, so that the continuation of this new type of locomotive is already a foregone certainty.



4-8-2 TYPE OF LOCOMOTIVE FOR THE CHESAPEAKE & OHIO RAILROAD.

J. F. Walsh, Gen. Supt. of Motive Power. Built by the American Locomotive Company.

The following are the principal dimensions of the new type of locomotives from the data on hand at the locomotive shops at Schenectady, N. Y.

Cylinder.—Type, piston; diameter, 29 ins.; stroke, 28 ins.

Track gauge, 4 ft. 8½ ins.; tractive power, 58,000 lbs.

Wheel base—Driving, 16 ft. 6 ins.; rigid, 16 ft. 6 ins; total, 37 ft. 5 ins. Total, engine and tender, 70 ft. 6 ins.

Weight—In working order, 330,000 lbs.; on drivers, 239,000 lbs.; in working order engine and tender, 503,400 lbs.

Heating surface.—Tubes, 3,795 sq. ft.; firebox, 310 sq. ft.; arch tubes, 27 sq. ft.; total, 4,132 sq. ft.

Grate area, 66.7 sq. ft.

Axles.—Driving journals, main 11½ ins. x 14 ins.; others, 10½ ins. x 14 ins.; engine truck journals, diameter, 6 ins.; length, 12 ins.; trailing truck journals, diameter, 9 ins.; length, 14 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.

Boiler.—Type, conical connection; O. D. first ring, 83¾ ins.; working pressure, 180 lbs.; fuel, bitum. coal.

Firebox.—Type, wide; length, 114⅛ ins.; width, 84¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; side ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 4½ ins.; back, 4½ ins.

Crown staying.—Radical stays, 15-16 in.; 1⅛ in. ends.

Tubes.—Material, Detroit seamless steel No. 243—40; diameter, 2¼ ins.,—

5½ ins.; length 19 ft.; gauge, No. 11 BWG small tubes; No. 9 BWG large tubes.

Boxes.—Driving, main, cast steel; others, cast steel.

Brake.—Driver, New York Sched. LT.; tender, New York; air signal, New York ES.; pump, 2 ft. 9½ ins., L. 11.; reservoir, 1 20½ in x 150 ins., 1 20½ ins. x 90 ins.

Engine truck, swing center bearing.

Trailing truck, radial with inside journals.

Exhaust pipe, cast iron; nozzles, 7⅜ ins., 7⅝ ins., 7⅞ ins.

Grate, style rocking.

Piston.—Rod diameter, 4½ ins.; piston packing, Hunt-Spiller rings.

Smoke stack.—Diameter, 20 ins.; top above rail, 14 ft. 11 ins.

Tender frame, 13 in. steel channels.

Tank.—Style, water bottom gravity; capacity, 9,000 gallons; capacity fuel, 15 tons.

Valves.—Type, piston, 16 ins. diameter; travel, 7 ins.; steam lap, 1¼ ins.; clearance, ⅛ in.

Setting, 3-16 in. lead in full gear.

Wheels.—Driving, diameter, outside tire, 62 ins.; centers, diameter, 56 ins.; material main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, McKee Fuller; trailing truck, diameter, 44 ins.; kind, cast steel, spoke center; tender truck diameter, 33 ins.; kind, Forged Steel Wheel Co.

Varieties of Horse Power.

Some engineering expressions are curiously vague and convey a different meaning to one set of men that they do to others. A striking example of this uncertainty is the term horse power. When critically examined we find the real horse power to be 22,000 foot-pounds, the Watt horse power, 33,000 foot-pounds and the nominal horse power the number of foot-pounds an engine maker is pleased to call it. Steam engineers have been in the habit of using Watt's 33,000 foot-pounds as a horse power so regularly that the term came to be generally accepted as a correct measure of work done. But the automobile makers are changing all that. There is no exact form of measuring the power capacity of an automobile and the purchaser has to take the agent's word, generally a most unreliable estimate on which to base an estimate of the actual power of the motor.

A Fuel Economy Reminiscence.

By George H. Baker.

Twenty-four years ago, while I was running an engine on the Wabash Railroad, an argument arose between another engineer and myself about the economy of using steam with a wide open throttle and a short cut-off, as I practiced, or of using steam with a light or partly open throttle and a later cut-off as he practiced.

My opponent claimed that there was no difference in the economy of the two methods, as the exercise of power required was necessarily the same with either plan. He said the economical difference between the two methods was about as much as whether a wagon were hauled by a horse or a mule.

We agreed to submit the question to the two great authorities on locomotives—Mr. M. N. Forney and Mr. Angus Sinclair, with whose books we were familiar, but in which there then existed no positive declaration of faith on the particular disputed point.

Both gentlemen promptly replied to my letter requesting their opinions. Mr. Forney said that while less steam and heat were used per stroke with a short cut-off and a full throttle, than with a late cut-off and light throttle to do the same work—yet the difference was so small as to be of not much importance.

Mr. Sinclair answered my letter with an enthusiasm that surprised me. He declared unhesitatingly and emphatically in favor of the full throttle and the short cut-off.

Years afterward, when I was called upon to write a book on economical locomotive management, I came to see why Mr. Forney had answered me as he did. I found that in an 18-inch cylinder, with 145 pounds steam pressure, a wide open throttle and a 6-inch cut-off—three-tenths (.3129) of a pound of steam would be used in the cylinder during a stroke, and that this would exert a mean pressure of 77 pounds per square inch on the piston. With the same boiler pressure and cylinder, but a ten-inch cut-off, and steam throttled to exert the same mean pressure on the piston during the stroke—nearly half (.403) of a pound of steam would be used—nearly a tenth (.091) of a pound more steam than in doing the same work with the shorter cut-off and greater expansion of the steam.

I have always thought that Mr. Forney, before he answered my question, estimated more or less accurately this difference of steam consumption per stroke, and considered a tenth of a pound of steam as too small a saving to be practically important. The quantity does seem small and, considered alone, hardly worth much effort to save. It is only an ounce and a half of water—about two tablespoonfuls turned to steam.

But a locomotive with 63 inch driving wheels will use in running a mile 1,280 cylinder fulls of steam. Thus this economy, so small when considered singly, becomes important when multiplied by 1,280. The ounce and a half then becomes 116.48 pounds; and as the engine runs 100 miles this grows to 11,648 pounds.

Estimating the average evaporation to be six pounds of steam per pound of coal burned, we see the saving in steam accomplished represents 1,941 pounds of coal saved, or practically a full ton of this most expensive supply that railroads buy.

And thus it is that the greatest economies can be accomplished in railroad operating by all in the service doing well the little things, and paying attention to the smallest details of their work; for in the numerous repititions of these duties daily by many men, they aggregate to vast sums of money annually on any railroad—quite enough to spell for the company, prosperity or poverty.

Inventor of the Miller Platform.

It is curious how little is known of the men whose inventive ingenuity has made American railway rolling stock the pattern for all the railways of the world. Everybody has heard about the Miller platform, but who knows anything about the inventor. Ezra Miller was born in New England in 1812 and died in 1885. He invented what was known as the hook coupler, largely used on passenger equipment until the Pennsylvania railroad adopted the Janney Coupler. The Miller platform is now universally used.

Charles Francis Adams in his book on Railroad Accidents does justice to Miller's inventions in the following paragraphs:

"The original passenger cars, however frail and light they may have been, were at least, when shackled together in a train, continuous in their bearings on each other—that is, their sills and floor timbers were all on a level and in line, so that, if the cars were suddenly pressed together, they rubbed in such a way as to resist the pressure to the extent of their resisting power, and the floor of one did not quietly slide under or over that of another. The bodies of these cars were about 32 ins. from the rails. This was presently found to be too low. In raising the bodies of the cars, however, the mechanics of those days encountered a practical difficulty. The couplings of the cars built on the new model were higher than those of the old. They at once met, and, as they thought, no less ingeniously than successfully overcame this difficulty by placing the couplings and drawheads of their new cars below the line of the sills. This necessitated pulling the platform which sustained the coupling also beneath the sills, and in doing this they disregarded, without the most remote consciousness of the fact, a fundamental law of mechanics. With a possible pressure, both sudden and heavy to be resisted, the line of resistance was no longer the line of greatest strength. During thirty years this stupid blunder remained uncorrected. It was as if the builders during that period had from force of habit insisted upon always using as supports, pillars which were curved or bent instead of upright. At the close of those thirty years, also the railroad mechanics had become so thoroughly educated into their false methods that it took yet other years and a series of frightful disasters, the significance of which they seemed utterly unable to take in, before they could be induced to abandon those methods."

The two great dangers of telescoping and oscillation were distinctly due to this system of car construction and of train coupling—and telescoping and oscillation were probably the cause of one-half at least of the loss of life and the injuries to persons incident to the first thirty years of American railroad experience. The badly built and loosely connected coaches of every train going at any considerable rate of speed used then to swing and roll about and hammer against each other after a fashion which made the infrequent occurence of serious disaster the only fair subject for surprise. In case of a sudden stoppage or partial derailment the train stopped or went on, not as a whole, but as a succession of parts, while the low platforms and slack couplings fearfully increased the danger; for if the train held together the cars in stopping were likely to break off the platforms making of what remained of them a sort of inclined plane over which the car bodies rode into each other at different levels; or, if the couplings, as was more probable, held and the train did not part the swaying and swinging of the loosely connected cars was almost sure to throw them from the track and break them in pieces. The invention through which this difficulty was at last overcome, simple and obvious as it was, is fairly entitled, so far as America at least is concerned, to be classed among the four or five really noticeable advances which have of late years been made in railroad appliances. It contributed unmistakably and essentially to the safety of every traveller known as the Miller platform and buffer, from the name of the inventor, it was like all good work of the sort a simple and intelligent recurrence to correct mechanical principles. Miller went to work to construct cars in such a way as to cause them to come in contact with each other in the line of their greatest resisting power, while in coupling them together in trains he introduced both tension and compression—that is, he, in plain language, brought the ends of the longitudinal floor timbers of the separate cars exactly on a line and directly bearing on each other, and then forced them against each other until the heavy spring buffers which played on those floor timbers were compressed, when the couplers sprang together and the train then stood practically one solid body from end to end. It could no more swing or crash than a single car could swing or crash. It then only remained to increase the weight and to perfect the construction of the vehicles to insure all the safety in this respect of which travel by rail admitted.

Simple as these improvements were and apparently obvious as the mechanical principles on which they were based now seem, the opposition for years offered to them by practical master mechanics and railroad men would have been ludicrous had it not been exasperating. There was hardly a railroad in the country whose officers did not insist that their method of construction was exceptional, it was true, but far better than Miller's. It was maintained that the slack couplings were necessary in order to enable the locomotives to start the train—that a train made up without the slack, on Miller's plan, could not be set in motion, and that if it was set in motion it must twist apart at every sharp curve, etc. The ingenuity displayed in surmounting theoretical objections to the appliance far exceeded that required for inventing it, and indeed no one who has not had official experience of it can at all realize the objecting capacity of the typical practical mechanic whose conceit, as a rule, is measured by his ignorance, while his stupidity is unequalled save by his obstinacy. Even when Miller's invention for one reason or another was not adopted, the principles upon which that invention was founded—the principles of trusion, cohesion and direct resistance—at last forced their way into general acceptance. The long-urged objection that the thing was practically impossible was slowly abandoned in face of the awkward but endurable fact that it was done every day, and many times a day. Consequently as the result of much patient arguing, duly emphasized by the regular recurrence of disaster, it is not too much to assert that for weight, resisting power, perfection of construction and equipment and the protection they afford to travelers, the standard American passenger coach is now far in advance of any other. As to comfort, convenience, taste in ornamentation, etc., there are so much matters of habit and education that it is unnecessary to discuss them. They do not affect the question of safety.

CONCORD R. R. LOCOMOTIVE. THIRTY YEARS IN SERVICE.

Our Traveling Engineer Friends.

Attending the recent convention of the Traveling Engineers' Convention there were 293 members. As this association was organized in the office of LOCOMOTIVE ENGINEERING the members have always been warm supporters of the paper and from what we have learned there has been very little falling off in the interest taken by this influential class of men. To test our present standing we had our agent canvass the members attending the convention to ascertain how far their interest continued to be of a practical character. He found that all of those present except four were subscribers to this paper, quite a number of them dating from the first issue. He easily persuaded two of the four to subscribe, the two who refused having prejudice against the paper which originated in our smoke preventory articles of long ago.

It may be added that the theories that we advanced at that time have been found to be correct, and our book, "Firing Locomotives," has become a text-book on nearly all of the leading railroads in America.

Circumstances Alter Cases.

By George Sherwood Hodgins.

One of the things which first strikes an American on arrival in England is the railway equipment. He is apt to say when he first sees British locomotives and carriages, "Look at these toy engines and bandbox cars." Later on he learns that there is a reason, and that things in Great Britain are done with a definite object in view.

In any hasty comparison of the railways of Britain with those of America one is apt to ignore the conditions which have made them different from each other, and we then come upon a problem very like an attempt to decide whether a bird is better adapted for flying than a fish is for swimming. Both bird and fish have rapid locomotion for their object, but the habitat of each prescribes the conditions under which each must act.

In the United States long, heavy trains of coal, ore and other rough freight which may be exposed to the weather are hauled many miles in bulk. In order to do this the locomotives are heavy and powerful. In the fall of year the "grain rush" takes place and every vehicle capable of carrying wheat is pressed into the service. This causes a constant movement of grain to the seaboard and a corresponding return of empty or often of lightly loaded cars. It may be said, in short, that the hauling of very heavy trains of fully loaded cars, for long distances is one of the salient features of the American railroad.

In the British Isles a totally different system prevails, owing to the conditions existing in that country. In the United Kingdom they are called upon to rapidly distribute a mass of heterogeneous material brought in from over seas and unloaded at many ports. The destination of such imports not being dependent upon the season or on the nature of the articles carried. Goods trains in England are not solid units of coal or ore or grain but are the products of all countries and come from all climes. British domestic traffic resembles in a way a sort of magnified express business. A merchant in Manchester or other outlying city may buy in London a few dozen bundles of iron, or an ornate brass bedstead or a bookcase and he expects to receive his purchase the next day. Often he does not carry a large stock but relies upon his ability to order perhaps by post card or telegraph. His order is promptly filled and the railway sees to the equally prompt delivery of the goods without any notion of holding the shipment for a carload-lot. The goods train performs this service and often the direction of movement of similar articles may actually be in different directions. The distribution of small consignments in great quantity on short notice may be taken as one of the salient features of the British railway system. The trains are consequently light and the locomotives are in proportion.

The conditions existing in the two countries determine the method to be employed, and while transportation is the function of railways here and there, yet each goes about the task in a different way, but each is the result of the requirements of the service to be performed. The law of evolution operates here as it does in the realm of organic life and it produces that which is endowed with the potentiality of growth, expansion and change when such becomes necessary, but it is always in harmony with its environment, and while the bird cannot make use of the experience of the fish nor can the fish make long uninterrupted flights through the air like the bird, each is practically the result of the survival of the fittest. Though limited by surroundings, each does that which is best for its own particular purpose. So it is with English and American railways, each endeavors to give to patrons the kind of service which existing conditions permit. Mere size and weight of train do not indicate any superiority of design or working, they are the result of a condition.

It has been said that Great Britain is always within three weeks of starvation and the Londoner has, owing to the recent dock strike, reason to appreciate the full force of the saying. If from any cause the railways of Great Britain were completely paralyzed the possibility of acute distress and even death to many would become a very real and dire calamity.

Mechanical Department of St. Louis & San Francisco Reorganized.

An official circular issued by the president of the above road reads: "General superintendent motive power will report to the general manager. He will have general charge of motive power, equipment and machinery; will direct all locomotive repairs described as Classes 1, 2, 3 and 4, and be responsible for boiler inspection and condition of locomotives, machinery and cars at all points. He will prescribe standards and see that all work is done in accordance therewith. He will keep all locomotives and car statistics, and handle all M. C. B. accounts, bills and vouchers.

"The general superintendent motive power will have charge of the operation of the shops and car works in Springfield, Kansas City and Memphis.

"The general superintendent will report to the general manager and be charged with the performance of all motive power, machinery and car work at all points excepting the operation of the shops and car works in Springfield, Kansas City and Memphis.

"Superintendents will report to general superintendents on all matters not specified above as coming under the jurisdiction of the general superintendent motive power, and will report to the general superintendent motive power on all matters specified above as coming under the jurisdiction of that official.

"Mechanical superintendents will report to the general superintendents and will advise with the superintendent on each division as to all mechanical department matters, excepting those at the shops in Springfield, Kansas City and Memphis.

"All shops, car works and mechanical department matters, excepting the operation of the shops and car works in Springfield, Kansas City and Memphis, will be under the jurisdiction of the master mechanics, who will report to the superintendents on their respective divisions."

Be Contented with U. S. Conditions.

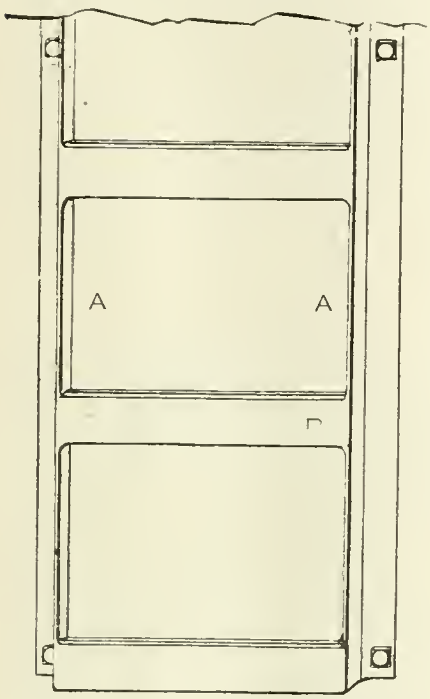
Vice-President Holden of the Kansas City Southern spent part of the summer in Europe, not automobiling like most American tourists, but studying the condition of railway men in the principal countries. What he saw and learned he has made the basis of a circular which he explains is to "show our own men the difference between the wages at home and those paid abroad; and to show the progressiveness of the railway owners and managers of the United States, who have far forged ahead of the owners and managers abroad in providing the necessary tools, namely, big engines, big cars, heavy rails, etc., whereby the men employed to handle trains can earn a greater wage than the same employment permits in England, France or Germany."

Grindstones.

A grindstone 3 ft. in diameter, with a 4 lb. face—that is, 4 in. thick—will weigh nearly 425 lbs., and may be driven with comparative safety at from 2,000 ft. per minute to 2,500 ft. per minute, or from 200 revolutions per minute to 225 revolutions per minute. To reach such speed the stone to be safe must be true in its periphery, and the lower part must not rest in water. This last feature makes the stone heavy at that part, and would produce a shock at each revolution and ultimately produce fracture or a "stone burst," a very undesirable feature from the fact that the flying pieces have no respect for anything and no specific direction, but invariably fly at a tangent.

The Interstate One-Piece Car Ladder.

The progress in car building and equipment has been marked by no feature so strongly as the effort that has been made to eliminate a multiplicity of parts. Up to the present time this progress has not extended to freight car ladders, and yet few parts of a car are responsible for more



ONE PIECE STEEL CAR LADDER.

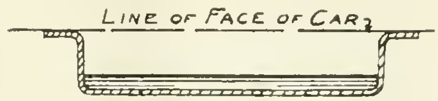
trouble, delay and expense to the owners. The ladders in general use, with rungs bolted to the stiles, or with individual rungs bolted to the car, simply multiply the chances of accident with each added bolt. The recent order of the Interstate Commerce Commission on this subject makes it one of very present interest.

The one-piece ladder shown here is made from a single steel plate with the rungs being solid and forming an integral part of the sides. The upper surfaces of the rungs are turned back-

SECTION AT A--A

ward to form a firm tread and a strong hand-hold. The front face of the rungs is flush with the sides, giving the foot an efficient guard against side slipping.

As is well known among railway men the best kind of bolted ladders are subject to rapid and frequent dangerous deterioration. It would be difficult to estimate whether the summer heat or winter frost or wet weather has the most pernicious effect on the older kind of ladders. Two things are certain—they fail rapidly and almost always unexpectedly. Among those who have already had opportunities of test-

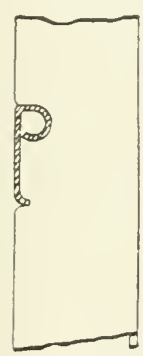


SECTION AT B--B

ing the meritorious qualities of this one-piece steel car ladder frequent surprise has been expressed that a ladder of this kind has not been in use before.

The ladder is much lighter and incomparably stronger than the best wooden type of ladder in use. It will outlive the car. It is indestructable unless accompanied by the demolition of the car itself. In point of economy it will be found to be as all things of superior quality are, much cheaper in the end.

In maintenance, the protection of trainmen from accidents and ease of



SECTION AT CENTER OF RUNG

inspection, it will be found to be much superior to the other types. The safety committees of the several railways look upon this device with unusual favor. Several roads are considering propositions to adapt it as standard.

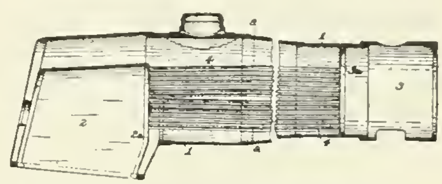
To the Ann Harbor Railway Company belongs the credit of placing the first order, which was 800 ladders with this company.

It is manufactured by the Interstate Railway Equipment Company, of Philadelphia.

So-called scientific experts were sent to England to study steel making by the Bessemer process. They returned full of knowledge and confidence but sadly lacking in experience. Under their direction the works were put into operation and some miserable steel produced. The work was carried on for twenty months at a loss of $300,000, and then abandoned.

Improved Steam Boiler.

An improved steam boiler has been patented by Mr. Donald R. MacBain, Cleveland, Ohio. The chief variation from the ordinary locomotive boiler consists in the act of mechanically imposing a compressive strain upon the boiler tubes, which opposes the tensile strength imposed upon them in service under the greater expansion of the boiler shell, by springing the boiler tubes into a slight longitudinal curvature, and, when so sprung, securing their ends into the tube sheets, thereby producing a condition by which the tensile strain is counteracted. Mr. Mac-



MACBAIN'S IMPROVED STEAM BOILER.

Bain is one of the leading living authorities on boilers, and his latest method of compensating the larger expansion of boiler sheets in relation to flues will be watched with interest.

Bronzing Cast Iron.

A German paper gives the following process of bronzing cast iron without covering it with a metal: Thoroughly cleanse the metal and rub it smooth Apply evenly a coat of sweet or olive oil and heat the iron, being careful that the temperature does not rise high enough to burn the oil. Just as the oil is about to decompose, the cast iron will absorb oxygen, and this forms upon the surface a brown oxide skin which holds securely and is so hard that it will admit of a high polish, thus giving it the appearance of bronze.

Fiftieth Anniversary of the Dynamo.

Fifty years ago Sr. Antonio Pacinotti invented the first commercial type dynamo. This event is soon to be celebrated in Pisa. At the time he invented the dynamo, Pacinotti was a student at the University of Pisa. He used a ring armature of the type now known as a "Gramme ring," having been reinvented by Gramme in 1870. It was not until 1881 that Pacinotti's dynamo attracted much attention, when, at the Paris Exposition, a diploma was awarded to the Italian inventor.

The restaurants along the Erie Railroad between New York and Buffalo which have hitherto been operated under supervision of the dining car service have been taken over by the Murphy Company, of Chicago.

Questions Answered

MAIN ROD BRASSES.

82. R. G., Memphis, Tenn., asks: Which is the best practice in refitting main rod brasses, to leave the brasses a small particle open at the points, or fit them together as if they were a solid piece? The locomotive is adapted for fast running and hard pulling.—A. The best method is to fit the brasses close together so that when keyed tightly in the strap before the rod is connected, the brasses will revolve readily in the pin. The tendency of many engineers to hammer down the keys of rods is so great, that it is not good practice to leave the brasses open. The brasses will require to be refitted oftener when left closed, but brasses so fitted rarely become heated.

BREAKING CRANK PINS.

83. E. J., Elmira, N. Y., writes: Some of our engineers claim that there is much danger of crank pins breaking when wheels are slipping in wet weather. Is the strain greater on the crank pin when wheels are slipping than otherwise?—A. The danger of breaking crank pins is considerably increased when wheels are slipping especially if sand is admitted to one rail and not to the other. Even when both are sanded there is a danger at the moment of adhesion.

LOCATION OF CRANK PINS.

84. C. K., Columbus, Ohio, writes: There has been dispute in the roundhouse here in regard to the tractive power of locomotives, otherwise of apparently equal size, except in the length of stroke of the piston. Will an engine pull as big a load with the crank pin set at 12 ins. from the center of the axle as one where the crank pin is set 15 ins. from the axle center?—A. The locomotive with the longer stroke will always pull the greater load. The longer the stroke the greater the tractive effort will be when everything else is the same. With a limited load the engine with the shorter stroke will attain a higher velocity, but not sufficient to overcome the variation in pulling power.

DECREASING LEAD OF VALVES.

85. T. H., Belfast, Ireland, writes: I understand orders have ben issued on one of our leading railways here, to decrease existing lead or opening of valve at the end or beginning of the piston stroke. Am I correct in stating that while there may be several ways of doing this, there is only one method tending to steam saving—that is by setting back the eccentric? But will this not cause a later cut-off and later exhaust? If this is the case there will be no saving. What will be the necessary changes?—A. Our correspondent is correct in his answer to his own question, presuming that he refers to locomotives equipped with the Stephenson valve gear. Assuming that the lead or opening of the valve at the end of the piston stroke is ¼ in. and it is desired to reduce this amount to ⅛ in. opening, the locomotive could be placed on front center, say on the right side to begin with, when it will be readily noted that the large part of both eccentrics incline toward the crank pin, or putting it more plainly, supposing the main crank to represent the hour hand of a clock pointing to 3 o'clock, the large part of the forward eccentric on a locomotive equipped with a rocker would approach 1 o'clock while the back eccentric would be about 5 o'clock. If the length of the rocker arms are equal, the two eccentrics would require to be moved ⅛ in. further away from the crank, and the keys refitted and the lead would be reduced the required amount. We may add that the tendency to experiment with valve gearing is fortunately being reduced in virulence. It is a real evil. The amount of lead or opening is an organic detail which should not be meddled with, as all of the other parts of the operation of the valve are interfered with. If the amount of lead is to be changed the change should be made in the construction of new locomotives. It is properly the work of the constructing engineer.

TESTING IRON AND STEEL.

86. R. B. K., Selma, Ala., asks: What is the simplest and surest method of distinguishing iron from steel?—A. If the iron is polished apply nitric acid, and if the metal retains its lustre it is iron. If the acid produces dark spots it is steel. The harder the steel the darker will be the spots. If the metal is not polished, a fracture of good iron will show long silky fibres of leaden gray color. Short, blackish fibre is badly refined iron. A fine grain shows hard iron approaching steel. Good iron heats readily and is soft under the hammer, throwing few sparks.

SHADOWS ON THE RAILS.

87. A. J. C. Cleaver, Wilkesbarre, Pa., writes: I was reading a story by Rudyard Kipling wherein he speaks of a leaf on the glass of a headlight casting a shadow on the rails which had the appearance of a live animal crawling upon the rails. Can a leaf or any other matter adhering to the headlight cast such a shadow?—A. It cannot. Kipling's story is purely imaginary. The story of an animal appearing upon the rails and never being run over appears occasionally in newspaper paragraphs, but it is without foundation in fact. The converging and expanding rays of light from the feeblest kind of locomotive headlight speedily swallow up the shadow of any kind of mark upon the glass. Some of the older headlights still carry numbers across the face of the headlight made of tin, but these figures do not cast any kind of shadow. The general flood of light, however, is clearer without them.

FREEZING WINDOWS.

88. J. H., Winnipeg, Manitoba, writes: On the approach of frosty weather what is the best method of keeping the cab windows that naturally gather moisture from freezing and so retain a clear vision? We had trouble of this kind last winter.—A. A thin coating of glycerine on both sides of the glass is a good preventive. The glycerine being transparent does not impede the vision and does not freeze under even extremely cold atmospheric conditions. It has the quality, however, of rapidly gathering dust, and must be occasionally cleaned off and a fresh supply added during the freezing period.

ELASTIC LIMIT.

89. G. Y. S., Minneapolis, Minn., writes: I am familiar with the expression "elastic limit" and know that it is generally understood to be the limit to which a bar can be stretched and return to its original length, but some of my friends say that there are other peculiarities about stresses which do not conform to the rules of the elastic limit. Can you explain them?—A. The belief used to be that a structure could be depended to carry a load up to the elastic limit, which was found to be an error. A bar would not carry safely a stress near to the elastic limit of the material, so the margin of safety was materially increased and the factor of safety had to be decidedly higher for a live load than for a dead one. If you subject a chain or bar to fluctuating stresses it will fail under a lighter load than it would do if the load was constant. These laws require to be carefully considered by people connected with bridge building. A deplorable example of the variations between theory and practice occurred in the Quebec Bridge construction.

Shop Kinks and Methods.

By William Hall.

The following paper was read at the General Foremen's Convention:

The matter of shop kinks and methods, as applied to railroad shops and other manufacturing establishments, is fast becoming a factor to be counted on when considering the efficiency, not only of our great and up-to-date shops, but of the small and isolated places, too, more especially the latter, for in the large shops it is not so difficult to get the required tools as in the smaller shops, and not until everything mechanical has been improved to its utmost, and universally adopted, there will be no such thing as a shop kink and individual effort will count for nothing.

Great inventors, like poets, are born, not made. We can't all be Edisons, any more than we can all be Byrons or Tennysons, but very happily it does not require a great inventor for most of our shop kinks, nor is it always the most intricate piece of mechanism, that has taken years to develop, that is the most useful and counts most for efficiency, but more often the home or shop-made tools, the result of a few hours thought, the tool that can be made use of every day, that gives us the best all-around results.

These kinks or short cuts, if you please, are designed for the purpose of reducing the exertions on the operator's part, and decrease the time on and expedite certain operations.

All shop kinks, however, are not applicable to all shops, for what would be practical in one shop could not be used in another owing to local conditions.

A great many more shop kinks would be designed and used were it not for the prejudice of some men in authority, and this same prejudice has killed the ambition and aspirations of many a good man; probably I should have used the word selfishness—the terms, however, are synonymous. A man may be intensely earnest in endeavoring to produce something very practical and very efficient, but his efforts are not appreciated; he receives no encouragement, hence his efforts count for nothing.

I believe that the practice of devising shop kinks and methods should be fostered and encouraged to its fullest extent, for it will be to the best interest of all concerned that this be done.

I also believe in giving every man his honest due. If a kink has been developed from a hint or suggestion from some workman, however humble a sphere he may be filling, let him get the credit for it, for possibly if he had the facilities at his command he could have brought out the kink himself; and I believe that the *Railway Age Gazette* would have had more kinks to publish, only for the fact that all of us are not draughtsmen and are unable to procure tracings or photographs to send to the editor of the shop kink section of that most valuable magazine, and right here I wish to say that too much cannot be said in praise for the *Railway Age Gazette* for the deep interest displayed and the publication of these shop kinks, as I am sure there is no foreman but who can derive more or less benefit from the study of the shop kink section.

That great service is rendered by these various and numerous kinks is without question. There is a great saving of energy on the part of the operator, thus reserving his forces for future operations, and the efficiency of the shop is increased according to the merit of the kink designed and adopted.

I have said that it is often the simple little kink that counts for efficiency, and as an illustration will cite a small tool designed by the writer, which was fully described in *Railway Engineering* some time ago, for the purpose of testing crank pins. Sometimes in tramming an engine in the running sheds we find the pins do not coincide with the main or wheel centers, indicating that one or more pins are either sprung or not quartered correctly, and in order to find this out, wheels must be removed and placed in a quartering machine to find out which pin or pins are out, requiring the services of from four to six men, but the simple kink designed by the writer eliminates this difficulty; pins can be tested without removing the wheels, and is so simple that it can be operated by any intelligent apprentice boy.

Another case of a very great increase in efficiency: I recall a case where, when it was necessary to finish a set of shoes and wedges from the rough, the planer hand would finish each shoe and wedge separately in a chuck, when by the introduction of a simple angle-iron five shoes or five wedges were finished in one operation, the number being limited to the length of the planer bed. This was on a single-headed planer.

I could cite numerous cases just as simple, and as equally efficient, such as using arbors for planing cross-heads, instead of removing the piston for that purpose; the introduction of frame spreaders made from piping, instead of using heavy jacks, thus not only increasing the efficiency of the men and shop, but eliminating the element of danger of the heavy jack falling and hurting some one.

The gain in efficiency of a shop using these various kinks is difficult to estimate, the gain depending upon the kinks themselves and local conditions, varying from 10 per cent. to 500 per cent., as in the case quoted above.

It has been said, and said truly enough, that "necessity is the mother of invention," and many of our shop kinks are the results of some hard thinking on the part of some man who was up against it good and hard; others, again, have been the result of accident, results have come unsought. Many eminent engineers have claimed that the working of our locomotive injectors was discovered by accident.

So much for shop kinks and their relation to efficiency.

All Mechanical Associations Are Useful.

In addressing the General Foremen's Convention, Angus Sinclair said: I have talked in season and out of season in favor of your organization. I have been in a position where I have heard very violent attacks upon your association by those who had great influence to suppress it. I have always taken the stand that there was a place for you as well as other organizations. A few years ago there was a tendency to say that there were too many organizations. I have heard it said "what is the use of the traveling engineers' association, what is the use of a shop foremen's association, and so on. Can't they all join together in a big association?" I always take the opposite stand, that there was a field for all and that the work could be done more satisfactorily by having it divided than it could by having a great big association. I have noticed in the last two years that things have been tending in that direction. The sentiment has been growing in favor of you. It has been stronger the last year than ever before. I have done my own share in trying to bring that about. I feel very much gratified that I have been able to use a helping hand and a strengthening voice in promoting the interests of the association.

Exhibits at the Traveling Engineers' Convention.

The Railway Supply Men's Association deserve commendation for the successful manner in which they worked up exhibits of railway appliances for the International Railway Foremen's Convention and for the Traveling Engineers Convention. There were about sixty exhibitors at each convention admirably arranged in such a manner that each individual exhibit could be easily examined. The space being comparatively limited the exhibits were naturally crowded but none of them were difficult of access. It seems to us that these exhibits were more select than they have been at the conventions where very large space was devoted to the display of railway appliances.

The list of exhibits which we published beginning on page 410 of our September issue covers the exhibits at the Traveling Engineers Convention so thoroughly that it is not necessary to repeat it this month.

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Traveling Engineers' Convention.

The nineteenth Annual convention of the Traveling Engineers' Association met in Chicago, August 29, and two sessions were held daily for four days. This association has always been particularly earnest in carrying on the work undertaken, but this year the members in attendance appeared determined to outdo all previous performances, and succeeded. Nineteen years ago a small group of traveling engineers met in the office of *Locomotive Engineering* and formed the Traveling Engineers' Association for the expressed purpose "To improve the locomotive service of American railroads," which has become the motto of the organization, and has been faithfully carried out.

Most of the members of the association who have not gone higher, which many of them have done, now hold the title of road foreman of engines, but the duties performed are substantially the same as those executed by the traveling engineers, except that most of the railroad general managers have inclined to place more responsible duties than formerly upon this class of officials.

For a few years after the Traveling Engineer's Association was formed, it had a thorny path to tread, for certain powerful influences looked upon it with no friendly eye, the belief being entertained that its existence would have a tendency to weaken the older mechanical association. The members kept along, however, in the line of work they had undertaken. They elected the strongest men among them as officers, with Secretary Thompson always guiding the business, and every succeeding year witnessed advances made in numbers and in work done, till the Nineteenth Annual Convention opened with a membership of 812, with a list of reports second in importance to none ever submitted to a railroad mechanical association. There were about 400 members present, not nominally to meet the roll call, but there in body and spirit, nervously solicitous to take active part in the deliberations.

President F. C. Thayer, in his opening address, dwelt upon the valuable work done by the association and directed attention to the successful manner the Traveling Engineers are promoting the efficiency and reducing the cost of locomotive operating. The lines followed to attain this desirable consummation are by educating enginemen in higher skill that results in the more economical use of coal, making every pound of coal burned produce more energy than formerly. Good results have been obtained from the more economical use of oil and other supplies, a line of expense difficult to restrain within close limits. Another important line of saving for which the members of the Traveling Engineer's Association deserve much credit is the successful introduction of tonnage rating and securing higher standards of efficiency for engines and enginemen.

The annual reports of Secretary W. O. Thompson and of Treasurer C. B. Conger indicated that the Association in moral influence and in financial standing was in a highly satisfactory condition.

A practice introduced by this association of obtaining addresses from prominent railway officials and others having some valuable information to impart, was very successfully carried out at this convention. The opening of nearly every session was brightened by an address from some accomplished speaker whose words and sentiments seemed to stimulate the meeting to unparelleled energy. All the addresses were so good that only want of space prevents us from publishing them verbatim, a thing we hope to do with most of them in future issues, since we are persuaded that these addresses will make as acceptable reading as anything we could select.

The first address was made by that veteran of the platform, Mr. Robert Quayle, superintendent motive power of the Chicago North Western, who has a masterly way of combining humor with serious thought, and is always instructive. On this occasion he talked on the duties of the traveling engineer and made the address so attractive that many of the ladies present wished to remain in the hall all day.

Other addresses were delivered by Mr. F. O. Melcher, vice-president of the Chicago, Rock Island & Pacific; by Mr. A. W. Whitford, on the Jacobs-Shupert fire box; by Mr. T. A. Fayne, general mechanical superintendent of the Minneapolis, St. Paul & Sault Ste Marie; and by Mr. Samuel O. Dunn, of the *Railway Age Gazette*. Dr. Angus Sinclair was invited to deliver an address and had prepared to do so, but finally excused himself on account of the time being too limited, and he felt conscious that his address would interrupt interesting discussion. As already said we expect to publish all or part of these interesting addresses when space becomes available.

The report submitted and discussed were unusually interesting and valuable, only one fault being found about them, which was, that there were so many good reports that the discussion upon them had to be cut off when valuable information was still pouring in from the lips of the members.

It is also a proof of the great good that comes from meetings of this kind, where thoughts naturally arise that are of real value by the social intercourse of the members.

From a collection of such genuinely good reports, it would seem invidious to pick out one for particular praise, but we do not like to publish a notice of this convention without saying something about the report on "Latest Developments and Improvements in Automatic Stokers," which represents a vast amount of painstaking labor and discriminating intelligence that reflect very great credit upon the author, Mr. J. R. Luckey. When the subject of mechanical stokers was introduced at last Railway Master Mechanics' Convention, the impression disseminated was that the investigation of this subject had been suspended and that the introduction of mechanical stokers was a far away proceeding; but Mr. Luckey's report to the Traveling Engineers indicated that the subject is still very much alive and that there are several automatic stokers giving a good account of themselves in firing locomotives. The discussion that followed its introduction was no less vigorous and light inspiring than the report was convincing, that automatic stokers are developing as rapidly as could be expected.

We expect to present the salient points of these reports and discussions in future issues while the subjects are fresh in the minds of our readers.

The Engine House Foreman.

Among the facts that came prominently to our notice during the recent conventions of railroad men, none struck us so forcibly as the fact that there is a marked improvement in what may properly be called the intellectual standing of the engine house foreman. As is well known, in spite of the many recent improvements in mechanical contrivances, the locomotive repair shop is no place for idlers. Mental and physical strength are in a marked degree required to meet the constantly arising difficulties that inevitably accompany railroad shop work.

All that human intellect can foresee and ingenuity accomplish cannot prevent breakages in the moving parts of machinery. Structural work must be taken apart speedily and reconstructed with haste, and with a degree of exactness that must leave nothing to be guessed at. Every piece of work in the locomotive has its story, and he who can read the aggregation of stories correctly and quickly is the man of the hour in the railroad shop. To know exactly what is wrong and what is best to do in the emergency are the qualities required. These attributes are not given to every one. They do not come to any one over night. They are the result of long and varied experiences clarified by study and observation, and crystallized into instinct.

There are many young mechanics who dream dreams. In their unsophisticated imaginings they are apt to think that if they were only a foreman all they would have to do would be to walk around with a gold watch in their pocket and an ivory rule in their hands and that, in an atmosphere of almost luxurious idleness, they would pass their days. This delusion is rudely dispelled if ever they come to the longed-for eminence. They will find their work doubled or trebled and their responsibilities magnified a hundred fold. They will find their superiors, figuratively speaking, jumping upon them morning, noon and night. They will find rivals watching them with hungry eyes. They must not only know how to do everything themselves but they must be able to give demonstrations to others, and so make good mechanics out of unskilled workmen by the sheer force of example. They must know the maximum speed limit of every tool in the shop and see that each is kept up to it.

As to the matter of recompense, the wages of the general foreman are far below that of the engineer. It is safe to state that of all men employed on railroad work they are the poorest paid in comparison with the duties expected of them. We believe, however, that there are better days in store for the engine house foreman. There is a growing tendency on the part of the powers that be in the railway world to give a better substantial recognition to the merits of foremen generally. It is from this class that the master mechanics and other higher officials come. Meanwhile he is the brains of the machine shop. His part has often been hard and dreary, but his future looks brighter.

How to Tell if a Crown Sheet Has Been Hot.

Low water, however caused, always produces excessive heating; and if the temperature rises sufficiently to weaken the material, failure may occur by stripping of the stay bolts or rupture of the sheets by bulging between them, or otherwise. If the temperature has raised the material to a low or bright-red color, this can be readily determined by superficial inspection. While the fire side will show red rust or a black color, the water or steam side will invariably show a typical steel-blue scale, which will not disappear even after years, as it is a so-called rustless coating. If this be once oiled it will always be distinguishable, even if the plates had been exposed to moisture and gases for years. The color of this scale will depend somewhat upon the temperature at which it was produced, being brightest at those points where temperature was the highest. Carefully made tests, with autographic diagrams, of such material will again demonstrate changes of properties which are very characteristic. The yield point will be found very low, while the diagram will show a material drop of curve just after the yield point. The elongation will, however, as a rule, be materially increased, with a diminution of tenacity. Nicked and quenched bending tests will again show marked difference between strips cut from the sheet at points which in one case were overheated or were above the low-water line, and in others were taken from a part below this line. The fracture will also be materially different. To demonstrate the temperature at which the plates happened to be at the instant of explosion, it is necessary to cut strips from points of the overheated plate below the water line. These strips polished on the edges are then held in a clear fire so that one end remains cold while the other is heated to a dull yellow or a very bright red. This temperature being reached, the bars are withdrawn, and while one is rapidly plunged with one end into a pot of boiling water, the other is allowed to cool in air, but not in contact with wet metal or stone. When the piece which had been immersed in boiling water about one inch deep has become nearly cold, below blue heat, it is plunged into cold water.

On the polished edges of both bars will be found scale and heat colors, the temperatures producing them being well established. These bars are then carefully nicked at points opposite every change of color and then broken off at these nicks. By comparing these fractures and their scale and color with those obtained from pieces cut from the overheated plates, the temperature at which they were at the instant of explosion can be determined with great accuracy. Having thus determined the temperature at which the sheets were during operation, it is also known whether the metal was sufficiently soft to bulge off or strip from the stay bolts; examination of plates and bolts will vertify the conclusion.

Examinations for Train Men on the Pennsylvania.

It is the intention of the Pennsylvania Railroad to require all their train men to pass examinations periodically, and the method has already been put into operation on the Maryland division.

Firemen, when first employed, will be required to visit the air-brake instructor at the earliest possible date to witness and take part in the instructions given to a class of older firemen or enginemen, and at the end of one year's service will be required to undergo the elementary examination. At the end of the second year they will be given the advanced examination, and at the end of the third year will be required to pass a final examination. If not promoted within one year after the final examination it will be necessary for them to take the examination again before being promoted to the rank of enginemen. Enginemen must be re-examined at least once every three years or when necessary by reason of the introduction of new equipment. They must also be examined before being transferred from freight to passenger service, or after being demoted to the position of fireman for a period exceeding one year. In each of the above examinations the applicant must obtain the minimum rating of 85 per cent. for each of the several subjects. Also with the firemen's final and enginemen's examination, a rating of 85 per cent., on proficiency in service is required. The examination of the trainmen will be similar to those of the firemen, with the exception of their taking the final examination at the end of the second year's service. Trainmen will be required to pass an examination every three years after passing the final examination. In the first examination a rating of 60 per cent. must be obtained, and in the second or final, a minimum rating of 85 per cent. is required.

The catechism of railroad operating, which we are publishing will cover most of the questions asked at these examinations.

To Prevent Flues from Failing.

We notice with pleasure that some railroad mechanical officials are encouraging their boiler makers to take part in discussions of motive power questions. As defects of boilers cause more failures of locomotives than any other, information calculated to prevent engine failures is certain to be received from the boiler makers.

In the course of a recent discussion Mr. A. N. Lucas, foreman boiler maker of the Chicago, Milwaukee & St. Paul, said:

After a flue has been rattled for some time, it is the practice of the Chicago Milwaukee & St. Paul to inspect it thoroughly, and if there is any indication of the flue being light it is weighed. A 2-in. flue weighing less than 1 2-3 pounds to the foot is scrapped, and a 2¼-in. flue must weigh 2 pounds to the foot. Care must be taken, since a flue that has five or six or more welds may have the required weight and yet the old part of the flue may not be fit for further service.

"It is the practice of a great many roads to apply safe ends on but one end of a flue. This I do not consider good practise for many times a flue will have as many as five, six and seven welds on one end only and after being rattled are badly split up or jammed up on the opposite end, due to the quality and lightness of the flue. This would not occur as often with safe ends on both ends of the flue, and not at all with a steel tube. The practice of the Chicago, Milwaukee & St. Paul is to weld on both ends of the flue alternately. A flue is put in service with a safe end at the firebox end and may run from one to two years, after which it is taken out; the bead is cut off the firebox end and about 1½ ins. is cut off the front end with a flue cutter. Before welding this flue again it is cut to length and the safe end is applied to the front end for the firebox. When the flue is welded it is cut to length to go in the boiler, it being necessary to cut only one inch off of the original safe end. This flue again goes in service for another year or two, and when the flue is again taken out the bead is cut off the firebox end and is cut at the front end with a flue cutter as before. It is then cleaned and cut for welding. This time the original weld is cut off, and the new piece or safe end is welded on the front end, which leaves the flue with but two welds. This operation continues through the life of the flue and always gives us a good new safe end for the firebox, while the old safe end is available for the front flue sheet."

System Federation Demands.

What is called a "System Federation" has been formed by the machinists, boiler makers, blacksmiths, sheet metal workers, car builders and other shopmen belonging to the Southern Pacific and other Harriman lines. They have formulated a list of twenty claims describing the conditions of employment on which they will remain at work. Similar claims were also presented to the Illinois Central Railroad and to the Chicago Rock Island and Pacific. Strike talk was freely indulged in unless the companies granted the demands, but as we go to press peace has settled down among the contestants for the present.

Mr. Henry Small, general superintendent of motive power of the Southern Pacific says, that the demands if granted would increase the annual expenses of the repair shops of the Pacific system alone $2,976,000. Mr. Small also says that within the last five years all the craftsmen in the shops have had their pay increased an average of 12½ per cent., and that the pay now prevailing is higher than the pay in any other railway shop.

The origin of the movement among shop workmen for higher pay is, no doubt, due to the increased cost of living, which has struck all classes that have to eat. Nearly all railway managers are in sympathy with the needs of their employees, but with reduction of transportation income forced upon them by state and national legislation, they do not have the money to meet the great increase of operating expenses that granting the demands of the shopmen would involve.

Favors Mallets.

Information about a Mallet locomotive performance on the Santa Fe was incidently given by Mr. F. P. R. Roesch during a discussion at the Traveling Engineers' Convention. He said that 2-6-6-2 Mallets with 69-inch drivers are in use on the Santa Fe freight service. Mr. Roesch had been prejudiced against that type of engine at first, but had been led to change his mind about them. Any new form of locomotive is expensive to maintain at first until the men become familiar with maintaining and repairing them.

In one instance he was on a Mallet compound pulling 60 loads weighing 2,300 tons. It went over the division of 102 miles, and as no locomotive was available was forced to go right on over the next division of 98 miles, and then the next one of 108 miles. In all 308 miles were covered in less than 15 hours, all delays included. The average speed of these locomotives over a division of 6 per cent. is from 25 to 29 miles per hour, although much higher speeds are attained—as high as 45 miles per hour. Every convenience is provided for the enginemen, including air operated fire doors, bell ringers, reverse levers and cylinder cocks; also coal passers. No trouble is experienced with break-in-twos and the trains get under headway quickly.

Which Side of Belt Should Run On Pulley?

There is curious diversity of opinion among shop foremen as to which side of a belt should run on the pulley face. A very successful shop foreman with whom we talked on this subject contends that the flesh side of the belt should run on the pulley for the following reasons: Leather is fibrous, and curiously constructed, as revealed under a microscope, in the form of a triangle, the tender part, or grain, representing the top part of the triangle, being very fine and delicate, whereas the flesh part, or bottom of the triangle, has a coarser and thicker fibre, and if it is properly skived will be just as smooth as the grain, although a great deal tougher, and will, therefore, stand more wear and friction. If you will notice belts that have run grain to the pulley for any length of time, you will find the grain cracked, and you wonder why. It is because you have subjected the tenderest part of the hide to the hardest usage; the friction has burned the grain, the burning brittled and hardened it; you can never restore it. If you let the flesh part do the work, the grain side being elastic, it will bind the coarser fibrous parts and keep them together. The principal proprietor of one of the oldest and most extensive manufacturies of leather belting in the country recently declared himself as positively and unequivocally in favor of running the flesh side to the pulley, as the result of more than thirty years' observation, and he offered, among other reasons, the quaint one that the belt run thus was in the natural position of the hide. *Per contra*, the superintendent of a large establishment, where heavy machine tools are built, runs all his belts grain side to the pulley faces, claiming a much longer life to the belts and a closer contact between belt and pulley face. In his case, however, all the pulleys are of turned and finished iron. And it is possible that all these disagreements on this question may arise from the differences in the materials of the pulley faces.

Two Tools.

There are two humble tools that have done much to identify and develop the inherent mechanical taste of the ordinary school boy. They are the pocket knife and the two-foot rule. They are the tools that have led up to many valuable inventions.

Catechism of Railroad Operation

By Angus Sinclair

Questions and Answers.

THIRD SERIES.

This is the last of the series of examinations to which a fireman is subjected as a test of the knowledge he possesses concerning the locomotive and its economical operation. Railway companies generally consider this the crucial examination for men making themselves competent to perform the duties of a locomotive engineer or upon the manner in which a candidate answers the questions depends his future standing in the company's service.

I would once more try to impress upon the fireman, who is preparing to pass this examination, that it is not enough that he should be able to answer the questions as they are here printed. He must understand the sense of each answer, because a common practice with the examiner is to give the questions in words different from those used in the examination manual.

I have on my desk the third year mechanical examination manuals belonging to nine railway companies, and I intend answering every question not duplicated that calls for answers. Most of the questions of the various manuals are the same in sense if not in words, but I propose giving answers that will cover the whole of the questions propounded by railway companies. The manual of one railway company makes a preliminary statement which applies to the practice of most railroads with perhaps some difference in the average percentage called for. The statement reads:

"When examined on the third series of questions, if a man shall fail to receive an average of 80 per cent. on the questions asked, he shall be given two more trials, not less than three months apart, in which to pass the same examination. If he fails to pass by an average of 80 per cent. on the third trial, he shall be dealt with according to rule 7, in the schedule of pay, 'Rules and Regulations for the Government of Firemen,' which means that he will be discharged.

Firemen passing the third and final series of questions will be promoted in order of their seniority as firemen, except that those who pass on the first trial shall rank, when promoted, above those who pass on the second or third trial, and those passing on the second trial shall rank above those who pass on the third trial.

So you see young firemen that there is every reason why you should earnestly study the principles of the locomotive engineers' art now and come out proudly with success marking your first trial.

Many firemen fail to pass the examinations because they follow a mistaken policy of preparation. They are not fond of study, and put off engaging their mind upon it until the time for examination is near, and then they fail. I am continually receiving letters from firemen saying that they have to pass the examination in a few weeks, can I help them with the information that will enable them to pass? That is very foolish. They should have begun studying years before, a little at a time, and they would have fallen into the knowledge acquiring habit, which comes easy after having been acquired.

As it is sometimes necessary for an engineer to take an engine over the road without the help of a conductor, he should be thoroughly familiar with the rules relating to the movement of trains.

1.—Has anything happened since you passed the last examination to prevent you from acquiring the information necessary to pass this examination?

A.—This question will be answered to agree with the candidate's experience.

2.—How long have you been in the employ of this company as a fireman?

A.—Answer truthfully.

3.—How many examinations have you undergone since entering the service as fireman?

A.—Tell how many.

4.—What was your percentage on your last examination?

A.—Tell the truth.

5.—How many different engineers have you worked with as a regular fireman?

A.—Give their names.

6.—What do you consider the qualifications necessary for a successful engineer?

A.—He must be a man of good habits, possess good judgment, be careful, cautious, and have thorough knowledge concerning the engine, of the road he is running upon, and the rules of train operating.

7.—When an engineer has been called to take out an engine, what duties must he perform before leaving the roundhouse?

A. His first duty is to try the water in the boiler and see that the gauge cocks and water glass cocks open and close properly; look at the firebox sheets and flues; examine the grate bars as far as practicable; see that the tender has the necessary fuel and water; that the sand box is full; that the headlight and signal lamps are in proper condition; find out that the injectors, lubricators and air pump are in working order; examine the machinery to see that no nuts or bolts are missing or loose, and that no signs of hot bearings are to be found, then oil around.

8.—What are the duties of a fireman on arriving at the engine to make ready on starting?

A.—See that the fire is in the condition to make up a proper fire box for starting on. Find out if the ash pan is clean; see that the engine has got all the necessary tools and supplies; that the engineer's oil cans are filled; that the tender is full of water and loaded with coal, that the coal is sprinkled, that the deck is swept clean, and that all parts of the cab are dusted.

9.—What tools are necessary to have on an engine?

A.—The tools that are found necessary in working the engine, such as shovel, rake, slice bar and coal pick. Certain tools are also necessary for use in case of a breakdown, such as wrenches, hammers, chisels, etc. The rules of some railways call for engines carrying lifting jacks, wrecking frogs and other tools required in case of derailment. Some companies specify what tools shall be carried on the engine. When a rule of this kind exists the answer will be guided thereby.

10.—What extra precautions should be taken by an engineer after repairs have been made on the engine?

A.—He should satisfy himself by personal inspection that the work has been done properly, that all movable parts have been put in place and safely secured by bolts, setscrews, or otherwise and that no nuts are left loose or keys insecured.

11.—Describe the general plan upon which a locomotive is constructed. Name the principal parts.

A.—A locomotive consists of a boiler, secured to frames and carried by the running gear, which generally consists of driving wheels and carrying truck. The boiler is the source of power by supplying steam to a double engine which has two cylinders, one at each side of the smoke box, strongly secured to the frames. The cylinders transmit power through piston and main rod to the crank pin on the driving wheels. The principal parts are boiler, firebox, cylinders, driving wheels, truck and frames. Admission of steam to the cylinders is regulated by the valve gear.

12.—What is a type of a locomotive?

A.—The form of construction, such as eight wheel, ten wheel, mogul, consolidation, switcher, etc.

13.—What is the modern method of describing the engines you have named?

A.—4-4-0; 4-6-0; 2-6-0; 2-8-0; 0-6-0; the description being based upon the wheel arrangement beginning with the forward end.

14.—Trace the steam from the time it is made until it escapes into the atmosphere; describing its various actions.

A.—Steam is generated through the water inside the boiler coming in contact with the surfaces heated by the fire. It passes through the throttle valve in the dome, down the standpipe into the dry pipe inside the boiler, through which it flows to the T-pipe in the smoke box, where it divides and passes into the steam chests. From there it passes into the cylinders through the steam ports being opened by the slide valves. In the cylinders it pushes the pistons nearly to the end of the stroke, from which it escapes through the cavity under the slide valve, passing from there into the exhaust pipe, thence into the atmosphere, through the smoke stack.

Invention Stimulated by Mutual Help.

Most of the inventions that promoted the industrial triumphs that are bringing so many comforts to mankind have not been the product of one, but of many minds. The steam engine is one of the most notable examples of this. Those who can follow the steps that brought forth the modern steam engine will go first to the æolipile described by Hero of Alexandria 200 years before the beginning of our era, which was probably in use centuries before Hero's time. Then we find Branca, an Italian, working with a rotary engine in the 16th century. An Englishman, the Marquis of Worcester, comes forth a century later and spends a fortune in trying to raise water by direct contact with steam. Other martyrs wrestled persistently but unsuccessfully with that same fallacy and then in 1705 Newcomen applied a piston inside of a cylinder which was the road of success to the modern steam engine.

To deduce natural laws requires mental accuracy in observing and reasoning; to make them useful in doing the world's work requires imagination and ingenuity. From the time of Hero to that of Branca was a lapse of 17 centuries, during which time nothing was done to develop the greatest invention the world has ever seen. After Branca came a host of inventors whose labors helped and stimulated the ideas of others and from the multitude of workers came the wonderful success of modern engineering.

Production of Cold by Heat.

For many years the energies of scientific investigation had been devoted to the invention of heat engines, when a master mind conceived the idea of producing cold by means of heat. In 1775 Professor Cullen, of Glasgow, Scotland, began a series of experiments for the purpose of producing cold by the combustion of fuel. To practical men the idea seemed absurd, but the investigations were supported by the same class of men who had aided James Watt to develop the steam engine and the work was warmly encouraged.

Professor Cullen experimented with quick-lime and spirits of sal-ammoniac as the best volatile substance for producing cold. His discoveries remained as laboratory experiments until Jacob Perkins in 1834, obtained a partial success in producing ice by the evaporation of ether. Then came Professor Twining, of New Haven; Leslie Valance Harrison, Pontifax, Leibe, Windhausen, Sellim, Carre and Pictch, with more or less doubtful success.

Up to 1869 the machine was in the experimental or unsuccessful stage. Then came an experimentor who deliberately read up the whole subject in a library, and made himself master of what patent attorneys call "the state of the act," and of the scientific principles concerned, working according to his own account, "harder than he ever had before in his life." He discarded the usual working fluids, and adopted anhydrous ammonia. After various struggles and successes, the machine was adapted to the difficulties of the case, and put in successful operation in 1874, since which time it has become of immense practical importance in warm climates, for making ice, cooling breweries, etc., though giving an efficiency of but 70 per cent.

In 1877 another inventor set himself deliberately to improve the machine. He put a practical mechanic, a chemist, and a patent attorney to work, and in 1878 built a machine which, however, gave no improved results. He did not let the matter rest here, however, but persevered, and in 1880 built an entirely successful machine, which did the work for which 7,000 tons of ice had been required. So rapid has been the introduction of refrigerating machines, that there are now several hundred of various makes at work in the United States. They produce as much cold for each ton of coal consumed as would be obtained by the melting of 20 tons of ice, at which rate natural ice is worth only 75 to 80 cents per ton, or less than the usual cost of harvesting and storing it, not to speak of conveying it to distant cities to find a market.

Degrees of Curves.

Nearly every intelligent railway man likes to talk intelligently about the track curves that he is familiar with. In America railway curves are always spoken of as being so many degrees. In foreign countries where English is spoken curves are described as of so many feet radius. American railway engineers measure and describe a curve as part of a circle whose radius is established by the angle of deflection. If the angle of deflection is 1 deg. the radius of the curve will be 5,730 ft.; 2 degs. half of that and so on. Consequently a 10-deg. curve is part of a circle having 573 ft. radius. People wishing to talk of curves with accurate knowledge ought to memorize the radius of a 10-deg. curve and then a simple mental calculation will enable them to tell about the true radius of any curve.

To Make a Wiped Joint.

In these days when many people find it necessary to do small repairs on automobiles and other appliances it is frequently convenient to be able to make a wiped joint. To do so, melt the solder in a ladle and pour it in the joint quite plentifully. Be careful not to pour it on your own knees. As the solder accumulates wipe it into shape with a piece of canvas folded several times and greased with tallow. The canvas is also useful to hold the solder as it is poured upon the joint.

Casehardening.

A quick method for casehardening consists in heating the material to be hardened to a red heat and submerging in a bath of molten cyanide of potassium, leaving it from one to five hours, according to the size of the article to be hardened. Cyanide of potassium gives off poisonous fumes, consequently the vessel containing it should be placed in a furnace with a draught.

Absence of Smoke on the Erie.

The officials of the Erie Railroad have for several years devoted close attention to smoke prevention with their locomotives and they seem to have gained the reward of success, for it is safe to assert that no locomotives on this continent burning soft coal are now so free from the nuisance of smoke as those belonging to the Erie Railroad. From statements made by Mr. V. C. Randolph, supervisor of locomotives of the Erie, in a paper submitted to the Traveling Engineers' Association we conclude that the success in operating their locomotives with notable absence of smoke is due to careful instruction imparted to the engineers and firemen.

Air Brake Department

Conducted by G. W. Kiehm

The "P. C." Brake Equipment.

This issue contains views of the general arrangement of the P. C. passenger brake as applied to a car, and several photographic views and line drawings of the principal features of the equipment, the No. 3-E control valve. Previous issues contain references to this type of brake which has been subjected to some slight modifications in design until it is now considered practically perfect to meet present day conditions.

We would impress upon the minds of our readers that this brake is not an experiment or substitute but a necessity if trains of modern heavy equipment are to be stopped in distances that will approximate the Master Car Builders' specifications that a passenger train must be stopped from a speed of 60 miles per hour in 1,200 feet in order to insure a reasonable degree of safety in train operation.

The weights of passenger cars have increased to such an extent that the single cylinder with the highest total leverage ratio permissible no longe produces adequate braking power to keep the lengths of stops from high speeds within distances consistent with safety in train operation, hence the introduction of a brake equipment that will shorten the stop in a manner that will meet with the requirements.

To appreciate the value of a brake of this description requires some knowledge of the difficulties encountered in stopping heavy trains from high speeds, which will not be dealt with at this time, but as an illustration it was generally considered that the difference between running and standing piston travel on a passenger car was from 1½ to 2 ins.; the writer has observed as much as 2½ and 3 ins. difference when riding alongside of the brake cylinder for the purpose of noting the effect of a certain type of journal bearing, but a statement that a 5-in. standing piston travel would increase to 10½ and 11 ins. on modern equipment under the influence of an emergency application would have been considered entirely out of the bounds of reason, previous to the time the Lake Shore emergency tests proved the existence of those conditions.

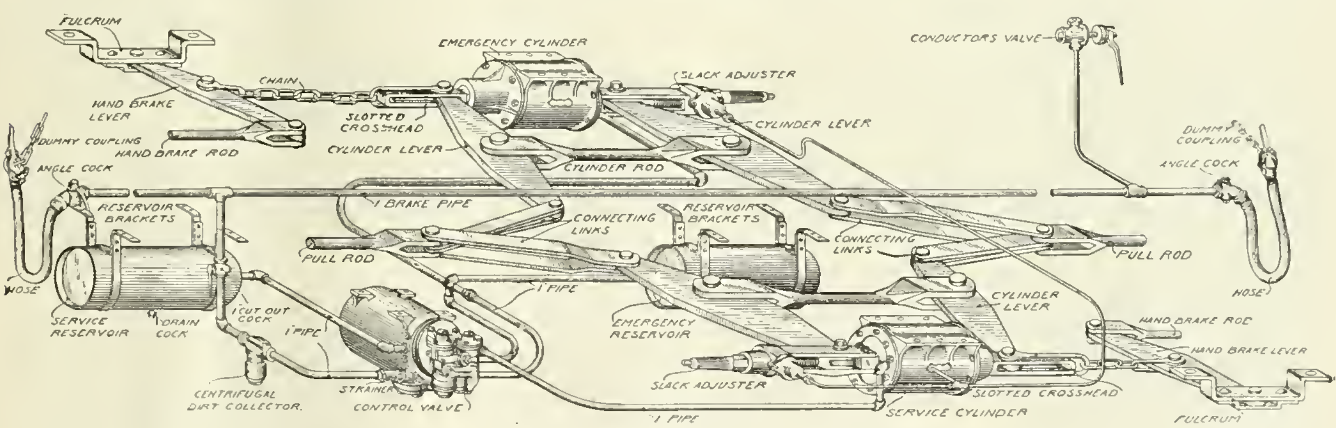
As another illustration, a prominent railroad man was surprised to note that other railroad men had difficulties in stopping trains from high speeds while trains on the road with which he was connected were being stopped from speeds of 60 miles per hour in 1,000 ft. with the high-speed brake, but upon a test it was found that the especially prepared train could not be stopped from a speed of 60 miles per hour in less than from 1,600 to 2,000 ft.

Briefly summed up, the triple valve as well as the single cylinder is a thing of the past where heavy equipment is concerned, while some railroads have reached the conclusion that the triple valve is comparatively inefficient, even for the lighter passenger cars, and are adopting the P. C. for all passenger cars.

The operation of the control valve will be described with the aid of diagrammatic views in the following issue, and only a general description is intended for the present.

Before this type of brake was introduced there were a number of requirements recognized as essential to an efficient air brake for passenger cars, and among them the following: It should be automatic in action, with a certainty and uniformity of service action not materially affected by unequal piston travel and brake cylinder leakage, a quick recharge and consequently a ready response to brake pipe reductions at any time, and a graduated release of brake cylinder pressure. It is desirable to charge only the brake pipe during an ordinary release of brakes, which will obviously prevent the storage reservoirs from absorbing the brake pipe pressure necessary to accomplish the release and should have a predetermined and fixed flexibility for service operations. The brake must be sensitive to release, and if possible be undisturbed by inevitable fluctuations of brake pipe pressure which would cause light applications or "brakes creeping on." Full emergency pressure should be obtainable at any time after a service application or after a predetermined figure in the depletion of brake pipe pressure has been reached, regardless of the cause. Emergency braking power should be at least 100 per cent. greater than the maximum service effort, and maximum brake cylinder pressure must be obtained in less space of time than is possible with a triple valve and must be maintained during the entire length of stop, and finally it is of inestimable value if one type of operating valve is adaptable to all weights of cars and classes of service and will operate in harmony with any other type of automatic air brake.

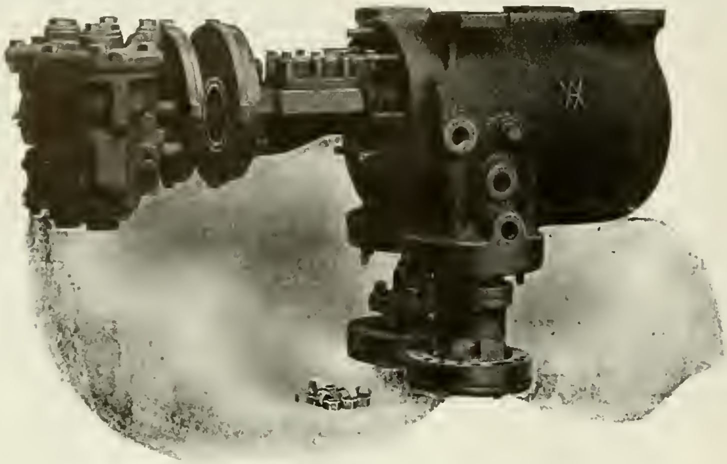
Through the P. C. equipment all of the above features are attained, and it should be understood that 180 per cent. braking power in emergencies and no blow down of brake cylinder pressure results in a destruction of brake shoes rather than in wheel sliding, and in this connection it may be of interest to state that during the Lake Shore tests, 220 per cent. braking power was at times employed without the injury or removal of



ISOMETRIC VIEW OF THE P. C. EQUIPMENT.

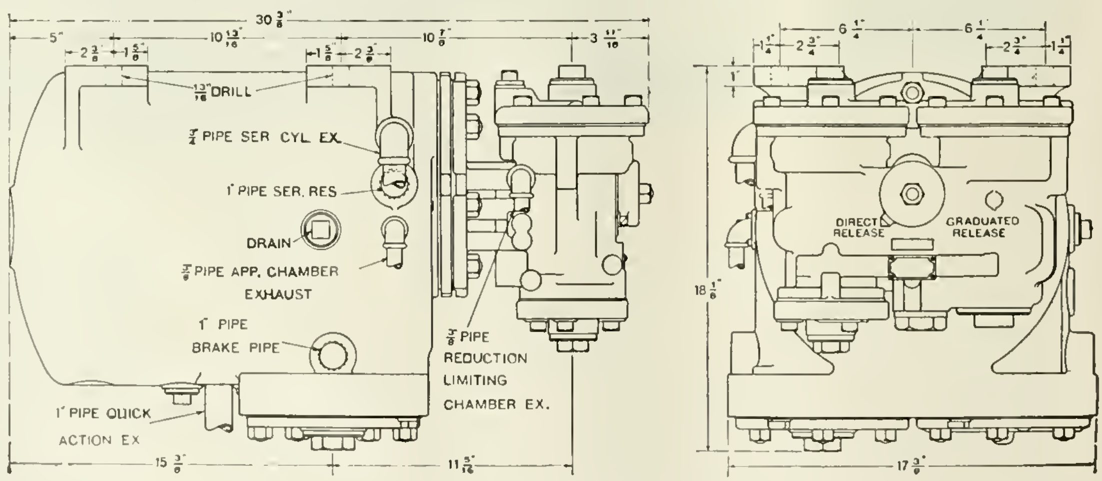
a single pair of wheels, and as a result the somewhat lower 180 per cent. braking power is relied upon to provide the necessary factor of safety against injury to the wheels.

In the general arrangement and outline drawings it will be observed that parts, pipe connections and exhaust ports are named, and this will be of advantage to the student. In the protographic view



NO. 3-E CONTROL VALVE, SHOWING THE DIFFERENT PORTIONS OF THE VALVE.

of the control valve and reservoir showing the valve mechanism detached, the part on the lower right-hand side is the emergency portion, on the left the quick action portion. The part about to enter the front of the reservoir is the application portion, and the remaining one the equalizing portion; thus there are four complete portions containing all the movable parts of the control valve, and the reservoir is of three compartments, namely: the pressure chamber, the application chamber and the reduction limiting chamber. The former two chambers perform identically the same functions for the control valve that the pressure and application chambers do for the distributing valve.



NO. 3-E CONTROL VALVE.

The piping diagram shows two auxiliary reservoirs and two brake cylinders, and, as their names indicate, one cylinder and reservoir is used in service operations, and both in emergencies, and the control valve performs the duties of the triple valve in controlling the flow of air from the brake pipe to the storage reservoirs and from the reservoirs to the brake cylinders and from the cylinders to the atmosphere.

One hundred and ten pounds pressure in the reservoirs equalizes with the cylinders at 86 lbs. pressure, and the service cylinder in operation transmits its power through a leverage that produces 90 per cent. braking power, as the term is generally understood, based upon an 86-lb. cylinder pressure, and when the emergency cylinder is thrown into operation 180 per cent, braking power results.

The slack adjuster pipe of the emergency cylinder is connected with the adjuster pipe of the service cylinder so that slack in the brake gear is taken up equally from operations of the service cylinder.

From the actual construction of the movable points of the control valve and reservoir it will at a first glance appear somewhat formidable, but a little study and comparison will show it to be almost as simple as the distributing valve, in fact, the operation is on the same principle. The quick action position, which is similar to the quick action portion of a triple valve, operates to exhaust brake pipe pressure to the atmosphere during the emergency application for the same purpose that the triple valve exhausts brake pipe pressure during emergency application. The emergency portion, composed of a double piston and slide valve, operates only during emergency applications and its duties are to control the flow of air to and from the emergency cylinder, and to assist, during emergency applications, in the operation of the application portion. The application portion is similar in construction and performs for the service cylinder the same duties that the application portion of a distributing valve performs for the locomotive brake cylinders.

The equalizing portion contains two pistons, slide valves and graduating valves, one called the release piston, the other the equalizing piston. They have a number of duties that will be explained in connection with the diagrammatic views, but all operations are governed by the operation of these two pistons.

The equalizing piston and slide valve admit pressure to the application chamber and face of application piston for service operations, and the release piston and slide valves exhaust this pressure when the release is desired. There is a feed groove in the release piston bushing, but the reservoirs are charged through separate valves, a service reservoir charging valve and an emergency reservoir check valve, being controlled by the movements of the two pistons of the equalizing portion.

Later on it will be observed that the work of the equalizing portion is divided between the two valves in a manner that permits of the movement of one piston influencing the movement of the other, and is arranged to produce a delayed, though perfect application and a positive return to release position when desired and incidentally preventing the "creeping on" or the "sticking" of brakes.

The brake will not apply with less than a 5 or 6-lb. brake pipe reduction, but this is not due to any frictional resistance but is accomplished by a slight drop in pressure due to displacement of the piston and by one piston momentarily restraining the movement of the other, and while the brakes will release before the reservoirs begin to charge, it requires no great differential in pressure to produce the results, as a differential of 1½ or 2 lbs. on the brake pipe side of the pistons will accomplish a complete release (if the action is desired), the pistons making the proper connections in their turn, each providing for a slight drop in pressure which insures the positive and complete movement to release.

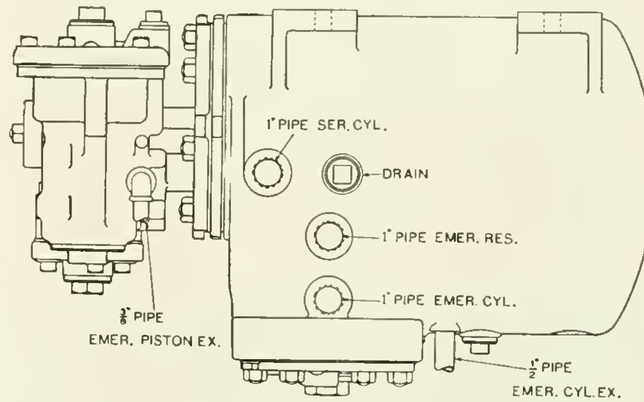
The No. 3-E control valve assumes 15 different positions, but many of them are but momentary and can be explained along with the diagrammatic views of the principal positions, which will make the movements of all parts and the reasons therefor perfectly clear, and we trust that those interested will, in the meantime, become familiar with the names of the portions containing the movable parts and learn the names and location of the exhaust ports and pipe connections of the control valve and reservoir, there being 6 on the left-hand side, when facing the equalizing portion, and 5 on the right side.

On the face of the equalizing portion is a cap that can be turned to provide either a direct or graduated release of brake cylinder pressure, so that when operating but one or two control valves among triple valves that have no graduated release feature, this cap can, and should be, turned to give a direct release with the other triple valves in the train.

The brake should be handled in the same manner as with cars equipped with quick action triple valves, the only difference being that an emergency application will be obtained should a service reduction reduce brake pipe pressure below 60 lbs. when using 110 lbs. brake pipe pressure, or below 35 lbs. from a 70-lb. brake pipe pressure.

To cut out the brake, close the cut-out cock in the crossover pipe and bleed both the service and emergency reservoirs.

Two sets of cylinder levers are connected to the same pull rods, consequently the push rod end of the emergency cylinder lever will move away from the cylinder with the operation of the service cylinder, but as the cross head is slotted the emergency cylinder piston does not move. To determine whether the brake is applied look at the push rod of the service cylinder.



NO. 3-E CONTROL VALVE.

Whenever it becomes necessary to change the adjustment of the automatic slack adjuster, it is imperative that the cross heads of the two adjusters be left at the same distance from their respective cylinder heads, in order that the piston travel of the two cylinders, in emergency applications, will be the same.

The pipe connections and exhaust openings are marked on the outline views, and should there be a blow or continual waste of air at the quick action exhaust port it indicates leakage past the quick action valve seat. Make an emergency application, and if the blow does not cease remove quick action portion and substitute a new or repaired portion.

In the event of a blow at the application chamber exhaust port make a 15-lb. service reduction and bleed both service and emergency reservoirs. If the blow continues it indicates that the equalizing portion is defective, which calls for the substitution of a new or repaired portion.

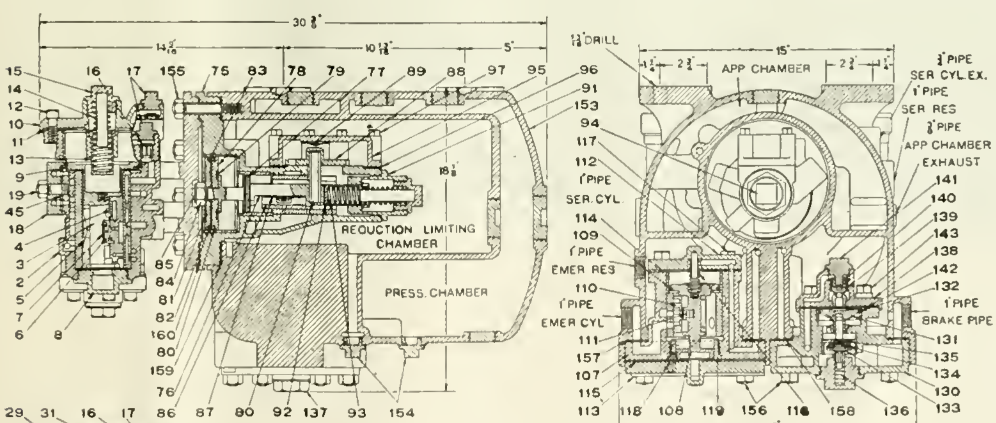
Should there be a blow at the reduction limiting chamber exhaust, make a 30-lb. brake pipe reduction and lap the brake valve. If the blow then ceases it indicates that the application portion is defective, that is, leaking into the chamber surrounding it. If the blow does not cease it indicates that the equalizing portion is not properly lapping this exhaust port, and in either event a perfect portion should be applied in accord with the indication.

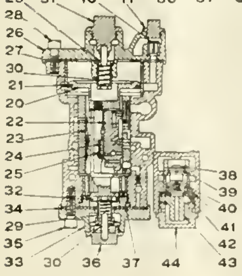
In case of a blow at the emergency piston exhaust, make a 15-lb. reduction and lap the brake valve. If the blow ceases it indicates that there is a leak past the lower end of the emergency portion, and if the blow does not cease it points to a slide valve leak in the release side of the equalizing portion. Repaired portions should be substituted accordingly.

A hard blow from the service cylinder exhaust port points to a defective application portion, and a hard blow from the emergency cylinder exhaust port points to a defective emergency portion which calls for the application of perfect portions.

If these troubles are not entirely overcome by the remedies suggested, the application portion should be removed and all gaskets carefully examined, as a leak through the gaskets could also cause the troubles mentioned, excepting the leak past the quick action valve.

When removing the application, emergency and quick action portions, their respective gaskets should remain on the reservoir. On removing the equalizing portion its gasket should remain on the application portion, except when the application portion is shipped to and from points where repairs are made.





NO. 3-E CONTROL VALVE, ACTUAL SECTIONS.

Every weld in a flue is a chance for a failure because many times flues are slightly overheated at the weld and become quite thin just back of the weld. Leaks develop at these points, and flues frequently break in two at the weld when being rattled, and it frequently happens that they hold together long enough to have the engine make a trip.

Questions Answered

on Air Brake Subjects:

BRAKE CYLINDER PRESSURE OBTAINED.

90. F. A., Norfolk, Va., writes: If a train can be stopped with a 10 lb. brake pipe reduction why is it that 50 lbs. brake pipe pressure cannot be used on a level road if brake pipe reduction from 50 to 40 lbs. results in the same brake cylinder pressure as a reduction of 10 lbs. pressure from a 90 lb. brake pipe?—A. Under the influence of a lower air pressure in the brake pipe and a slower rate of brake pipe reduction on a train of cars the brake mechanism on the cars does not move as promptly as if but one brake was being operated, therefore, the 10 lb. reduction from 50 lbs. pressure will not result in as much brake cylinder pressure in actual practice as a 10 lb. reduction from a 90 lb. brake pipe pressure.

If but one brake is considered and if the brake pipe pressure falls at the same rate in both cases the 10 lb. brake pipe reduction results in approximately the same cylinder pressure from either the 50 or 90 lb. pressure, but if the point of equalization is noted, it will be observed that the low pressure brake provides no degree of safety for emergencies, while with the 90 lb. pressure a full service reduction and release, without recharge, can be followed by an emergency application that will yield the brake cylinder pressure obtained from a 70 lb. brake pipe pressure which is approximately 60 lbs.

BROKEN AIR PIPE.

91. K. N., Wheeling, W. Va., writes: What is the proper method of making temporary repairs to a broken feed valve pipe of the No. 6 E. T. brake, if this happens while out on the road and the train is to be brought to the terminal with the brake pipe charged and the brake valve handle in release position?—A. As the break occurs, the brake valve handle should be placed on lap position to prevent an application of the brake and the spring box of the feed valve should be quickly unscrewed and the broken pipe plugged toward the automatic brake valve. If the excess pressure pipe connection is between the plugged portion and the brake valve, the valve handle can then be placed midway between release and running positions, which will permit air pressure to enter the governor top above the diaphragms and thus keep it inoperative, then the maximum governor top can be adjusted to maintain the pressure desired in the brake pipe.

If the pressure pipe happens to be connected with the broken off portion of the feed valve pipe, the excess pressure operating pipe must also be blanked.

If there is any inclination of the brake to "creep on," due to leakage (which would necessitate movements to running position in order to accomplish a release, or the use of the independent valve), a union connection in the release pipe can be used to create enough leakage to keep the engine brake released.

Whether this can be done while the train is in motion, depends entirely upon circumstances and the co-operation of the fireman, who, if he happens to be a pretty handy man, can have the pipe plugging and the governor adjusting in hand while the engineer is attending his regular duties.

BLOW AT BRAKE VALVE.

92. K. N., Wheeling, W. Va., writes: What could cause a blow of air from the emergency exhaust port of the automatic brake valve when the independent brake valve is placed in application position? This with the No. 6 E. T. brake and the blow does not exist at any other time, the automatic valve being in running position.—A. It is either due to a defective rotary valve and seat in the independent brake valve or to wrongly connected pipes between the brake valves. If the release pipe branch between the brake valves was connected to the automatic brake valve at the point the application cylinder branch should be, and the branch of the application cylinder pipe connected where the release pipe branch should be you would have this effect.

BLEEDING OFF BRAKE.

93. F. A., Norfolk, Va., writes: How can a brake on a car be released by bleeding the auxiliary reservoir when the retaining valve is turned up?—A. If the brake pipe pressure is maintained the brake cannot be bled off when the retaining valve is turned up as the retaining valve will prevent the escape of brake cylinder pressure, unless it or its connections are defective.

If the car is alone, the brake pipe pressure will escape with the auxiliary pressure by flowing through the feed groove while auxiliary pressure is reducing through the bleeder cock, and regardless of the position the triple valve may be in, the brake cylinder pressure under the slide valve of the triple valve will unseat the slide valve and escape with the auxiliary reservoir pressure as soon as auxiliary pressure has reduced enough to permit this action.

In releasing a brake in this manner, brake pipe pressure being exhausted, an unusually strong slide valve spring might trap a light pressure in the brake cylinder, but it would eventually escape by the way of the leakage groove.

Wood Boiler on New York Central.

The boiler was thoroughly examined internally by C. J. Chester and Mr. Hennessey, the New York Central superintendent of the boiler department, Depew shops, on August 22, 1911, and on the 23d by Edward Oldman, boilermaker for Farrar & Trofta, who made the boilers, and Fred H. Snell, inspector for this company; C. F. Pierce, of New York City; Mr. Hennessey and Wm. H. Wood being present.

The general condition of the boiler was conceded to be much the same as when examined internally October, 1910. The corrugation of firebox forming side and crown was examined very carefully and found free from defects. It was noted the crown staybolts showed having sweated after dumping of fires, but after lying on the branch from July 14 to August 21, when she was put in the shops for general repairs, it was found that more effective washouts might have kept crown chest much freer from cake scale, same as the sides of the firebox which were clean. The back tube plate was examined carefully and tube holes were found round and in good form, *not distorted*—no cracks between bridges of tubes.

The Attack of Rust.

The density of iron, together with its smoothness of surface, has a deal to do with its corrosion. Rust does not attack a heavy, smooth piece of iron with such eagerness as a piece of thin plating, so that careful filing and bulk in coach iron work are helpful qualifications in resisting the attacking nature of rust.

The Social War in France.

During the troubles with railway employees in France last summer, persons who pretended to act for dissatisfied railway men cut 125 telegraph and telephone lines at Lille, France, and 57 at Roubaix. At Havre 10 telegraph cables connecting with England were severed, and attempts to derail trains have been made. A newspaper, *La Guerre Sociale* (The Social War), had openly advocated measures of this sort. Its office was searched by the police and six members of its staff were arrested. It delivered its parting shot as follows: "*La Guerre Sociale* will be published no longer; but brave fellows will continue to destroy railway tracks and telegraph lines."

Mallet Articulated Locomotive for the Southern Pacific

The Southern Pacific Company has recently received, from The Baldwin Locomotive Works, twelve Mallet articulated compound locomotives which will be used in passenger service on the Sacramento Division of the Central Pacific Railroad. On this line, eastbound, there is a continuous ascending grade from Sacramento to Summit, a distance of 105 miles. The total rise is 7,000 feet, and the maximum grade is 116 feet per mile for about 40 miles. Since 1907, passenger service on this division has been handled by ten-wheel locomotives built to Associated Lines standards, and weighing 203,000 pounds, with 160,000 pounds on driving wheels. The tractive force exerted by one of these locomotives is 34,700 pounds, and two engines are required to handle a 500-ton train on the 116-foot grade. Each of the new Mallet locomotives is equivalent, in capacity, to two of the older engines, and under ordinary conditions double-heading of passenger trains will thus be avoided in the future.

The design of the new locomotives generally follows that of the Mallet freight locomotives with 2-8-8-2 wheel arrangement, which have been in successful use on this division since 1909. A number of modifications have been introduced, however, and these include some features which are new to the practice of the builders.

The boilers of the new Mallet engines are of the separable type, as usually applied by the builders to locomotives of this capacity. In the present instance the dome is placed a short distance ahead of the firebox, and an internal dry pipe conveys the steam to the intermediate combustion chamber. This chamber contains right and left-hand steam pipes of ordinary construction, and these communicate with short horizontal pipes, which lead to the high-pressure steam chests. The high-pressure exhaust is conveyed to the smoke-box through a horizontal pipe located in a large flue which traverses the water heater. This pipe communicates with a cast iron elbow pipe at each end. The elbow in the combustion chamber is in the form of an inverted Y, one branch of which leads to each high-pressure cylinder. The flexible receiver pipe is placed on an angle, under the smoke-box.

The injector piping is arranged so that the feed-water enters the heater on the bottom center line and leaves it on the top center. The water, therefore, circulates through the entire heater. The hot water enters the boiler proper on both sides, at a distance of 35 ins. from the front tube sheet. Check valves are placed at both the heater and boiler inlets.

The steam distribution to all cylinders is controlled by inside admission piston valves, which are of the built-up type 15 ins. in diameter. The valves are operated by Walschaerts gear, and are set with a lead of 5/16 in. The exhaust clearance of the high-pressure valves is ¼ in. and of the low-pressure ⅜ in. No by-pass valves are used, but a large relief valve is tapped into the steam pipe leading to each cylinder. The low-pressure pistons have extension rods, and these are supported at their outer ends, on crossheads. The guides for these crossheads are supported by the cylinder heads and cast steel bumper beam. The crossheads have cast steel bodies and bronze gibs, and bear on the tops of the guides only.

TYPE OF MALLET ARTICULATED LOCOMOTIVES FOR THE SOUTHERN PACIFIC CO.
H. J. Small, Gen. Sup. Motive Power. Baldwin Locomotive Works, Builders.

The method of securing the high-pressure cylinders to the frames and saddle is worthy of notice. Interposed between each cylinder and the saddle is a slab frame, 26 ins. deep and 2½ ins. wide. This slab is spliced to the main frame by 21 bolts each 1¼ ins. in diameter, and by two vertical keys driven in a parallel key-way with their tapered faces in contact. The same plan is used for keying the frames to the cylinders and saddle. The saddle itself is of cast steel and is composed of two sections. The lower section extends the full depth of the slab-frames, and supports the hinge-pin, which is 7 ins. in diameter. With this arrangement the separate cross-tie heretofore used to support the lower end of the hinge pin is combined with the saddle casting, and the cylinders, frames and saddle are bolted and keyed together to form an exceedingly strong and rigid structure. The low-pressure cylinders are bolted directly to a steel box-casting which is secured to the frames in accordance with the well-known practice of the builders.

This engine is similar to the Mallet freight locomotives operating on the Central Pacific, in that it is designed to run fire-box end first, in order to give the enginemen an unobstructed view of the track. The truck under the fire-box therefore, becomes the leading truck. This truck is of the Hodges type, with spring links so jointed as to allow a fore-and-aft as well as lateral motion. A new design of centering device is applied to this truck. A double coil centering spring is used, and it is held in a vertical position, between two cast steel washers, and is guided by a vertical thrust bar. This thrust bar is placed on the center line of the locomotive and is suspended from a cross-tie. Interposed between the top spring washer and the cross-tie is a bearing plate. Two pins, each 2 ins. in diameter, are placed between the bearing plate and the cross-tie, and on these pins is suspended a U-shaped strap, which is wide enough to embrace the spring washers. A link connects the lower end of the strap with a lug which is bolted to the truck frame. When the frame is displaced from its middle position, the strap is pulled to one side, and one of the upper pins is drawn down, thus pushing on the bearing plate and throwing the spring into compression. The bottom spring washer is held in place by a link which is pinned to the engine frame.

These locomotives are equipped for oil-burning, and the tenders are coupled at the smoke-box end. The two tanks are semi-cylindrical in shape, and are placed end to end. They have respective capacities for 3,200 gallons of oil and 10,000 gallons of water. The tender frame is composed of 12-inch channels weighing 40 pounds per foot, and strongly braced transversely; while the end bumpers are of cast steel. The tender trucks, and also the back engine truck, are equipped with "Standard" forged and rolled steel wheels.

In designing these locomotives, full advantage has been taken of the experience gained with the Mallet freight engines which have been operating for some time on the Central Pacific. Special attention has been given to the steam distribution, and to providing ample sectional areas in the steam and exhaust piping. Although the duty which these locomotives are intended to perform is excepionally severe, there is every reason to anticipate that they will prove successful in service.

The following are the principle dimensions:

Gauge, 4 ft. 8½ ins.

Cylinders, 25 ins. and 38 ins. x 28 ins.

Valves, balanced piston.

Boiler.—Type, straight; material, steel; diameter, 82 ins.; thickness of sheets, ¾ ins.; working pressure, 200 lbs.; fuel, oil; staying, radial.

Fire-box.—Material, steel; length 120⅝ ins.; width, 84 ins.; depth, front, 87¼ ins.; depth, back, 74 ins.; thickness of sheets, sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube, ½ ins.

Water space.—Front, 5 ins.; sides, 5 ins.: back, 5 ins.

Fire-Tubes.—Material, iron; thickness, 0.125 ins.; number, 495; diameter, 2 ins.; length, 20 ft. 6 ins.

Feed-water heater tubes.—Number, 424; diameter, 2¼ ins.; length, 6 ft. 3 ins.

Heating surface.—Fire-box, 235 sq. ft.; fire-tubes, 5,292 sq. ft.; feed-water heater tubes, 1,590 sq. ft.; total, 7,117 sq. ft.; grate area, 70 sq. ft.

Driving wheels.—Diameter, outside, 63 ins.; diameter center, 56 ins.; journals, main, 11 ins. x 12 ins.; journals, others, 10 ins. x 12 ins.

Engine truck wheels.—Diameter, front, 30½ ins.; journals, 6 ins. x 10 ins.; diameter, back, 45 ins.; journals, 8 ins. x 14 ins.

Wheel base.—Driving, 32 ft.; rigid, 11 ft.; total engine, 51 ft. 4 ins.; total engine and tender, 85 ft. 1 in.

Weight.—On driving wheels, 320,100 lbs.; on truck, front, 21,000 lbs.; on truck, back, 43,700 lbs.; total engine, 384,800 lbs.; total engine and tender, about 568,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, water 10,000 gals.; oil, 3,200 gals.; service, passenger.

Help to Bring Around the Pay Car.

One of the most sagacious movements inaugurated by rairoad companies has been putting it up to all employees to aid in effecting small savings where that can be done by the exercise of a little care. The Erie Railroad management was the first to appeal to their help for the exercise of care that counts for reduction of operating expenses, and now the Pennsylvania Railroad has adopted the same policy and entered into details of what can be done by the help of their employees.

By circular the management has called on the 200,000 employees of the system to help in keeping down operating expenses. In notices just posted the following appeal is made: "How easy it would be for each employee to do this in his own line of work—enginemen in the use of oil; firemen in the use of coal; clerks by economy in the use of stationery and by avoiding errors; trackmen in gathering up old bolts and spikes; shopmen by doing their work properly and thus avoiding breakdowns on the road; warehousemen by loading freight so as to avoid damages; and all employees in many ways which will occur to them in the intelligent performance of their respective duties. Remember the old adage: 'What is everybody's business is nobody's business'; and let each employee make it his personal business to join in this laudable effort." It is roughly figured that if all hands will join in the effort proposed all over the Pennsylvania Railroad system, operating and maintenance costs can be cut down by an average of 10 cents per day per man. That would be $20,000 a day, or, say, $7,300,000 per annum.

The Brooks Locomotive Works at Dunkirk, belonging to the American Locomotive Company has been closed. Want of new business is reported as the cause for the closing up of these works, but incidentally the movement on the part of the municipality of Dunkirk, in raising the valuation of the works some eight thousand dollars may have had something to do with the movement. The closing of the works is a great blow to Dunkirk interests for four thousand men were employed by the works when running full.

A French alloy, especially good for coating sheet iron for constructive purposes, consists of zinc 5.5, lead 23.5, tin 71. If it is a metal of a fine white color and high lustre, 5 to 10 per cent. of bismuth may be added, making a composition of tin 90 to 95, bismuth 10 to 15. An admixture of one-half, or at most 1½ per cent. of iron in tin greatly increases its hardness and durability.

Common heirship in the things of the spirit makes a closer bond than common heirship in the things of the body. The bonds which unite people of the same calling are much stronger than pride of race. There is no Irish, English, German, Scots, French or Spanish in the Brotherhod of Locomotive Engineers or in the other organizations formed for mutual help and protection.

Half the sting of poverty is gone when one keeps house for one's own comfort and not for the comfort of one's neighbors.—*Dinah M. Mulock.*

Electrical Department

Development of the Electric Motor.

By A. J. Manson.

(Continued from page 400.)

We have described in our previous articles the development of the electric motor up to the year 1888, outlining in our last article the experiments conducted by Frank J. Sprague on the Thirty-fourth street branch of the Manhattan Elevated and describing the Richmond Road, which was the beginning of the modern development.

A great step in the progress of the electric railway was made by Sprague. The Richmond Road was a radical change. The amount and extent of the system, and the number of motor cars operated were far in excess of anything attempted previously. Then the method of control and the method of collecting the current from the overhead wire was entirely new. The contact with the wire was made underneath, and practically the same arrangement of trolley pole and wheel as is used today was used by Sprague.

The locomotive, "Benjamin Franklin," which we described on page 354 of our August number and outline of which is shown by Fig. 6, was shipped back to Daft's factory after the trials on the Ninth Avenue Elevated during the Fall of 1885, to be remodelled, as it was not powerful enough to handle full weight elevated trains. In November, 1888, the remodelled "Benjamin Franklin" was in operation on the Ninth Avenue tracks. Referring to Fig. 6 the trailing wheels were made of the same diameter as the drivers and a side rod connected the two wheels, thus making use of the weight on the trailers for adhesion. The motor had been redesigned and was slightly larger. On one of the trials eight cars making a total weight of 122 tons, including the locomotive, were hauled up a 2 per cent. grade requiring 120 horsepower. After these tests the locomotive was put into regular operation for several weeks hauling a shuttle train between Fourteenth and Fiftieth streets from 11 a. m. to 2 p. m.

The West End Street Railway Co., of Boston, Mass., decided to operate some of their lines by electricity and gave Sprague, in 1888, a contract for equipping the line on Beacon street to Brookline. He used the overhead wire system supporting the wire 18 ft. above and over the center of the track, by means of iron poles set in concrete, spaced 125 ft. apart. The trolley wire used was 3/16 in. in diameter and was made of silicon bronze. Besides the regular equipment, which consisted of 2-15 h. p. motors per truck, 3 cars with snow plows attached, were equipped with 2-30 h. p. motors. The motors were a great improvement over those at Richmond, which were exposed to the dust and dirt. They were provided with self-oiling and dust-proof bearings. In the down town streets the underground conduit system was installed and arrangements were such that change from the overhead to the underground could be made with the cars in motion. Due to continued interference and interruptions with the conduit system it was torn out and the overhead trolley installed. Tests had been made on this electrified stretch during December, 1888, but regular operation did not commence until February of the following year.

Another company which had much to do with the rapid development of the modern railway was the Thomson-Houston Electric Co., of Lynn, Mass. This company had been manufacturing electric apparatus for power and lighting. In March, 1888, it bought out the Van Depoele and the Bentley-Knight patents and entered into the railway field.

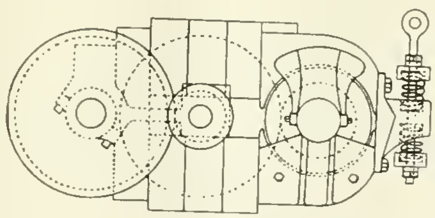


FIG. 9. SPRAGUE'S NEW MOTOR. 1889.

The West End Street Railway Co. also ordered from the Thomson-Houston Electric Co. twenty cars to operate on the Cambridge division between Bowdoin and Harvard Squares. They commenced to equip the road in November, 1888, using a single overhead trolley. The most important step in advance made by the Thomson-Houston Co. was the use of a carbon brush in the motor instead of a copper brush which had been used on all motors up to this time. The Thomson-Houston Co. had several other roads in operation and samples of these brushes had been sent for trial. The tests showed much longer life could be obtained from them and the effect on the commutator was excellent. This was a decided advantage, for anything that tended to reduce the wear on the commutator was welcomed.

In August, 1889, a contract was made between the West End Street Railway Co. and the Thomson-Houston Co. for the latter to equip 217 miles of track and the 1,584 cars owned by the railway company. The work and apparatus which had been built by the electric company was very gratifying. By the end of August, 1889, there were 62 roads in operation using their apparatus with a total of 563 miles and 691 cars.

By July, 1889, Sprague had built a new motor with which he was equipping many roads. In the new motor he used an intermediate shaft. It was also fitted with a special graphite brush which would lubricate the commutator slightly and thus decrease the wear greatly. The motor was supplied with dust-proof and self-oiling bearings, and was designed so that it was controlled without the use of practically any resistance. Fig. 9 is an outline of this motor and shows position of years, pinions and intermediate shaft. Only one end of the armature shaft was fitted with a pinion and thus a double gear reduction was obtained. The same general arrangement of motor suspension was used as in Sprague's earlier motor.

In August, 1890, the Westinghouse Electric Co., one of the two greatest electrical companies in America today, and the company which has been the foremost in trunk line electrification, had in operation in Lansing, Mich., an electric street railway six miles long. Two motors each of 15 h. p. were mounted on each truck. The design of the motor was carefully thought out and there were improvements over previous motors, which constituted important advantages, especially in the handling and maintenance of the equipment. A cast iron frame carried the car axle, the intermediate axle, and the armature so that all three were in perfect alignment. The field magnets were hinged, the pole piece swinging out, so that the armature could be removed easily, which was an important step in advance. The gears were placed in oil-tight castings partially filled with oil, thus protecting them from dirt and grit and at the same time properly lubricating them so that the wear would be reduced to a minimum. Two coils of unequal size were used on the two pole pieces giving two steps for field control. These coils were waterproof and were easy of access which was another added advantage and improvement. The operation of these motors were most satisfactory.

Each of the recently mentioned systems, namely, the Sprague, the Thomson-Houston, and the Westinghouse had slightly different methods of controlling the speed of the car from start to maximum.

The Sprague system depended mostly on the change in field strength for change in speed. We know, as explained in our February issue, that when the field of a motor is weakened the speed increases; also that a resistance placed in series with the motor cuts down the current to the motor and the voltage at the terminals, and hence decreases the speed. Sprague's motors were wound so that several different field strengths could be obtained, i. e., the field coils were made up of several parts. In starting, a small resistance was inserted in the circuit, to allow the motor to start up slowly and to prevent the sudden rush of current and shock which would occur if the motor was connected directly to the power. This resistance was cut out in one step and increase of speed was then obtained by cutting out sections of the field coils which would weaken the fields and hence increase speed.

The Thomson-Houston system depended mostly on the change in resistance, in series with the motor, for change in speed. The resistance was cut out step by step until full voltage was on the terminals and the motor was running full speed. A slightly increased speed could be obtained by cutting out a few turns of the field.

The Westinghouse system was a compromise of the above two systems. The field control was used to more advantage than in the Thomson-Houston system and the resistance or rheostatic control was used to more advantage than in the Sprague system. The motor had two field coils of unequal size which made up the field control and a resistance was placed in series with the motor which could be cut out by steps.

The Thomson-Houston Co. had designed a new method to get as near absolute economy of power as possible at the expense of simplicity. The use of resistance for control is wasteful of power. A great deal of power is used up in this resistance, the electric power being converted into heat which goes off as wasteful energy. The field control is limited in range due to the sparking and commutation if weakened too far. At this time this new method of control had not been put into operation but we will describe the same fully as it considered the operation of the two motors on one truck, first connected in series and then in parallel, which is done today on all equipments and which had not been done before. This control contained seven steps as follows:

First Step.—The motors were connected in series with all resistance in the circuit and all the field turns or full field. This would give the slowest speed as each motor would receive less than one-half of the line voltage, but a large torque could be obtained as torque depends on the current, which would flow through both motors, and the proper amount was regulated by the resistance in the circuit.

Second Step.—The resistance was cut out. This would give increase of voltage at the motor terminals and increase of current, resulting in higher speed and maintaining torque, as we know (February issue) that the current drops off as the motor speeds up due to the back electromotive force.

Third Step.—Part of the field turns were cut out. Gives weaker fields which results in higher speed. The motors are now connected in series so that each has one half of the line voltage across its terminals and runs at one-half of the full speed.

Fourth Step.—The armature of No. 1 motor was connected in series with No. 2 motor with full field. This condition gives increase voltage on No. 2 motor, hence more speed. An excess value of current does not occur as the No. 1 armature is still in the circuit.

Fifth Step.—The armature of the No. 1 motor was cut out and the No. 2 motor left in circuit. This, of course, gives increase of speed and the No. 2 motor is connected with full line voltage across its terminals and is running at maximum speed for full field.

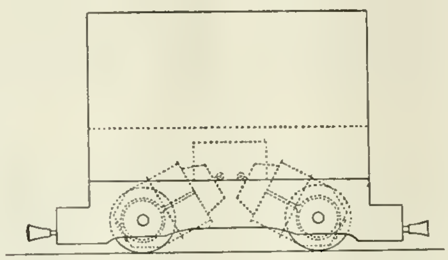


FIG. 10. CITY AND SOUTH LONDON LOCOMOTIVE.

Sixth Step.—No. 1 motor was connected in parallel with No. 2 motor with full field. This in no way affects the No. 2 motor. There is now, however, two motors, hence double the horsepower, which did not occur in the fourth and fifth steps.

Seventh Step.—Part of the field turns on both motors were cut out. This gives a slight increase speed over the sixth step. This method of control would give much smoother acceleration and at greater economy.

Ut to this time the motors built ran at very high speed so that gearing with intermediate shafts were necessary for use with car service. In November, 1890, the City and South London Railway Co., England, commenced operation of 3 miles of underground railroad, double track of 4 ft. 8½ in. gauge, hauling trains with electric locomotives mounted with gearless motors. The armature of the motor was built up solidly on the axle and nearly the whole weight of the fields was also supported directly on the axle. A third rail, mounted on glass insulators carried 450 volts. Fig. 10 shows an outline of these locomotives, total length 10 ft., of which there were fourteen, each consisting of two motors, mounted on a 2-axle truck. The locomotive weighed 13 tons and was rated at 100 h. p. A speed of 20 to 25 m. p. h. was obtained.

(*To be continued.*)

Thirsty Occupations.

Those familiar with the working conditions of mechanics and others are aware that the men following certain trades and occupations are more liable to fall into drinking habits than the men engaged in other kinds of work. We have always believed that molders, boiler makers and blacksmiths are more moved with temptation to indulge in drinking than any other class of employees. It used to be the case that train men were noted for drinking habits but that has been entirely changed. The occupation of engineman or trainman is not of a nature to cultivate a desire for stimulants, but once on a time the jolly good fellow engineer and conductor thought the frequent invitation to come and have a drink was necessary to maintain popularity. That led to bad habits that could not be tolerated in men doing work that required a clear head at all times.

The Medical Officer of Health to the port of Manchester, Dr. W. F. Dearden, has lately been pointing out the connection of alcoholism with certain trades. Workers subjected to great heat, he said, naturally suffered much from thirst, and were addicted to the use of alcoholic drinks. Then there were some outdoor occupations which involved great exposure to the weather, and had the same influence. Printers, hatters and shoemakers were shown to have a special tendency to drink. Insufficient air space and bad ventilation have a deleterious effect on workers; the excess of carbonic acid creates a feeling of lassitude, and makes a man unable to get through his work satisfactorily. The result, only too often, is that he seeks stimulation from alcohol, which freshens him up for a little time, but in combination with the effects of bad surroundings the drink does this man more harm than it would another whose days were passed in healthier occupation. We ought to go to the root of the matter, and to insist that every trade shall be carried on under the best and most sanitary conditions, so that those engaged shall run less risk of disease.

Cleaning Steel.

Rub rusty steel with emery paper dipped in turpentine to remove rust. Polish with a fresh piece of emery paper and the result is said to be satisfactory.

General Foremen's Department

General Foremen's Convention.

(Continued from page 386.)

Question from Mr. Packard's report on "Best Method to Promote Shop Efficiency." *Do you find that strong leadership, force of personality and a way of doing things will accomplish much?*

Mr. W. W. Scott: Leaders should be men of positive dispositions, who will say "I cannot do it," instead of I hardly think it possible. The present tendency is for shop men to show a disinclination to assume responsibility. Working conditions in the shops have improved so much of late years that mechanics are satisfied to remain at the work bench and leave the difficulties of carrying the responsibility of supervisory work to the small proportion of men who are inclined to advance in the several mechanical trades. Proper organization of your shop forces must be the key note of high efficiency. Whatever plan appeals to you most strongly you will find strong leadership essential.

Mr. Pickard: If a leader of any shop goes about with his hands in his pockets, the workmen are liable to do likewise. If he sets a good example his men are likely to follow it.

Mr. W. D. Bunker, Col. & Wyo.: A drone cannot lead men. A man who steps to the front and is ready and willing at all times to help is the man that is necessary. We find in the western country that these are the people successful in handling the work.

Mr. H. D. Kelley: Made the point that the condition of a shop can always be seen to represent the leaders. Inferior leaders bring about inferior shop conditions.

Mr. U. T. Gale: Believed that foremen should have a strong personality that had to be considered in various aspects. It was necessary that he should be loyal to his employers, but he should also be considerate towards the men under his supervision, and make them feel that they are our equals as far as humanity is concerned.

Mr. L. O. North did not know anything in a shop that had a better tendency to bring out desirable results than encouragement to men of appreciation from the foreman. If they know that ther work is appreciated it has a tendency to inspire them into developing their ideas. When a man advances an idea compliment him and try it. The proper amount of encouragement has much to do with successful shop management.

Question: *That the test of an organization is to maintain efficiency during the absence of a unit.*

Mr. Pickard had seen organizations in which when a man stepped out there was no one to take his place. That he considered wrong. If I have a man to step into my place when I leave the office, so much the better for me, for the men and for the company.

Mr. W. G. Reyer: With the organization we have in our shop, I can leave at any time and the work goes on as well as if I were there.

Mr. Pickard advocated weekly meetings as a splendid means of training subordinates to step in to take the place of absent superior officers. By this means you train your men to just what you desire to accomplish. Take your assistant freely into your confidence. We have the weekly meetings to instruct all concerned. We have in each gang a man to take the place of the gang foreman during his absence.

Mr. W. W. Scott: The best way to find out if the absence of a unit affects the organization is by the unit absenting himself. Under the old school there was a great deal of jealousy about the selection of a man to take the foreman's place. It is for the foreman to educate the man next to him to quickly step into his place during his absence.

Mr. W. G. Reyer: We have a general foreman and an assistant. The assistant is in position to step into the general foreman's place in his absence, and the work moves on without interruption. There is always a machinist who can take the gang foreman's place. Any man who is put into another man's place is paid his rate. We find the practice beneficial. The weekly meetings that we hold are popular and eliminate friction.

Question. *Should mechanics be paid according to their merit or should they be compensated alike?*

Mr. T. F. Griffin: On the road I am connected with, the man who does the work gets paid for it under the piece work system. We have not touched the piece work rate in five years. The piece work rates are printed and posted where the men can examine them.

Question. *Young men and responsibility. What do you find in their ability in the direction of foremen and executives?*

Mr. J. A. Boyden: We have a system that gives the young fellow a chance. We take a fourth year apprentice and give him a chance at all vacancies. It gives us an opportunity to find out what sort of an organization we have. We work all piece work. If you give your young boys a chance, something to work for, something to encourage them, you will meet with very good success. We endeavor to keep our eyes upon the apprentice boys. If they know that they are going to get a chance, they will produce the goods. We have five fourth year apprentice boys acting as foremen in our shops.

Shop Kinks.

Mr. W. W. Scott: If I may be in order, I would like to say that this discussion of shop kinks has brought to my mind the thought of who originated them. It originated from the vast amount of advertising that our various publications have brought out. I am only sorry that I am not endowed with the power of expression to tell you exactly how I feel about the men who have brought out these ideas and made this discussion possible. We have heard a resolution read complimenting the *Railway Age Gazette*. They have built for themselves an everlasting monument.

I think of what our old time friend and mechanical expert, Dr. Sinclair, has done with the RAILWAY AND LOCOMOTIVE ENGINEERING. We must not lose sight of the fact that he is the pioneer of the business. I believe if it were not for Dr. Sinclair and his publication, and the able manner in which it has been edited, we would not have any convention here today. I have a brotherly feeling in this connection, because I was at one time an editor. It would require a long stretch of imagination to realize that when you look at me now, but I am telling you the truth when I say to you that for two and a half years, when I edited a little paper in a small Wisconsin town I nearly starved. I believe that the troubles I had are small in comparison to those who are trying to publish a paper on mechanical work. They have nothing sensational to offer, nothing to thrill the populace. It is a hard business proposition from the word go. You have got to catch them when their mind is in such a condition as will promote study. We have tried it in all phases. It is only when a man reaches middle life that he realizes the opportunities to be gained by study. I am only too proud to be privileged to stand here today and say we cannot express ourselves too strongly when we enlarge upon the fact that we are here by reason of the advertising given us by the mechanical publications.

Shop Methods.

By William R. Hall.

I will endeavor to answer each question as propounded.

(*a*) Method of shopping engines and advance information.

I have always been a strong advocate of advance information, not only regarding going into the shop for repairs, but as far as possible for running repairs also.

It is apparent that if this advance information can, and is given, engines can be gotten into service much sooner than if this information had to be gleaned after the engine is shopped.

The practice in vogue at the principal shops of the Chicago & Northwestern is as follows: Engines are put on what is termed the hospital track. Here they are checked up daily, as to number and class of engines and nature of repairs required. The nature of the repairs is gathered from what is called an X and O sheet, which should be sent in with each engine. These X and O sheets are gone over very carefully by the shop superintendent, who selects such engines from the hospital track that will keep all departments busy, and not crowd one department to the detriment of another. For instance, he is careful not to have in too many engines needing heavy boiler repairs at one time, not too many engines with broken frames, etc., but he distributes the work as evenly as circumstances will permit, and by this means get out an average number of engines each day.

The storekeeper and heads of various departments are advised that certain engines, giving their number and class and nature of repairs, are coming in the shop. The material is looked up and conveyed to the various departments, the boiler-shop foreman takes his measurements and makes necessary preparations such as flanging flue sheets, punching and shearing of side sheets and so on; other departments can be getting their material worked up into shape and making all preparations as per advance information, so that when the engine is shopped the work is pushed through to completion with the least possible delay. If an engine requires new cylinders, it is seen to that cylinders are on hand before the engine requiring them is shopped, thus avoiding any delay and taking up unnecessary shop room.

So I think it is very apparent that if the heads of the various departments are advised in advance of what engines are coming in that the efficiency of the shop is increased quite materially, friction is eliminated and great economy accrues.

(*b*) Specializing the work.

I am a firm believer in specializing the work, wherever and whenever it is possible to do so. It was my privilege to inaugurate the system of specializing in vogue at our Chicago shops at the present time. When I started it, I did so by degrees. I was watched very closely, criticized more or less, but the results obtained proved that I was on the right track. That was about twelve years ago. Since that time the system has been extended and elaborated upon.

In support of my theory, I wish to say briefly that in specializing the work the men have the necessary tools and appliances for doing their particular work, and they become so proficient at their particular branch that time is reduced to the minimum and there is no lost time moving from one job to another. I fully realize that this system could not obtain in all shops, as local conditions would not warrant it, but in all large shops where work is done in large quantities it can be made to work most satisfactorily.

(*c*) Manufacturing material before shopping engines, etc.

I believe that every progressive man will answer that question in the affirmative, and say by all means, whenever it is possible and as near the point of completion as circumstances will permit, and here is where your advance information will stand you in good stead, so that the required material may be manufactured before the engines are shopped.

(*d*) System of delivering.

While we have no regular system of delivery, I will say that upon requisition the storehouse delivers by cheap labor to our manufacturing department all material required. Here it is delivered to the machines by laborers, and after manufacture is delivered to the engines by laborers. I am sure everyone will agree with me that system in this regard is a step in the right direction; viz., efficiency, using cheap labor for this class of work, thus keeping your high-priced men at their own work.

(*e*) Sub-store rooms.

In reference to the location of sub-store rooms, I wish to say that that depends largely upon the size of the shops, and the proximity of the shops to the main storehouse. If these sub-store rooms were adopted it would mean an increase in the stock to be carried, consequently an increase in dollars and cents invested in stock, and that is what we are all guarding against. At the same time, I believe that much time will be saved and less material used by the judicious use of sub-store rooms for small supplies, such as nuts, pins, bolts, washers, etc. I have tried this with great success. The carrying of sufficient stock on hand is a great factor in the output and efficiency of any shop. I am strongly opposed to an overstocked storehouse, but I am as strongly in favor of carrying a sufficient stock for the safe and economical operation of the shop forces. There is no money saved, but lots of time and money lost by waiting for material, or by having to rob Peter to pay Paul, as the saying goes, or in other words, saving at the spigot but losing at the bung-hole. I believe it is every foreman's duty to the railroad employing him to watch the stock and assist the storekeeper in keeping it to the minimum, as closely as he watches his own financial affairs, using every pound of usable material he can find, keeping a sharp eye on the scrap pile to see that nothing that can be used again gets away from him.

(*f*) Permitting high-priced men to get material from store room.

This, in my judgment, must be governed by local conditions and the help at one's command. All things being equal, I should deem it a great waste of time and money to permit high-priced men to leave their work and get his own material from the storehouse. In small shops, where an insufficient amount of help is employed, this can't always be avoided, but in the larger shops messengers should be employed for this purpose.

(*g*) In the manufacture of material, etc.

The most of our material for outside shops is manufactured in Chicago, where we have a distinct department for this purpose. The manufacturing is done by lot numbers. The storekeeper issues an order for so many pieces of this or that to be manufactured, at the same time issuing a lot number. To this number is charged all the material used, time and labor expended in its manufacture, including cartage, and when the lot number is completed the manufactured articles are returned to the storehouse, the lot numbers are signed by the various departments, stating the time commenced and time completed, and the number of articles manufactured. The cost of manufacture is then computed and when these articles are drawn out for use the prices are used in computing the cost of repairs. All scrap from locomtives is charged to an engine general account, thus every locomotive gets credit for its quota of scrap.

(*h*) Allotting various kinds of work, etc.

In our Chicago shops, as in several other of our larger shops, the stripping of engines, removing of wheels and wheeling of engines is done entirely by common labor, supervised by a gang foreman, who is a machinist. At other points this is done by at least two machinists, and as much common labor as necessity requires, these under the supervision of the foreman, as required by the machinists' schedule. The removal of ash-pans, and the application of the same, front ends and draft appliances is done by handy men employed in the boiler and tank shop.

(*i*) Schedule for engines, etc.

At all our large shops we have a schedule in force and giving great satisfaction. Everything on the engine is done according to schedule, from the stripping of the engine to the last operation before she is ready to leave the shop again for service.

The schedules are as follows:

Light repairs, $——; 54 hours.
Heavy repairs, $——; 90 hours.
General repairs, 126 hours.
General and half-side sheets, 162 hours.
General and new fire-box, 198 hours.

(*j*) Up-keep of machine tools.

The up-keeping of machine tools, both big and little, is done by a force of competent men employed in the tool room, and under the supervision of a tool-room foreman. Any irregularity tending to impare the usefulness or efficiency of any tool is immediately reported to the tool-room foreman, who gives it his prompt attention. All lathe and planer tools, etc., are ground by a competent grinder.

(*k*) Handling of tools issued to machinists, etc.

I am not aware of any set rules governing tools given to employees for their use during their employment, other than it is generally understood that he must return all tools assigned him, in case he is leaving the service, before he can receive his time-check, and as a rule we have very little trouble from this source. I am not so sure if the courts would uphold one for deducting the value of a lost tool from a man's wages.

(*l*) Checking of tools.

When a man enters the employ of the company, such as a machinist, boilermaker, or any other man that may be required to use the company's tools, he is assigned a given number of tool-checks. Upon his application to the tool room for a tool, or tools, he must give one of these checks for each tool he takes out, and upon the return of the tools in good condition he receives back his checks.

If a man has not completed his job at the end of the day, he is permitted to retain any tool he may be using, with the exception that at the end of the week all tools are expected to be returned to the tool room. This is a good practice, to allow an employee to retain a tool over-night, as it saves time in the morning. He is held responsible, however, for all tools he may have out, until the man in charge of the tool room returns to him his tool-checks.

(*m*) System of delivering tools.

As far as the delivering of tools to the men, both systems have been tried, that of delivering of tools by messenger and that of allowing each man to get his own tools, but not having gone into the matter deep enough, I am not prepared to say which is the most economical.

(*n*) Selection of tools.

The selection of tools is done by recommendation of foreman and master mechanic, to the superintendent of motive power and machinery, who allots each shop its proportion of a general appropriation for the purchase and maintenance of tools.

(*o*) Relation of standards to cost of production.

I am not prepared to give out any figures upon this important question, but the maintaining of standards is a very good practice, as it is economical in various ways. It is much cheaper to manufacture in large quantities parts that are interchangeable, and this adds quite materially to the efficiency of the shop.

(*p*) Inaccessible parts.

We have no regular system that I am aware of covering the question of remedying inaccessible parts, etc., but if we find parts of this nature they are remedied the best that circumstances will permit; but we have so little trouble of this nature, and of the nature mentioned in the next question, that I am not prepared to say what system should be inaugurated.

(*s*) The system used on our road for keeping accounts of repairs to locomotives is that of checking up the X and O sheet, which I have mentioned before; the X standing for new articles applied and O stands for articles repaired.

The foreman's orders for articles drawn from the storehouse are also checked up, also the time-slips.

The X and O sheets contain the name of all the important parts of the locomotive and these parts are numbered.

There is also ample room for remarks, covering work done to minor parts not mentioned.

When an engine, after undergoing repairs, is ready for service, this X and O sheet, properly filled out, is sent to the storekeeper, who then by the aid of the X and O sheet, requisition for material and labor slips, computes the cost, and all papers are sent to the superintendent's office.

In ordering parts for outside points, such as eccentrics and straps, driving boxes, brasses, etc., wanted for stock, the class of material wanted is given, such as Class A—locomotive material; but if wanted for immediate use the class of engine material wanted is given. In some cases a serial letter or number is also given—for instance: Driving axle. No. 1, main for engine number 1402, Class R-1. In the case of piston rod and valve-stem packing, I have a chart, giving the number and class of each engine on the division, also giving size of each piston rod and valve stem. When packing is required, reference is made to the chart, packing bored, and sent out ready for immediate application. When piston or valve stem is turned or renewed, chart is corrected.

American Workman Inventor of Labor-saving Appliances.

In addressing the General Foremen's Convention Angus Sinclair discussed at some length the subject of shop kinks. The subject of shop kinks had been very conspicuous at the meeting and most of the members had been talking of various methods and appliances devised for facilitating shop production. In his address Dr. Sinclair said:

In regard to shop kinks, I can tell you something. The expression "Shop Kinks" came from an assistant editor of the *American Machinist*, Mr. Lewis F. Lyne. He had been a machinist in a railway shop and had charge of a tool room. He had a very keen eye for anything that was of a labor-saving character, and he began going about for the purpose of writing mechanical notes, and when there was any labor saving method, he made especial prominence of that and was in the habit of writing articles under the heading of "shop kinks." That is where the expression came from and it has become world-wide. I notice that the engineering papers all over the world use the expression now, and that is where it originated.

I was the successor of Lewis F. Lyne on the *American Machinist* in the editorial department. I left railway service to join that paper, and I ought very much to thank my experience as a shop foreman for being selected for what was a high position in the technical world—assistant editor of the *American Machinist*. Mr. Lyne went into other work and I followed him in recording shop kinks, as I had found out from my visiting railway shops, that the describing of labor-saving devices had been very popular and was a means of pushing the circulation of the paper. I followed that up and continued the practice in Locomotive Engineering, which has done more than any other paper to make shop operations popular. The paper has always taken notice of any new invention for the purpose of labor-saving.

In this regard, I wish to say that my experience was that the best devices come from the workmen. It was not men appointed to work up labor-saving methods, but the workmen who had thought of it themselves in the course of their daily labors—and what has made the American workman famous and the American engineer famous, is the labor-saving methods. To a great extent, that is due to the workmen themselves.

One time I was in the mechanical headquarters of the Great London and Northwestern Railway, at Crewe, England, and they talked about the value that publications I was connected with had been to them in suggesting labor-saving methods. I said to Mr. Webb, the famous mechanical engineer, "Don't you encourage your men to produce labor-saving devices?" "Oh, no," he replied, "we have mechanical engineers for that purpose. We employ mechanical experts for doing all of our inventing." On that account they have a small range for original inventing.

There is a spirit among the American workmen moving them to introduce things that will reduce their labor. Shop kinks have come from the American workmen. Of course the tool machinist is very often selected from the most efficient one in the shop, and naturally he will turn his attention to labor-saving devices; but if we were merely to say that we want all of our devices to come from the tool room, we would have very few in comparison to what we have today. It is the idea "stretch" that gives you the greater amount of labor-saving methods.

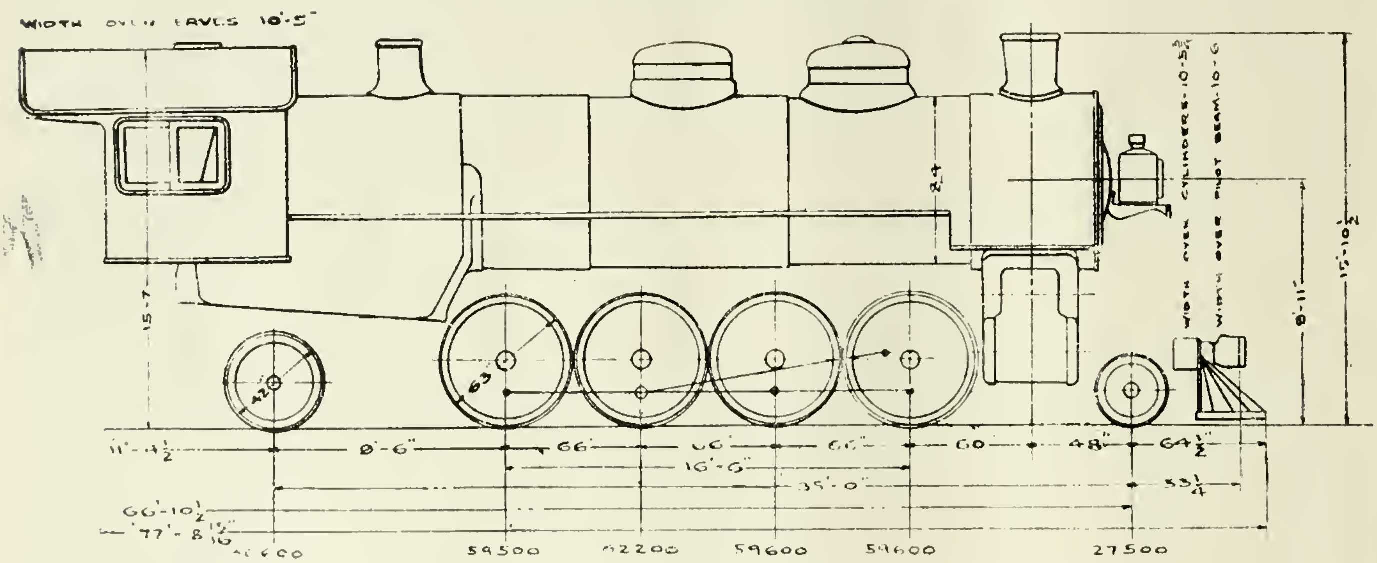
It is better to follow even the shadow of the best than to remain content with the worst. And those who would see wonderful things must often travel alone. —*H. Van Dyke.*

Erie Mikado Locomotives.

We here present an outline of a Mikado locomotive, one of a group of thirty-five, under construction by Baldwin and the American Locomotive Company for the Erie Railroad. The engines are simple, with cylinders 28 x 32 ins. The drivers are 63 ins. in diameter, the weight resting upon them being 240,900 lbs., the total weight, 305,000 lbs. The boiler is straight, 84 ins. in diameter, designed to carry a working pressure of 170 lbs. to the square inch. There are 234 tubes, 2¼ ins. in diameter and 21 ft. long, and 36 flues, 5½ ins. outside diameter. The firebox is the wide type, being 120 ins. long and 84 ins. wide, made of Otis steel. The grate area is 70 sq. ft. The total heating surface of the boiler is 4,230 sq. ft., 4020 sq. ft. being in the tubes and 210 sq. ft. in the firebox.

The tender, which is the form designed by Theodore Vanderbilt, very popular on the Erie Railroad, is of tubular form, with a water capacity of 9,000 gals. and capable of carrying 16 tons of coal.

Among some of the details specified are Carnegie steel axles, simplicity bell ringer, Franklin boiler laggings, New York & Westinghouse cross-compound air pump, Damascus brake beams, A. B. S. & F. Co. brake-shoes, Erie card brick arch, Gould coupler, Erie driving boxes, Dressell headlight, Hancock 5,000-gal. injector, Bronze Metal Co. journal bearings, U. S. King piston and valve rod packing, Consolidated safety valves, Leach Sander, Chicago, sight-feed lubricators, Springs railway steel spring, Bethlehem stays, Ashcroft steam gauge, Ward steam heat, Locomotive Superheater Co.'s superheater, Latrobe tires, Parkersburg tubes, Baker valve gear, wheel centers, cast steel.



MIKADO TYPE FOR THE ERIE.

T. Rumney, Gen. Mech. Supt. Baldwin and American Locomotive Cos., Builders.

Divisibility of Gold.

We notice that as a means of economy several railroad companies are using cheap substitutes for gold leaf in car lettering. Gold can be distributed so finely that it is doubtful if any cheaper substitute can be found.

In the manufacture of gilt wire used for decorative purposes, the amount of gold employed to cover a foot of wire does not exceed the 720,000th part of an ounce. Those fond of figuring know that if the 720,000th part of an ounce is used in covering a foot of wire that in an inch there is only 8,640,000th part of an ounce. We may divide this into 100 parts and yet see the gold quite distinctly with the naked eye.

Seasonable.

The coldest place on earth inhabited by man is Verkhoyansk, above the Arctic circle, in northeastern Siberia. The thermometer there drops to 90 degs. below zero in January, but sometimes rises to 86 degs. above zero in the shade in July, dropping, however, to the freezing-point on the warmest Summer nights. The hottest place in the world is the interior of the great Sahara Desert, in Africa, where the thermometer rises to 122 degs. The wettest place is Greytown, Nicaragua, where the mean annual rainfall is 260 ins. The place of least rain is Port Nolloth, in South Africa, where less than an inch sometimes falls in a year.

Those men who try to do something and fail, are infinitely better than those who try to do nothing and beautifully succeed.—*J. L. Jones.*

'Tis the old secret of the gods, that they come in low disguises.—*Emerson.*

Items of Personal Interest

Mr. H. E. Richards, has been appointed superintendent of the Union Pacific, with headquarters at Ellis, Kans.

Mr. E. E. Bradley has been appointed signal engineer of the Western Maryland, with office at Baltimore, Md.

Mr. H. A. Witzig has been appointed master mechanic of the Missouri Southern, with office at Leeper, Mo.

Mr. Robert G. Garden has been appointed superintendent of the Missouri Pacific, with office at Atchison, Kans.

Mr. William C. Weldon has been appointed purchasing agent of the Colorado & Southern, with office at Denver, Colo.

Mr. H. Shoemaker has been appointed shop superintendent of the New York, Ontario & Western at Middletown, N. Y.

Mr. C. D. Purden has been appointed consulting engineer of the St. Louis Southwestern of Texas, with office at St. Louis, Mo.

Mr. John W. Kearney has been appointed to the new publicity department of the Missouri Pacific, with office at St. Louis, Mo.

Mr. C. A. Gerard has been appointed storekeeper for the Western Division of the Santa Fe, with headquarters at Dodge City, Kans.

Mr. L. L. Ulrey has been appointed foreman of the air brake department of the Chicago & Eastern Illinois, with office at Oaklawn, Ill.

Mr. N. S. Brooks has been appointed general foreman of the Baltimore & Ohio Southwestern, with headquarters at Storrs, Cincinnati.

Mr. W. H. De France has been appointed general superintendent of the Louisiana Southern, with headquarters at New Orleans, La.

Mr. William McIntosh has been made foreman of the erecting department in the repair shops of the Delaware & Lackawanna at Scranton, Pa.

Mr. John Purcell, shop superintendent of the Santa Fe at Topeka, Kans., has been appointed superintendent of the shops of the entire system..

Mr. E. E. Bates has been appointed assistant superintendent of locomotive fuel service of the St. Louis & San Francisco, with office at Francis, Okla.

Mr. A. S. Clopton, general foreman, has been appointed superintendent of bridges and buildings of the Missouri, Kansas & Texas, with office at Parsons, Kans.

Mr. R. Budd, chief engineer of the Spokane & Seattle, has been appointed chief engineer of the Spokane & Inland Empire, with office at Portland, Ore.

Mr. George Seanor, division foreman of the St. Louis & San Francisco, at Joplin, Mo., has been appointed general foreman of shops with office at Sapulpa, Okla.

Mr. J. B. Reifert, motive power inspector of the Baltimore & Ohio, has been appointed assistant master mechanic at Keyser, W. Va., a newly created position.

Prof. John E. Sweet, the eminent engineer, is to make a tour around the world, leaving New York on October 21, and returning by San Francisco next February.

Mr. J. Fitzgerald has been appointed machine foreman at the Forty-seventh street shops, Chicago, Rock Island and Pacific. He succeeds Mr. George Stone, who has been promoted.

Mr. P. M. Hammett, superintendent of motive power at Portland, Me., on the Maine Central Railroad, has been appointed to a similar position on the Sandy River and Rangeley Lakes.

Mr. J. J. Kelly, formerly master mechanic on the Baltimore & Ohio, at Cumberland, Md., has been promoted to the position of superintendent, with headquarters at Keyser, W. Va.

Mr. T. T. Cloward, foreman of locomotive repairs of the Philadelphia, Baltimore & Washington, at Bay View, Ind., has been appointed general foreman of the machine shops at Wilmington, Del.

Mr. A. C. Stone, traveling engineer, Panama Railroad and Isthmian Canal Commission, has resigned to engage in real estate business, in Rochester, N. Y., and Mr. Dan E. Irwin has been appointed in his place.

Mr. T. E. Freeman has been appointed general foreman of locomotive repairs on the Duluth & Iron Range, at Two Harbors, Minn. He succeeded Mr. L. H. Bryan, who has been engaged by the Chicago Pneumatic Tool Company.

Mr. J. J. Shaw has been appointed master mechanic of the 'Frisco repair shops at Enid, Okla. He has been acting as division foreman in the company's service for several years and received his early training as a machinist on the Illinois Central.

Mr. Calvert Townley has been appointed assistant to the president of the Westinghouse Electric & Manufacturing Company. For the last five or six years Mr. Townley has been identified with the electrification of the New York, New Haven & Hartford Railroad.

Mr. Eugene McAuliffe has been appointed general coal agent of all 'Frisco lines, with office at St. Louis, Mo., and the office of general fuel agent in Chicago is abolished. Mr. McAuliffe, in addition to his other duties, will assist in the solicitation and handling of coal traffic.

Mr. H. Weitzel, superintendent of shops of the Southern Pacific Railroad of Mexico at Empalme, Sonora, Mex., has been appointed master mechanic at Empalme, and the position formerly held by him has been abolished. Mr. Weitzel is a machinist of the highest training and experience.

Mr. W. H. Kinney, Carbondale, Pa., Mr. W. W. Daley, Norwich, N. Y., and Mr. P. H. Minshull, Middletown, N. Y., who were general foremen on the New York, Ontario & Western, are appointed master mechanics in their respective locations, and the office of general foreman has been abolished on the above divisions.

Mr. J. S. Cook, master mechanic of the Georgia Railroad, is over eighty years of age, yet he attends to the business of his department as vigorously as he did when a young man. A genial, warm-hearted man, he is, with a kind word for every deserving person and as keen to keep to the front with the most approved methods and finest appliances as he ever was. He was born in Brooklyn, N. Y., in 1827.

The older readers of Railway and Locomotive Engineering who were admirers of Skeevers and the John Alexander articles, will be pleased to learn that their author John A. Hill has developed into a great publisher and financier. The Hill Publishing Company, of which Mr. Hill is the principal owner, controls the *American Machinist, Power, The Engineering and Mining Journal, The Coal Age*, and now they have purchased the *Engineering News*, for which report credits them with paying one million dollars.

Mr. William C. Hayes, superintendent of locomotive operation of the Erie Railroad, has been elected president of the Traveling Engineers' Association, a position he is eminently fitted to fill with credit to himself and to the Association. For ability as a presiding officer, Mr. Hayes has few equals in any railroad organization and his knowledge of the duties performed by road foremen of engines will make him a guide, a teacher and example to all his associates. The Traveling Engineers' Association is rising rapidly, based on the useful work it is performing and its upward progress is certain to be accelerated by the energy of President Hayes.

President Mellen Remains at His Post.

New England papers were much excited last month with the report that President Mellen of the New York, New Haven and Hartford had resigned and was about to retire from railroad life. The reports were contradicted by President Mellen who said, "I have always considered the subject of my retirement as inevitable, but have never yet been able to fix the date satisfactorily. Advancing years, physical incapability, or dissatisfaction of board are possibilities governing such a question. The first two have not occurred to me, and the board, so far as my knowledge goes seems very well pleased with the idea of my remaining in office indefinitely, therefore the date is somewhat remote."

A Superintendent Robbed.

A curious case of robbery happened to Joseph Glass, superintendent of the Ontario & Western Railroad last month. It seems that he was carrying $400 on his person and was robbed while walking along the track. Mr. Glass said "it is customary for railroad men to carry their surplus cash with them, which accounted for the large sum that he had on his person." Very few of the railroad men had heard of the attack mentioned by Mr. Glass.

A Good Boy.

The name of Eugene Libby, 17 years old, deserves special mention, for that youth prevented an accident on the Chicago & North Western Railroad, near Mendota, Minnesota, by running and warning the engineer about a bad wash-out.

New Headquarters for the I. O. C. System.

The International Oxygen Company has removed its New York headquarters from 68 Nassau street to 115 Broadway, where increased facilities have been secured for transacting its steadily growing business.

No Sympathetic Strike on Atlantic Coast.

The Atlantic Coast Line general officials announce that the difference with its car workers and threatened sympathetic strike have been satisfactorily adjusted, following a conference between General Superintendent of Motive Power R. E. Smith and E. H. Dougherty, chairman of the car workers' committee.

A man in authority with a good heart in him, and men under him who can work and think, generally come to a good understanding.

C. J. Pilliod at Work on a Mechanical Stoker.

People who are familiar with the Pilliod valve motion are aware that M. C. J. Pilliod the inventor is a highly ingenious mechanic. At present his hours of leisure and recreation are lightened by experiments on the development of a mechanical stoker. That is far from being an easy problem and we trust that Mr. Pilliod's choice of mental amusement may yield him pleasant amusement.

Frederick M. Nellis Goes to Chicago.

On September first Mr. F. M. Nellis resigned from the service of the Westinghouse Air Brake Company, after twenty years' service, to accept the position of Western representative of the General Equipment Co., with office in Chicago. At the age of fourteen he entered the shops of the Pennsylvania

F. M. NELLIS.

Lines at Dennison, O., served three years as machinist apprentice, three years as fireman and two years as locomotive engineer on same line, then resigned to become traveling engineer for the Pittsburg Locomotive Works. In 1889 he entered the service of the Westinghouse Air Brake Co. In 1897 he obtained a two-years' leave of absence to take a special course in mechanical engineering at Cornell University. For the past six years he has been New England representative of the Westinghouse Air Brake Co. and Westinghouse Traction Brake Co., office at 53 State street, Boston, Mass. Mr. Nellis was for ten years air brake editor of RAILWAY & LOCOMOTIVE ENGINEERING.

Mr. Nellis takes with him the good wishes of all who have the honor of his acquaintance. He will be an acquisition to the Western railroad men.

Obituary.

JOHN DRISCOLL.

John Driscoll, of Davenport, Ia., died last month, aged 83 years. His friends claim that John Driscoll at the time of his death was the oldest locomotive engineer in the country. In 1846 he began firing a locomotive on the Hartford & New Haven Railroad.

DAVID HAWKSWORTH.

David Hawksworth, for many years master mechanic of the Burlington lines west of the Missouri River, died at Plattsmouth, Neb., on August 25. Mr. Hawksworth was born in England in 1831 and did his first railway work on the Liverpool and Manchester Railway, the first railway in the world opened for general transportation. He came to this country in 1849 and went as engineer of steamers on the Mississippi River. When the war broke out he joined the U. S. Navy and had some stirring experiences, was captured and spent some time in Southern prisons. Went into railroad service as a machinist after the war and in 1875 was appointed master mechanic at Plattsmouth. In 1888 was made superintendent of motive power, a position which he held until retired on account of age limit in 1901. Mr. Hawksworth was a warm friend of this paper and always commended its educational influence.

GEORGE H. BROWN.

Mr. Geo. H. Brown, formerly master mechanic of the Chicago, Milwaukee & St. Paul railway, at Dubuque, Iowa, died at Elkhart, Ind., on September 7, aged 58 years. Mr. Brown began his apprenticeship as a machinist on the Lake Shore & Michigan Southern in 1870. He ran a locomotive on that road and in 1879 he entered the service of the Chicago, Milwaukee & St. Paul, where he remained until 1904. He occupied the positions of traveling engineer, roundhouse and general foreman and was promoted to master mechanic in 1892, and retired on account of ill health in 1904.

Mr. Brown took an active part in the Master Mechanics' and Master Car Builders' Conventions for a number of years, and was highly esteemed by all.

Good sense and honesty are qualities too rare and too precious not to merit particular esteem.—*Washington.*

Whether a life is noble or ignoble depends not on the calling adopted, but on the spirit in which it is followed.—*Lubbock.*

An aim in life is the only fortune worth finding, and it is not to be found in foreign lands but in the heart itself.—*Stevenson.*

Another Safety Appliance For Railways.

Any improvement in railway equipment that provides against injury to railway employees deserves—and usually receives—prompt consideration. Self preservation instinctively arouses interest when mention is made of any safety appliance. Stationmen and yardmen appreciate the hazard of working with live steam. It is one of the functions of the steam yard coupler illustrated herewith to safeguard the railway employee against injury.

The method employed to heat trains, when disconnected from the locomotive, is by a connection with the station or yard steam plant. A hose is coupled to the car at one end of the train and through this hose live steam is supplied to the steam heating system on the train. When the locomotive is coupled to the train, the yard hose is, or at least should be, uncoupled. If by any circumstances the train is moved before the yard hose is disconnected, it does not require a vivid imagination to foresee the result. Either the hose is severed or the coupling breaks and live steam plays havoc with any employee or passenger within its range. The development of an automatic coupler is, therefore, welcome news to the man who is assigned to station or yard work.

By reference to Fig. 1 the automatic operation of this coupler will be readily understood. The lock on the coupler is connected to a band on the yard hose by a chain. This band is so located that the length of the chain is shorter than the portion of the hose between the band and the lock. If the train is moved without disconnecting the coupler the hose is pulled taut. This causes the chain to lift the lock free from the car coupler and the two

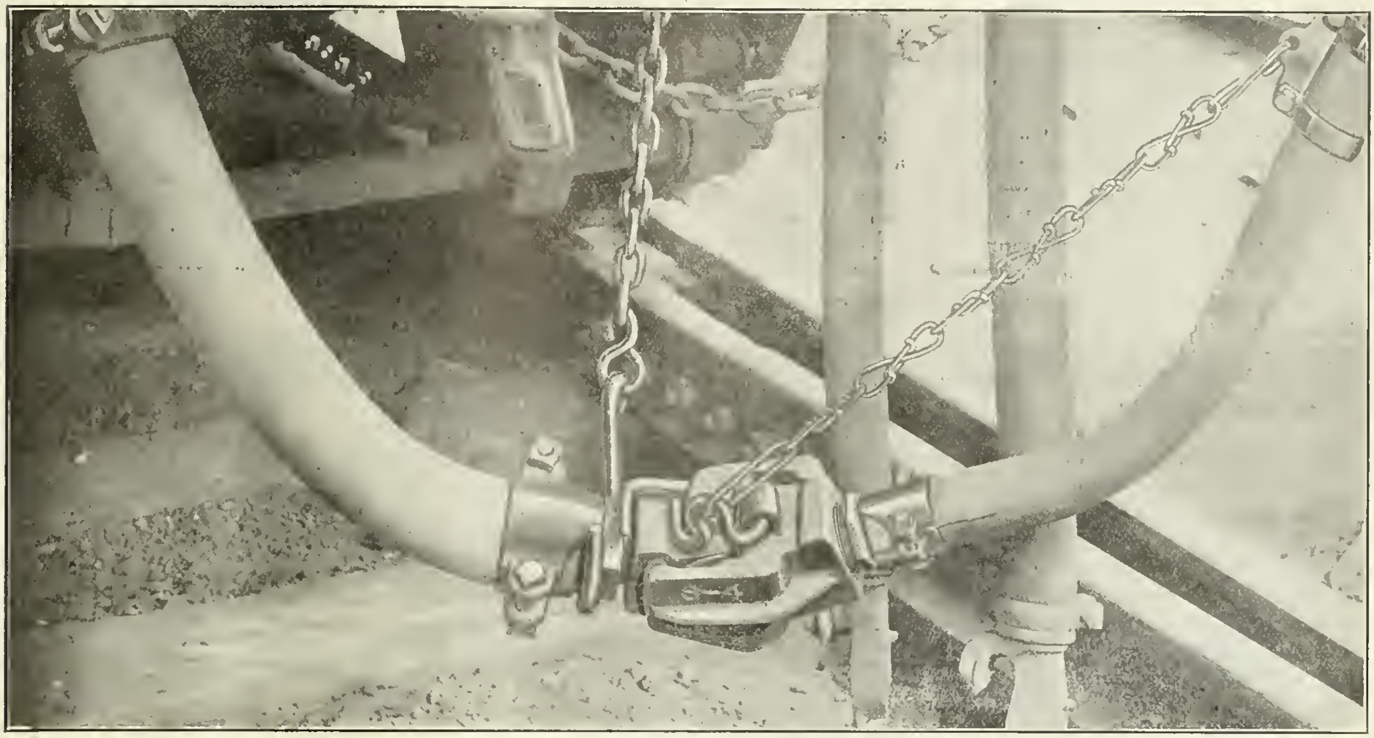


FIG. 1. IMPROVED HOSE COUPLING.

couplers disengage in the usual manner.

The check-valve in the coupler head is immediately closed when the yard and car couplers separate, which guards against the escapement of steam. The simplicity and positive action of this check valve eliminates any delicate parts and repairs.

The advantages derived from the use of this coupler are manifest, but we emphasize the following:

Injury to passengers and employees is prevented and damage to wearing apparel guarded against, in case the train is moved from the station or yard before the couplers are disconnected.

Both the hose on the car and the yard hose are saved and the couplers protected against breakage; since without this automatic feature either hose must tear or the couplers break when the train is moved without disconnecting the couplers.

Steam is saved, as little or no steam can escape, even though the plant control valve is not closed after disconnecting couplers.

Freezing of plant hose is entirely overcome. A small orifice in the check valve allows the condensation to discharge if the control valve is open in severe weather. This orifice is shown in Fig. 2.

A "tell-tale" is provided by the small orifice in the check valve. Inspectors or trainmen can tell from the steam escape if the control valve is open. They would then not be liable to couple the plant hose to the car without first shutting off the pressure.

The Safety Car Heating and Lighting Company is entitled to the credit for developing this latest acquisition to the list of safety appliances particularly important in railway operation, and their works deserves approval.

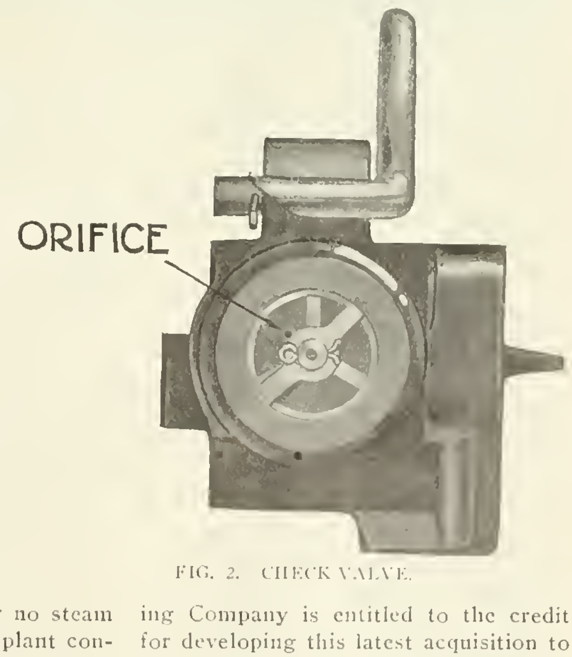


FIG. 2. CHECK VALVE.

Development of Tools.

All railway mechanics interested in the development of their business naturally like to know particulars about how the tools they handle reached their present condition of high efficiency. That line of investigation has been a favorite study with me for many years, said Angus Sinclair at the General Foremen's Convention, the current and the long ago manifestations of progress receiving keen attention. I have visited many museums where old time tools are preserved and I have examined and studied pictures of implements and working appliances that were used by people in the infancy of civilization. Comments on these matters ought to be attractive to people who supervise the operations of the most highly developed tools known to the world's industries.

In my reading and study I have traced back tools and implements to their most elementary forms. History does not inform us what kind of cutlery ware was used in the Garden of Eden, but we may be certain that knives and forks were very scarce, but it is likely that Mother Eve used some kind of thorn as a needle to fasten the leaf garments together. The line of progress led to some form of knife for cutting and a brad awl as a boring tool. Some form of grindstone was probably the first form of rotary tool, succeeded by the potters wheel on which the first forms of pottery were fashioned. Then came the lathe. The lathe developed very slowly, for at the beginning of the last century, it had in very few instances been used, except as a man-driven tool. They used a belt that was operated by up and down vibrations and was connected with a flexible piece of wood fastened to the roof, which was known as a lath. This piece of wood drew the belt up and the workman drew it down. That is the origin of the word, lathe—the lath that returned the power. The first real improvement on the lathe was the slide rest. Watchmakers had invented the slide rest in Switzerland, goodness knows, how many years ago, but perhaps in imitation of their little lathe attachments, it was re-invented in England about 1810, and that put the lathe forward as a real tool.

Until the slide rest was invented, the power was done by one man and the work was produced by the skill of his hand and not by the rigidity of an accurate holding tool. At that time the lathe was a one man power. All the power applied was done by the physical exertion of one man. The lathe gradually developed until now you have lathes that require the exertion of from 50 to 100 horse power. The Pond wheel lathe calls for the exertion of about 50 horse power and the Sellers wheel lathe requires nearly 80 horse power to keep it going. A horse power represents the work of twelve men. One horse power is twelve men's work or twelve men's effort. The tool that requires 50 horse power to drive it, is representing 600 men's work. You see how, in the course of a century, the tool has developed so that instead of one man doing the work, it is performing the work of 600 men. Imagine what it would take to turn out the machine work of today with one man power. I think that is a very striking thing to think about in relation to the great development that has been going on.

In connection with the development of tools, the railway shop foremen of America are entitled to the very greatest praise. Nothing would progress fast if it was obstructed, and it went forward faster because it was pushed by such men as yourselves and on that account alone. I think you are entitled to the very greatest praise that the progressive men of the age wish to bestow.

American Water Softener.

The American Water Softener Company, of Philadelphia, are gaining golden opinions among railroad men generally for their successful efforts in the purifying of water for use in locomotive boilers. As is well known, the formation of scale in boilers is the cause of much increase in the cost of fuel. Scale, 1/16 in. in thickness, adds nearly 15 per cent. to fuel cost, and scale ½ in. in thickness increases the fuel cost 60 per cent. The compound furnished by this company is said to practically remove all scale-forming matter at a cost of ½ to 3 cents per 1,000 gals. of water treated. The introduction of the water softening apparatus is slight, compared to the saving, and the operations are automatic. The chemicals are mixed on the ground level and are pumped automatically to the top of the tank where the softened water flows by gravity into the storage tank.

Only a few years ago we published a description of a shop where the making of cutting-off saws was a specialty, and particulars were given of how many operations in railroad machine shops were carried out with wonderful expedition under the cutting-off saws. We supposed then that the highest efficiency in cutting metal had been reached, but the possibilities of the acetylene flame current had not then been manifested. The manner in which this flame cuts through beams of steel is simply astounding.

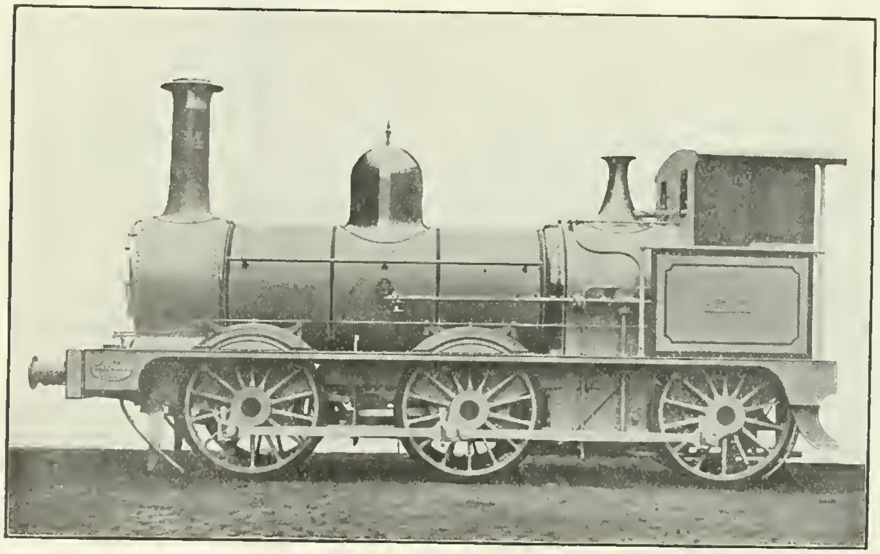
Lubrication of Locomotive Valves and Cylinders.

The problem of properly lubricating locomotive valves and cylinders seems to have been more completely solved by a device which has been successfully used on a number of locomotives and railroads in Europe and which was applied in October, 1910, to an American locomotive on the Long Island Railroad.

On Wednesday, September 20, a number of leading engineers and representatives from the motive power departments of several railroads met at the railroad shops of the Long Island Railroad and examined the valves, valve seats and cylinders of locomotive No. 100 to which the device is connected. All present found that the machine parts of the locomotive had a complete thin coating of a dark, lead color lubricant. The engineers who had given careful observation to the operation of the locomotive for eleven months stated that a considerable saving in oil and fuel had been made and this they attributed mainly to the coating of surfaces resulting from the services of the device and not to other conditions.

The device which is manufactured by Messrs. Knowles & Wollaston, of London, England, with office at 18 East 34th street, New York, consists of two small but powerful pumps tested to a pressure of 800 lbs., and enclosed in containers attached to the frame by rods and levers. The casing or container of the pump holds about three pints of a mixture consisting of valve oil and three per cent. of fine crystalline graphite. A two-vaned propeller stirs the mixture continuously while the machines are in service and the mixture is pumped into a copper feed pipe leading to a valve fitted to the steam chest. In this copper feed-pipe there is a spiral which is revolved continuously by attachment to the spigot of the pump. The rotating spring keeps the fine crystalline graphite thoroughly mixed with oil until it reaches the steam chest. The motion of the parts is slow and consequently the wear is small. The method for heating the lubrication mixture during the winter months and the regulation of the length of the pump stroke is controlled by simple appliances.

Under similar operating conditions with a number of locomotives the approximate cost of lubrication of valves, cylinders and rods by this method would be about sixty cents per thousand locomotive miles run. With this single locomotive the cost is between seventy cents and eighty cents per thousand locomotive miles. This locomotive averages about 188 miles per pint of lubrication mixture and about 80 miles per pint of oil when oil alone is used. On American railroads it is considered that one employee can take proper care of lubrication equipment necessary for 100 locomotives inclusive of the time employed in filling the lubricators. The saving in fuel per locomotive mile has not yet been definitely ascertained though the engineers who have watched the locomotive carefully consider that they are justified in stating that a considerable saving in fuel takes place.



"CEDRA," BUILT LONG AGO BY SHARP, STEWART & CO., MANCHESTER.

Chicago Pneumatic.

The Chicago Pneumatic Tool Company announces an important change in the trade designation of the air compressors manufactured by them, which heretofore have been known as the Franklin compressors, their compressor works being located at Franklin, Pa.

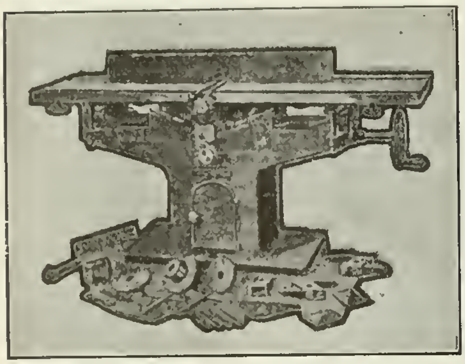
Because of the fact that its pneumatic tools, electric drills, rock drills and other articles of manufacture are invariably identified with the name of the company, it has been determined to hereafter use the trade name, "Chicago Pneumatic" as applying also to their air compressor product.

An Efficient Tool for Repair Work.

Where one machine can be obtained to do the work of several there is just so much more saved on invested capital and just that much less invested money standing idle.

A good illustration of this point is the Universal Woodworker, illustrated here. So great is the variety of work that can be done on it that it takes the place of several machines which are usually required in the repair shop. It will plane out of wind, surface, straight or tapering, rabbet door frames, rabbet and face inside blinds; joint; bevel; gain; chamfer; plow; make glue joints; square-up posts, table legs, newels; raise panels, either square, bevel or ogee; stick beads; work circular mouldings, etc.; rip; cross-cut; tenon; bore; route; rabbet; joint and bead window blinds; work edge mouldings, etc.; in fact, as its name, "Universal Woodworker," well describes its almost invaluable uses, and it will be found a whole wood-shop in itself.

A machine of this kind well fills the requirements of the term "efficient," as it seldom stands idle; for when through with one task it can be instantly changed to do something else.



UNIVERSAL WOODWORKER.

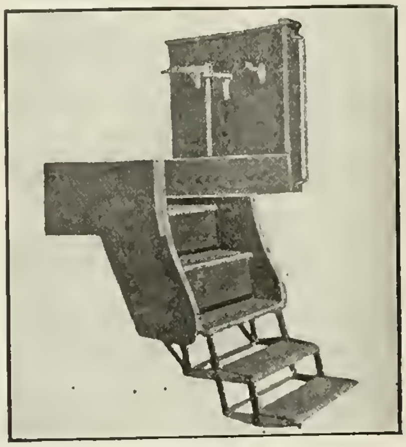
The manufacturers, J. A. Fay & Egan Co., 445 W. Front St., Cincinnati, Ohio, have just issued a handsome booklet containing two large photographs and full description of this machine, together with a number of illustrations of the work done on it, which can be obtained free on request and will prove of great interest to the repair-shop foreman.

Apprentices Become Ambitious.

Having enjoyed considerable intercourse of late with the young men forming railroad apprentice schools we find that the instruction they are receiving is stimulating many of them to seek further instruction. This desire is moving them to join correspondence schools. From the talk we have heard the International Correspondence School of Scranton, Pa., is the favorite mecca of the apprentice boys, and some of them are prepared to do much extra work, in order to earn sufficient money to pay the school fees. In the talk with the apprentices the writer has always advocated the practice of self-help in acquiring higher education and the tendency to enjoy the benefit of correspondence schools has no doubt been promoted by the advice given.

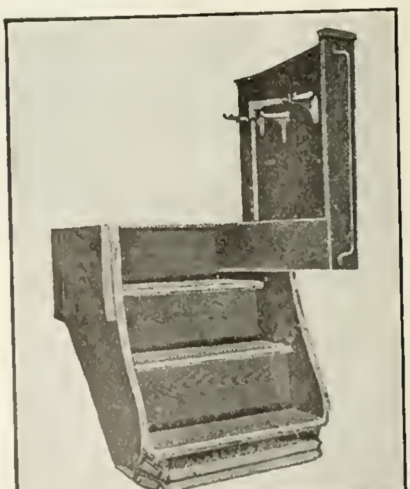
Extension Car Step.

Mr. John S. Blake, of Charlotte, N. C., has invented an "extension car step," which is designed to take the place of the stool now used by conductors to assist passengers in alighting from cars. It can be readily attached to the ordinary car step. As shown in the accompanying illustrations, it folds neatly under the car step. It cannot be let down or opened, while the car is in motion.



BLAKE EXTENSION CAR STEP. OPEN POSITION.

It is being received with much favor more especially by the older passengers whose high-jumping days may be said to be over. It is also much more preferable in the matter of handling than the old-fashioned stool.

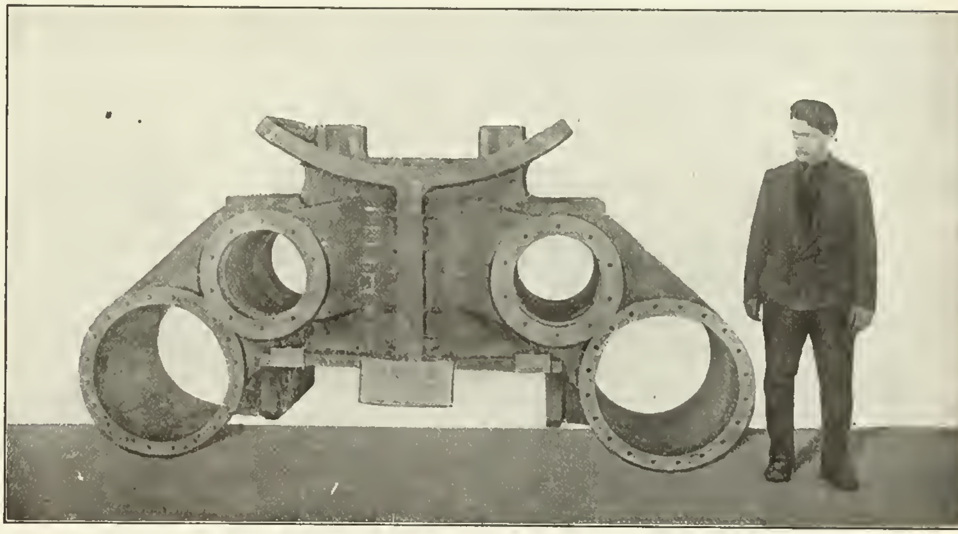


BLAKE EXTENSION CAR STEP. CLOSED POSITION.

General Railway Castings.

The continued progress toward more powerful construction and higher speeds which has marked the history of railway engineering for the past half century, is very largely the result of the development of the steel foundry practice. The high state of efficiency obtained by the use of cast and wrought-iron parts in the railway service, has been further increased in recent years by the development of high-grade steels, which possess, in addition to great static strength and ductility, a well-determined ability to resist the disintegrating effect of repeated strains and shock stresses.

Among the manufacturers, whose work in this direction may properly be said to be of the highest order, the Penn Steel Casting & Machine Co., of Chester, Pa., have won an enviable reputation. In the August issue of Railway and Locomotive Engineering we published an article describing the lift lock at Peterboro, and it is of interest to learn that this fine piece of mechanism was entirely produced from the castings of this company.



THE FIRST CAST STEEL LOCOMOTIVE CYLINDER EVER SUCCESSFULLY PRODUCED. MADE OF OPEN HEARTH STEEL, SHOWING TENSILE STRENGTH OF 74,000 LBS. TO THE SQUARE INCH AND AN ELONGATION OF 25%. MACHINED COMPLETE AND TESTED TO 700 LBS. HYDRAULIC PRESSURE BEFORE SHIPMENT. WEIGHT 17,000 LBS.

It is also interesting to learn that cast steel locomotive cylinders of open hearth steel are now being regularly manufactured by this company. These castings show a tensile strength of 74,000 lbs., and an elongation of 25 per cent. They are machined complete and tested to 700 lbs. hydrostatic test. The accompanying illustrations show a pair of locomotive cylinders machined and ready for shipment.

The Alaska Northern Railway has purchased two McKeen gasoline cars. The high cost of coal is reported to be the reason why the motor cars were chosen.

NEW CATALOGUES.

Hydraulic Jacks and Pressure Pumps.

Dudgeon's Catalogue, No. 8, is a publication of much value, embracing as it does 86 pages of closely printed matter with numerous illustrations presenting all the latest details of the hydraulic jacks and pressure pumps and expanders, and other appliances which have made the name of Richard Dudgeon famous as an inventor and manufacturer. Apart from the interesting descriptive matter there is a considerable portion of the publication devoted to directions for using and maintaining hydraulic jacks. Among the more recent mechanical appliances introduced are a complete set of tools for repairing the universal hydraulic jack. The latter are of especial interest, as the tendency to allow hydraulic jacks to fall into a state of disrepair is more common than it should be. It is a singular circumstance that even in the largest railroad repair shops there are very few mechanics who are familiar with the construction of the hydraulic jack, and consequently it is rarely to be seen that the jacks are kept in as good state of repair as they ought to be. Hence not only purchasing agents, but those who are handling the hydraulic jacks should have a copy of this valuable catalogue at hand, and much would be learned and much saved. Copies may be had on application to R. Dudgeon, Broome and Columbia streets, New York, N. Y.

Pilliod Locomotive Valve Gears.

The Pilliod Brothers Company have just issued a new bulletin, descriptive of their valve gear styles "B" and "C."

As is well known their syle of gearing "A" is the original crosshead connection, and has been frequently described in our pages. The later modifications of this style of valve gearing should attract the attention of those who desire to have the gear applied to old power at a much less cost than any other gear, and especially where a change is desired to be made from the Stephenson link motion to an outside connected gear. This style of gearing has its motion from the crosshead only. Style "C" has its motion from both crank and crosshead, and resembles the Walschaerts gearing, only that no links or sliding blocks are used, the reverse motion being of the Marshall type. Full information may he had from the manufacturers, Toledo, Ohio.

Staybolt Information.

The latest catalogue of the Flannery Bolt Company, Pittsburgh, Pa., throws more light on the important subject of staybolts. Practical and theoretical discussions by leading mechanicians and engineers enhance the value of the publication. A variety of experiments are described and illustrated, and all point strongly to the absolute necessity of the use of flexible stay bolts. An important new feature in this fine catalogue are a series of illustrations with accompanying letter press descriptions of the burnt ends of stay bolts, and the relation they bear to the breakage of the bolts. This is a subject which, perhaps, has not been so thoroughly investigated as some of the other causes of breakages, but it can be readily understood that the repeated stresses and strains brought to the material submitted to such a high temperature naturally causes a recrystallization of the particles of which the bolts are composed. The Flannery Bolt Company are meeting the involved problems of boiler staying in a way that it has never been met before, and their catalogues and other publications should be in the hands of all interested in boiler construction and maintenance.

Thermit Welding.

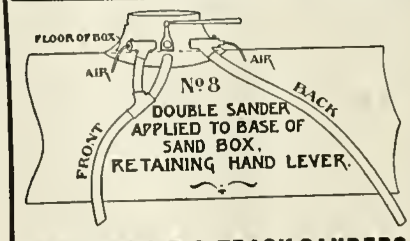
A finely illustrated pamphlet of 36 pages has been issued by the Goldschmidt Thermit Company, giving full instructions for the use of Thermit in railroad shops, and will be widely welcomed by railroad men as the pamphlet is carefully written to cover a specific class of repairs largely confined to the mechanical appliances used on railways. Much of the matter, however, applies equally as well to all welding operations by the Thermit process. A list of the tools and material to be used is given and any intelligent mechanic carefully following the directions could not fail to secure successful results. The experience of this enterprising company has demonstrated the advisability of a gasolene-compressed air preheating torch which they furnish at a very low cost. The use of this apparatus is also fully described in the pamphlet, copies of which may be had on application to the company's head office, 90 West street, New York.

Hydraulic Tools, Cranes and Machinery.

The original pamphlet descriptive of hydraulic tools and machinery issued by R. D. Wood & Co., Philadelphia, for use at the World's Fair, has passed through six subsequent editions, each edition being revised and enlarged, until the present issue extends to 122 folio pages profusely illustrated. Probably the most conspicuous feature of the fine publication are the varieties of hydraulic riveters. The company has earned an enviable reputation in the construction of these ponderous, effective and time-saving machines. No boiler shop is complete without several of these fixed and portable machines. Their products generally embrace every kind of hydrants, valves, sluice gates, tanks, towers and stand-pipes, gas holders and gas apparatus, gas producers, turbines and power pumps, pumping engines and centrifugal pumps, and a variety of heavy special machinery to designs of purchasers. Those interested in these products should send for a copy of the revised catalogue. Address Wood Building, 400 Chestnut street, Philadelphia, Pa.

Fibrous and Metal Packings.

The products of the Garlock Packing Company are so well known that they need no introduction to railway or other mechanical men. Their work has kept pace with the requirements of twentieth century strenuousness. It is said that armor plate keeps pace with improvements in heavy artillery. Whatever truth there may be in this we do not know, but we do know that Garlock's packing has kept pace with the increase in steam and other pressures. The most recent, perhaps, is the introduction of superheated steam, and Garlock's packing has stood this test as it will likely stand other tests that may arise in the undiscovered future. In the catalogue of 176 finely illustrated pages before us, there is a wealth of information in regard to packing that is not surpassed. The diversity of purposes to which the packings may be put, and the multiplicity of designs seem to meet every imaginable requirement. The company will furnish copies of the catalogue to all interested. Address, Palmyra, N. Y.



An Odd Shipping Rate.

The great variety of produce carried by railway companies may be judged from the fact that a shipping firm last month notified the Southern Pacific that they intended shipping twenty-one crates of live alligators and two boxes of alligator eggs. The station agent had no difficulty in finding a rate on which to charge the alligator product. He was more fortunate than an English station agent who received a monkey for shipment. "A monkey," remarked the Englishman, "is a hinsect, and a hinsect is a lobster. Your monkey will be shipped on the lobster rate."

Accident Bulletin.

Of all kinds of printed matter Government reports are perhaps the dreariest. If they were printed to be sold, like most other publications, they would be sold by the pound and not by the volume. As it is they fill niches here and there in lean libraries. What they lack in interest they usually make up in bulk, and the bindings in green and scarlet and gold refresh the eye, if the contents do not illumine the mind. The bulletin before us, however, is an exception to the general rule. It has only 19 pages, and dealing as it does with a vital subject full of tragedy and pathos, each page has the white light of a page of Shakespeare. Coming to the statistics which are brief, we learn that in the first three months of 1911, the number of passengers killed in train accidents throughout the United States was 28. In 1910, during the same period 110 were killed. Of the number of employees on duty killed in train accidents it is also gratifying to observe that the falling off as compared with the preceding year is very marked. In 1910 no less than 199 were killed during the first quarter of the year. In 1911 the casualties were 105, and so it might be stated that through the entire list of casualties and injuries and losses from all causes there is a marked falling off in railroad disasters, which speaks volumes for the general improvement in methods and efficiency.

The Value of Courtesy.

The Illinois Central Railroad Company are doing a notable service to their employees, particularly and railroad men generally, in issuing a series of instruction pamphlets, which embrace not only the details of the mechanical appliances with which the employees must necessarily become familiar, but, as in the publication before us, matters are discussed of an ethical nature that cannot fail to raise the standard of railway men as members of society, large numbers of railway employees coming closely in contact as they do with every phase of humanity, and, as is well known, the traveling public are, generally speaking, in a state of semi-dementia, which requires a treatment which only those of a fine philosophical nature can use with grace and spontaniety. All railway men have not this shining gift, but all may read and learn much from this pamphlet, which has been prepared by Mr. W. L. Park, the worthy vice-president and general manager, Chicago, Ill.

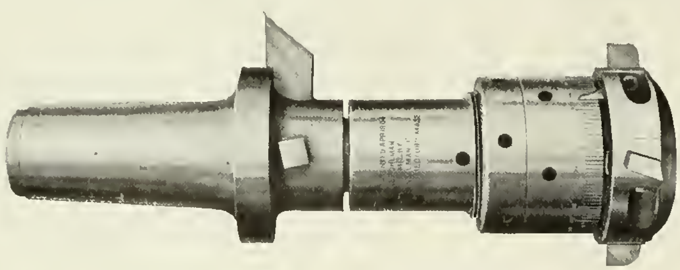
Toil, says the proverb, is the sire of fame.—*Euripides.*

The Twentieth Century Boring Tool.

The Wellman Company, Medford, Mass., has perfected a boring bar, which is meeting with marked approval among railway men. As shown in the accompanying illustration, the tool as adapted to wheel boring has the roughing and finishing tools mounted on an adjustable shaft, the disposition of the cutters being such that but ¼ in. additional feed over the length of the hub is necessary to put through the finishing cut. The micrometer attachments are such that the cutting tools are withdrawn as well as set out by the fine micrometer screw, no set screws being called into play for adjustments, the set collars alone being used.

The elements of perfect accuracy and rapid speed are such that the output as compared with the older methods, especially in the fitting of new wheels to old axles is more than doubled. The easy adjustment to the desired diameter with the absolute knowledge that the increase or decrease is certain to be that wished for does much to reduce cost.

To those familiar with the work of boring wheels, it will be of interest to learn that a record of 2 minutes and 28 seconds for two 750 lb. car wheels, with 7¼ in. hubs, cored to 6 ins., roughed and finished, perfect fits being obtained, has been repeatedly made. Complete details may be had on application to the company.



THE TWENTIETH CENTURY BORING TOOL.

Valves and Packing.

Jenkins Bros.' catalogue and price list has been revised up to the present year and forms a neat and compact publication of 146 pages, and over 100 illustrations. It points out very convincingly the merits of their standard pattern and other valves, among these the peculiarity of using a removable disc of softer material than the solid metal clapper is explained. Some new features in back pressure valves and iron body safety valves show that this enterprising firm continues to add to the number and variety of their products. New forms and new features in rubber specialties, including discs, packing, gaskets—flat and tubing, and pump valves, bibb washers and union rings, are shown and described. Accompanying price lists enhance the value of the catalogue and place the interested reader at once in possession of the desired facts in regard to Jenkins Bros.' products. Copies of the catalogue may be had on application to the main office, No. 80 White street, New York, N. Y.

Commonwealth Castings.

A new catalogue of over 70 pages, with high class illustrations and descriptive matter in regard to the fine products of the Commonwealth Steel Company of St. Louis, Mo., has just been issued, and as a specimen of the illustrators and printers' art it is superb. A view of the constantly expanding works of the company at Granite City, Ill., properly serves as a frontispiece. As is well known the company has been a leader in the development and application of open hearth steel to car construction. Their boltless truck frames and underframes for passenger train cars have saved much in maintenance and repair costs. Among their latest products is a one-piece cast steel tender frame which with its silica coating is rust-proof. Another valuable addition is a transom draft-gear readily applicable to old wooden cars, making the cars stronger than when they were new without the replacing of center sills. Among the smaller recent additions of importance is the Flory carry-iron and striking plate, which were described in a recent issue of RAILWAY AND LOCOMOTIVE ENGINEERING and which is meeting with much favor. All interested in the efficiency and economy of railroad car construction should send for a copy of this fine catalogue.

Too Long a Route.

During a recent examination of applicants for the position of mail carrier, a colored boy appeared before the Civil Service Commission.

"How far is it from the earth to the moon?" was the first question asked him.

"How fah am it from de earf to de moon?" he repeated, as he began to reach for his hat. "Say, boss, if you's gwine to put me on that route I don't want de job."—*Circle Magazine.*

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXIV. 114 Liberty Street, New York, November, 1911. No. 11

From Lake Michigan to Puget Sound.

In May of the present year, a new daily transportation service was inaugurated between the Great Lakes and the Pacific coast, beginning at Chicago in the east, passing through Milwaukee, St. Paul, Minneapolis, Aberdeen and Seattle to Tacoma in the West. The route is known as the Chicago, Milwaukee & St. Paul, and the Chicago, Milwaukee & Puget Sound Railways. The railroads are 3,277 miles in length, and they hold the record in railroad construction, the building of these great roads only occupying a little less than three years. With the numerous branches already in operation, the tracks extend to nearly 9,000 miles. There are nearly 3,000 locomotives in operation, and the general equipment is of the best. The daily special trains that we refer to are known as the "Olympian" and the "Columbian." They are steel constructed trains from end to end, and are the first complete steel trains to be operated between Chicago and Puget Sound.

The accompanying illustration shows the superb steel bridge which crosses the Missouri River at Mobridge, ninety-eight miles west of Aberdeen, S. Dak. This is the point where the two divisions of the great railway meet. The bridge is one of the most notable structures of its kind in the world. There are three towering spans, each 425 ft. in length, rising to a height of 65 ft. above the rails, and four massive piers of solid masonry, that raise the superstructure 55 ft. above the river. The bridge is the heaviest that has yet been constructed across the Missouri River.

As may be expected, the opening of this fine railway through a beautiful and fertile country, rich in natural products, has been marked by a growth in cities and towns that is without a parallel in rapid progress in the newly opened regions of the Northwest, and bids fair in a few years to rival the clustered industrial centers of the East. The present year has in many respects been the most remarkable in this rapid growth, owing largely to the magnificent and vast areas that have blossomed into wheat fields and which a few years ago were vast treeless wildernesses, but are now teeming with life and energy. A particularly pleasant feature is the number and, what may be called, rural elegance of the tree-embowered homesteads that breathe so eloquently of that spirit of thrift and industry, combined with a love of the artistic, which is such an admirable feature of the character of the American people.

STEEL BRIDGE, MISSOURI RIVER, MOBRIDGE, S. D.

Apart from the beneficent utility of the new railway with its growing chain of expanding cities and broadening belt of happy farms, the road passes through scenes of unsurpassed beauty in natural scenery. There are long stretches of flower-spangled prairies where the cattle wander at will almost the entire year.

Perhaps the most remarkable feature of the scenic wonders along this road are the sudden transitions from the purely pastoral and quietly picturesque to the sublimely grand and terrible. From the apparently boundless prairie the eye is suddenly confronted with towering peaks and precipitous canyons, the appalling sublimity of the mountain ranges cleft by gorges where tumultuous torrents boil and thunder from cataract to cataract, and the mind is never weary of contemplating the ever-changing and ever-awful panorama of the marvelous profusion of forest and stream and cliff and canyon. Nowhere in the world is there such wealth of coloring. In the valleys there is the amazing luxuriance of Brazilian forests. Sombre-hued trees are wreathed with scarlet climbers that burst like flames of fire. Even the bare rocks are rainbow hued, striped and barred with russet and blue and gold, and glittering into iridescence as if a million gems were scattered along their broad breasts.

Nor is the human element wanting in this weird wilderness. The copper-colored Indian and the white settler—the Indian, calm-faced and colossal, the white man, white-browed and keen-eyed—may be seen side by side. The touches of the white man's hand may be seen here and there, the clang of machinery may be heard occasionally mixing its music with the sound of waterfalls and the multitudinous murmurs of the interminable forests. The passing train seems to have an endless attraction for the settler and the Indian alike. To the settler doubtless it brings visions of the homeland. One can imagine that in the eager faces that look out of the car windows there is something of the "touch of a vanished hand and the sound of a voice that is still" that stirs the hearts of those who have wandered into a far country, while to the poor Indian there is a vision of the immensity of the white man's power and of his own insignificance in the grand march of human progress, as manifested in the triumph of steam, and the resistless power of mind over matter.

Even the skies seem to have a burnished beauty unknown elsewhere. The clear vault of heaven seems higher. The blue glory of the East is clarified into amethyst fading from sapphire to cobalt as it approaches the horizon. As one approaches the calm, broad ocean of the West, the scenery seems, if possible, to increase in magnificence. Probably the most remarkable vision in this vast wonderland is the view of Mount Tacomo, the highest peak in the United States outside of Alaska. A sunset view of this snow-clad, glacier-crowned mountain is something that would require the hand of an Oriental poet to describe. Rising to an altitude of three miles into the golden sunshine, white-capped, broad-based, conical-shaped, it is a revelation unparalleled in dazzling splendor. In the light of the setting sun the base is barred with crimson and green, fading into saffron and yellow, and suddenly flashing into a myriad of flames of crystalline splendor like the fiery flashes of some finely fashioned diamond magnified into measureless magnitude.

The Mallet Compound.

The Mallet compound locomotive is by no means a favorite type of power with train men, but it is forcing its way into favor for the reason that it does the work of train hauling at less expense than any other type of locomotive. Engineers and firemen handling this form of locomotive are allowed from 25 cents to $1 a day above the wages paid for working consolidation locomotives, but on most roads where such engines are used, there is no competition among the men to secure the higher-paid occupation.

In the report submitted to the Traveling Engineers' Association on the Mallet compound in road service and the discussion that resulted, a good case was made out for that form of engine. The information brought out concerning the working of Mallet compounds convinces us that locomotives of that form are destined largely to take the place of consolidation or other powerful forms of freight-hauling power. Most of the Mallets in use have been designed for pushing service, and have comparatively small driving wheels, which adapts them for slow moving and puts them at a decided disadvantage when placed upon road service. In the report referred to, particulars were given of the performance of Mallet locomotives used for road service on the Great Northern, the Santa Fe, and the Chesapeake & Ohio. On the Great Northern the performance of these engines was decidedly more economical than that of consolidation engines, although the Mallets have driving wheels only 55 ins. diameter. Those used by the Santa Fe do better road work than any others because they have driving wheels 69 ins. diameter, which enables them to make good mileage speed with moderate piston speed. A compound locomotive of any kind labors under a great disadvantage when the piston speed is high. Comparative tests were made on the Great Northern between a Mallet and a consolidation without the findings being given. But it was reported that the Mallet caused considerably less shock to the train than the consolidation in passing over grades, because both units of the Mallet never slip at the same time, and the slack of the train does not run up as in the case of a consolidation engine. The consolidation engine had the faculty of running a train over a grade faster than the Mallet, a peculiarity that might be expected.

The Santa Fe mechanical department has adopted a very sensible policy in trying to reduce the natural prejudice of enginemen to the Mallet compound. Every convenience that could be devised to help the enginemen was introduced, including air operated fire doors, bell ringers, reverse levers and cylinder works, also coal passers. Weight of opinion goes to show that the Mallet is easier on the track than consolidation and Mikado types, and it is found that they will go with ease into sharp curve sidings that consolidation engines will not enter.

Mr. W. F. Walsh, of the Chesapeake & Ohio, is quite enthusiastic about the performance of a Mallet compound which he is using. This engine, equipped with a superheater, consumes about one ton of coal per trip more than a consolidation engine, but does 50 per cent. more work between repairs. He says the average speed of a Mallet is about the same as that of a consolidation, both being able to reach a speed of forty-five miles an hour. The firemen on the Chesapeake & Ohio consider it takes less exertion to fire a Mallet than any other form of locomotive.

We have devoted considerable space to this report on the Mallet compound, which is practically two locomotives handled by one set of men, because reports have reached us that engineers and firemen in certain quarters are scheming to make a combined effort to oppose the use of Mallet engines in road service. We dislike to see the manual labor or the responsibilities of enginemen increased, but we earnestly advise the men who occupy these positions to refrain from any combined agitation against this most highly developed type of motive power. Railway managers are pushed to their wits' end in securing the revenue that enables them to send out the pay car regularly. Near-sighted legislators are constantly striving to have laws passed tending to reduce the rates of transportation, and every city and village, almost, is agitating to secure higher assessments for taxation of railway property. Under these conditions it will be a very great hardship if obstructions are thrown in the way of managers who perceive means of lowering expenses by the introduction of the most economical motive power in the market.

Water and Railway Levels in North America.

Great misapprehension exists concerning the relative levels of water and railroad lines of transportation.

The Northwestern water line is formed by Lakes Erie and Ontario, with the Niagara and St. Lawrence rivers. The elevation of Lake Erie is 565 ft. above tide; of Lake Ontario, 232 ft. The Niagara River descends 333 ft. in 36 miles. The St. Lawrence descends more than 180 ft. between the lake and Montreal, 80 ft. of which occurs at the Long Sault rapids, opposite Messona, in St. Lawrence County.

The surface of Lake Erie is 134 ft. below low water at Pittsburgh; it is level with the Ohio ten miles below Marietta, 133 ft. above low water at Cincinnati, and 290 ft. above the mouth of the Ohio at Cairo. It is 408 ft. below the summit of the Ohio canal at Akron; 211 ft. below Columbus, Ohio, 21 ft. below the lowest summit between the Illinois River and Lake Michigan, and 62 ft. below Lake Superior.

On the East, the surface of Lake Erie is 1,195 ft. below the highest summit of the Erie Railroad, 1,556 ft. below the summit of the Pennsylvania Railroad; 2,055 ft. below the summit of the Baltimore & Ohio Railroad; 2,189 ft. below the summit of the Alleghanies at the crossing of the Chesapeake & Ohio Railroad.

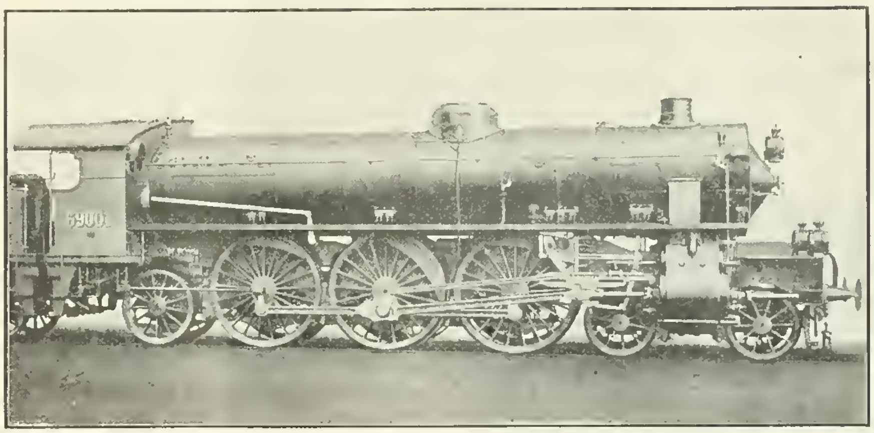
The surface of Lake Ontario is about level with the top of the Aquarium Building, New York. The Great Lakes lie upon an elevated interior table land, sloping away on all sides except against the Alleghanies.

Farmer Who Was His Own Engineer.

The farmer who acts as his own land surveyor or civil engineer sometimes employs expensive ignorance. A farmer in Cattaraugus County took advantage of the dry spring weather to dig a deep ditch intended to drain a piece of meadow of his own into an extensive pond on another man's farm. When the dry spell was over and ponds began to fill up this neighbor's pond just moved right into the meadow of the farmer who had been his own engineer, and has established a permanent swamp where corn and hay used to grow.

Pacific Express Locomotive, Italian State Railway.

We illustrate herewith a four-cylinder simple Express passenger locomotive recently built by Ernesto Breda of Milan for the Italian State Railway. It is provided with a Schmidt superheater, and has the following leading dimensions: Cylinder (4), 17¾ ins. diameter by 26¾ ins. stroke; diameter of bogie and trailing wheels, 3 ft. 6⅞ ins., and of six-coupled driving wheels, 6 ft. 7⅞ ins.; rigid wheelbase, 14 ft. 1⅛ in.; total, 32 ft. 11¾ ins.; working pressure of boiler, 176.4 lbs. per sq. in.; height of center of boiler above rails, 9 ft. 5 ins.; length of tubes between tube plates, 19 ft. ⅜ in.; number: 158 of 2 x 1⅞ ins. diameter, 27 of 5¼ x 4⅞ ins. diameter; heating surface: firebox, 172.22 sq. ft.; tubes, 2,088.24 sq. ft.; total, 2,260.46 sq. ft.; grate area, 37.61 sq. ft.; superheater surface, 721.20 sq. ft.; weight of engine, empty, 77 tons 11 cwt. 2 qrs., and in working order, 85 tons, 18 cwt. 3 qrs., of which 50 tons 4 cwt. are available for adhesion. The tender is of the double bogie type, with wheels of 3-ft. 7⅛-in. diameter, occupying a total wheelbase of 20-ft. 4⅛ ins., it has capacities for 4,400 gallons of water and 8 tons of coal, and weighs empty 21 tons, 5 cwt. 1 qr., and, full, 48 tons, 16 cwt. 2 qrs. A separate illustration of the boiler of this engine is given.



4-6-2 LOCOMOTIVE FOR THE ITALIAN STATE RAILWAYS.
Built by Ernesto Breda, Milan, Italy.

This locomotive is one of four built by Ernesto Breda for service on the Italian State railways, all of which are now on view at the Turin Exposition. The other engines are of the 2-6-0, 2-6-2 and 0-8-0 types, respectively, the second mentioned being a four-cylinder compound, and the others two-cylinder simples.

Great Men Who Thought Operating Railways Impracticable.

The great Chancellor Livingston, of New York, who was associated with Robert Fulton in promoting the introduction of steamboats, is credited in some quarters with having used his influence to promote the use of the steam engine on land transportation, but that was not true, as we have learned from the copy of a letter written by the chancellor in 1811. He was president of the New York Society for the Promotion of Useful Arts, and was reported to be well informed about the steam engine, but, like James Watt, he could conceive a locomotive steam engine only as one carrying the steam condensing apparatus along, this, too, after Oliver Evans had several non-condensing engines at work in Pennsylvania.

A friend having made inquiry of Chancellor Livingston in March, 1811, as to his ideas concerning railways with cars about four-ton weight, to be operated by steam engines, received the following reply: "I fear they will be liable to serious objections and ultimately more expensive than a canal. They must be double so as to prevent the danger of two such heavy bodies meeting. The walls on which they are placed must be at least four feet above the surface, and three feet below, and must be clamped with iron, and even would hardly sustain so heavy a weight as you propose moving at the rate of four miles an hour on wheels. As to the wood, it would not last a week. They must be covered with iron, and that thick and strong. The means of stopping these heavy carriages without great shock and of preventing them from running against each other would be very difficult. In case of stops to take wood and water, many accidents would happen. The carriage of condensing water would be very troublesome. Upon the whole, I fear the expense of operating railways would be much greater than that of canals and not so convenient."

It is always too hot or too cold for the man who wants to quit.

Compressed Air.

In the compression of air or any other gas, the change of pressure due to increase or decrease of volume follows certain laws which have been named after the men who discovered or enunciated them.

The first of these is the law of Boyle (or Marriotte), and governs the relation of pressure as compared to volume, but only under the specific condition that the *temperature* shall remain constant.

The second law is that of Charles (or Gay Lussac), which governs the relation of volume as compared to temperature under the condition that the pressure shall remain constant.

Boyle's law.—The pressure of a quantity of air or gas at a given temperature varies *inversely* as the volume it is made to occupy.

Charles' law.—The volume of a quantity of air or gas under constant pressure varies as the temperature, increasing or decreasing equally per degree of temperature between the freezing and boiling points.

We may obtain the condition necessary for a demonstration of Boyle's law by taking a given volume of air, say 2 cu. ft., at atmospheric pressure, and compressing it to 1 cu. ft., and then allow it to cool to its former temperature, when the isothermal condition is obtained, and the air will be found to have twice its former pressure. The measurement of air or gas pressure must always be taken from a vacuum, or what is termed absolute pressure, as distinguished from gauge pressure, and therefore our 2 cu. ft. of air before compression was under a pressure of 14.7 lbs. absolute, and after compression the pressure was 29.2 lbs. absolute, or 14.7 lbs. gauge pressure. The same comparison holds good for any other change, always provided that the temperature has time to adjust itself.

As an example, we may take a Westinghouse compound air pump having an L. P. cylinder 14½-in. dia. x 12-in. stroke, and H. P. cylinder 9-in. dia. x 12-in. stroke. The relative volumes swept out by the piston are 1,981.56 cu. ins. L. P., and 763.61 cu. ins. H. P., and assuming the clearance spaces for one end of both cylinders and the connecting ports to be 10 per cent. of the L. P. cylinder, or 198.15 cu. ins. If the H. P. piston is at the bottom and the L. P. piston at the top of its stroke, the contained volume between them is 1,981.56 + 198.15 = 2,179.71 cu. ins. Now let both pistons make a full stroke, and the volume between them is then 198.15 + 763.41 = 961.56 cu. ins., and the air is at 14.7 lbs. absolute. Then by Boyle's law we have 961.56 : 2,179.71 : : 14.7 : x, where x is found to be 33.3 lbs. absolute (or 18.6 lbs. gauge).

However, if we assume the temperature of the air to have been 60 degs. Fahr. before the compression, or 520 degs. above absolute zero, then for every 1/520th of the original volume that the air is compressed, the temperature will have risen 1 deg. Fahr. Thus we have 2,179.71 ÷ 520 = 4.19 cu. ins., or 1/520th of the original volume, and the total compression is 1,981.56 — 763.61 = 1,217.95 cu. ins., and if each 4.19 cu. in. represents 1 deg. Fahr. of increase in temperature, we have 1,217.95 ÷ 4.19 = 290.6 degs. Fahr., or 520 + 290.6 = 810.6 degs. above absolute zero (350.6 degs. Fahr.) Now in obedience to Charles' law, the pressure (which by Boyle's law is 33.3 lbs., i. e., if allowed to cool), will become 520 : 810.6 : : 33.3 : x, or x = 51.9 lbs. absolute (or 37.2 lbs. gauge).

This difference in pressure between 37.2 lbs. and 18.6 lbs., or 18.6 lbs. excess, is work done against the heating of the air during compression, and if the air is then stored in a receiver where it cools, before being used, to the normal temperature of 60 degs. Fahr., this work is lost.

In air compressors the heat is abstracted during the stroke as far as possible, formerly by injecting water into the air cylinder, but more recently all compressors have been made surface cooling. All the heat, however, is not taken out, but a large portion is, and is lost in any system, but economy is effected by the decreased resistance to compression.

When the energy stored in compressed air is to be reconverted back to mechanical motion there are additional heat losses incurred. As we have seen, there is a great amount of heat developed when air is compressed, so, also, as natural laws are reversible. There is an equal amount of heat consumed when compressed air is allowed to expand in order to perform that expansion. Thus, if, for example, 2 cu. ft. of air is suddenly compressed into 1 cu. ft. there will be a development of heat in the process, but conversely, if it be allowed to expand immediately and give out the amount of work which was used in compressing it, its temperature will be instantaneously reduced to about the temperature at which it stood before compressing, but there will be a slight loss due to radiation to the vessel containing it. If, however, this proceeding be altered by allowing the air while under compression to cool down to the temperature it had before compression, and then be allowed to expand to its former volume, doing work during the expansion, it will cool down just as before, and the fall in temperature will be equal to the rise of compression. In addition to this, if there is any water vapor present, as there always is in the atmosphere, it will behave almost like a pure gas, while the compression takes place, and also while cooling, but during expansion it will condense and even freeze, and to that extent its volume will have disappeared, so that the work put into it is lost, and the solidification may also cause mechanical difficulties.

Heroics of the Machine Shop.

The machine shop is not popularly regarded as an arena of hero making, but it has developed men whose bold originality has made the whole industrial world their debtors.

The nineteenth century witnessed advances in modern tool making that stamped some leaders as heroes of industry. In all lines of human endeavor the crying need has brought the man of action devising what the world was demanding. When deep mines were going to ruin in Britain because animal power could no longer pump out the water, Thomas Newcomer invented the atmospheric engine. When the stage coach and the carrier cart had become intolerably slow as methods of land transportation, Oliver Evans invented the high-pressure engine adapted to run over the face of the earth.

With great pumping stations, mills and factories calling for machinery, the hand lathe and the crude boring mill became obsolete. Swiss clock makers had invented a lathe that had a rest guided tool, and when the demand came Henry Maudsley enlarged that with a slide rest that brought forth the engine lathe. William Sellers evolved planing machines, whose tool finished surfaces were straight, straighter than most work retouched by file and scraper. Darling, Brown and Sharp devoted themselves to refinement of hand tools and produced appliances that incited the ambition of workmen to excel in masterly accomplishment. Pratt and Whitney produced cutters for gear teeth based on correct mechanical principles that manipulated correct work. Some one in the Niles Tool Works imagined an up-ended lathe, and evolved the modern boring mill.

But these were mere beginnings of machine shop developments in which the native inventive ability of Americans far surpassed the inventors of all other countries. Here accurate screw cutting machinery was developed; here the milling machine in all its varied applications came into use, and here were brought into activity a multitude of apparatus poems in metal that came to lift weary toil off men's bodies.

General Correspondence

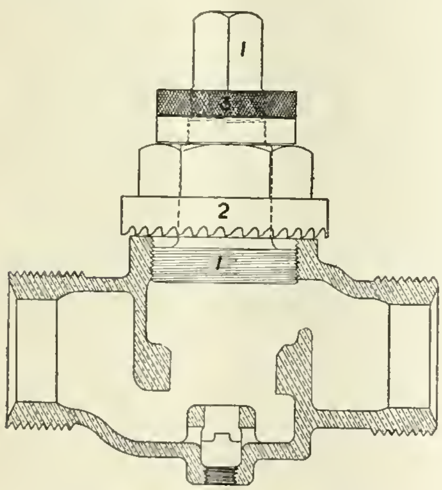
Saving Coal.

Editor:

I have seen locomotives with Baker-Pilliod, and Walschaerts valve gears, equipped with Allan balanced valves and set with ¼ in. lead, and 1/16 in. inside clearance. If the valves were set line and line, the valve having 1/16 in. inside lap, or what is known as negative lead, they would be better working engines, and would save at least 20 lbs. of coal per mile.

From personal experience I have also learned that the outer wall of the Allan valve should be strengthened by making the valve 1⅛ ins. lap. The back motion to be set with negative lead. We are experimenting in the direction of saving coal by proper valve adjustment, and the results are very gratifying. We are open to conviction. H. R.

Cincinnati, Ohio.



Check Valve Cap Seating Tool.

Editor:

The attached drawing shows a new seating tool that will be found to be very handy in engine house and machine shop work to face the top or flat joint to injector checks. The tool does fine work, and it only requires a few turns of the cutting tool to form a perfect joint.

1-1, is an iron plug that is adapted to screw tightly into the check which is threaded to receive the cap, and this plug acts as a support and centers the cutting tool. 2, is bored out and adapted to fit slidably on the plug, and is held down, and fed while being turned, by knurled nut—3.

This fine tool was invented by one of our machinists, Mr. A. D. Cunningham, and was a success from the start.

Charles Markel, Shop Foreman,
C. & N. W. Ry.

Clinton, Iowa.

Fallacies about Superheated Steam.

Editor:

In reading the September number of Railway and Locomotive Engineering my attention was particularly attracted to the article on superheated steam, page 377. While this is well written and very readable, yet, in the opinion of the undersigned, the author starts from wrong premises and naturally winds up with a wrong conclusion. As your publication is so widely read and as any article appearing therein uncontradicted is usually accepted as correct, I feel that if no exceptions are taken to the article in question the same wrong impressions may be strengthened that are so prevalent at the present, i.e., that the terms pressure and temperature as applied to steam are synonymous.

There is no question but what heat is the source of power and that in a locomotive the heat is utilized by the conversion of water into steam; but that the addition of heat to *steam* would result in an increase of pressure, as is claimed by the author of the article on superheat, is altogether wrong. In the first place, the pressure in a boiler is due to heat being imparted to *water*, converting a certain portion of the water into steam. When water has been converted into steam its volume is increased. As the space provided for this increased volume is restricted, however, the natural result of a large volume being confined in a restricted space means an increase in pressure, exactly the same as the pressure in an air reservoir is higher than the surrounding atmospheric pressure, although the atmosphere and the contents of the air reservoir are exactly the same, except that in the case of the air reservoir a greater volume of air is compressed into a smaller space.

The author of the article on superheat referred to makes a statement that "with a superheater the steam goes through the dry pipe, then to the superheater tubes, where it adds to its heat, etc., which can produce only one result, *higher pressure.*" That his premises are wrong can be easily seen when we take into consideration the fact that the boiler end of the superheater tubes is in direct communication with the steam in the boiler, consequently if adding heat to the steam in the superheater tubes resulted in an increase in pressure this pressure would naturally flow back through the open end of the tubes into the boiler, thereby raising the *boiler pressure.*

Referring to the use of packing hooks in the pop valve, he does not retain the excess *heat* in the boiler, but retains the excess quantity of *steam* due to the conversion of more water into steam. Undoubtedly the temperature of the steam at 190 pounds is higher than that at 140 pounds, yet it is the excess *pressure* that gives him the additional power, although this pressure, of course, was obtained by adding more heat to *water*, thereby producing a greater quantity of steam. That Mr. H. H. Vaughan is absolutely correct in regard to loss of pressure can be proven by any one interested by the use of an ordinary steam gauge.

In regard to covering the steam pipe running to the centrifugal pump with fire: While this was a very ingenious arrangement and highly creditable to its author, yet the conclusions he draws from this are incorrect, in

ERIE SHOPS AT MEADVILLE, PA.

that he did not make an outdoor superheater adding heat to the *steam* as it passed along, but simply added heat to the *pipe*, which prevented condensation. If the volume of steam passing through the pipe had been sufficient to raise the temperature of the pipe to its own temperature, so there would not have been so much condensation, his pump would have run just the same. In this instance he simply supplied by the external fire the heat that would otherwise have been taken from the steam.

In the concluding paragraph the statement is made that if you would boil water to 212 degrees F., let the steam go through zig-zag pipes through a furnace until it had absorbed 377 degrees of heat, you would find the gauge at the other end read 190 pounds above vacuum. It is hard to conceive how the author of the article in question would be able to force steam at 14.7 pounds pressure against 175 pounds in order to produce the condition stated. The subject of superheat is very interesting, but is not as thoroughly understood as it should be. This, however, is not strange, as its introduction in locomotive practice in this country has been quite recent, and nearly all the information published in respect to superheated steam up to the present time has been of such a highly technical nature as to make it uninteresting reading to the average railroad man.

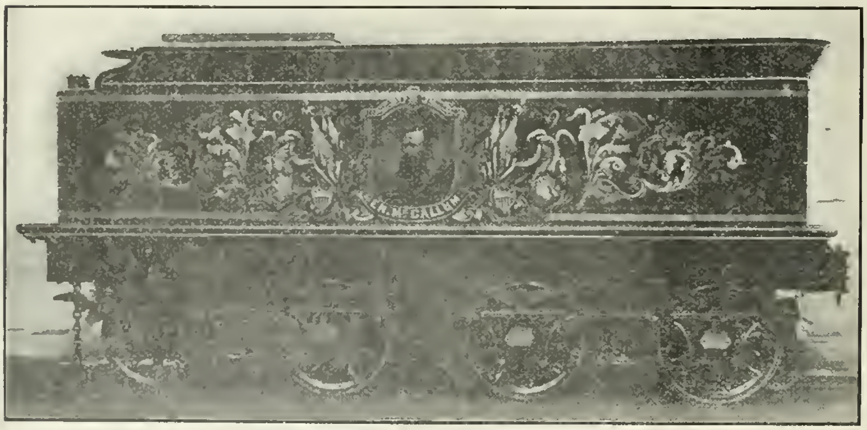
F. P. Roesch,
Master Mechanic, El Paso & South-Western System.
Douglas, Arizona.

Relic of the Civil War.

Editor:

The enclosed photograph of a locomotive tank is a relic of the American civil war. It was built by Mr. William Mason, the eminent New England engineer in 1864. There were painters as well as engineers in those days.

Constant Reader.
Taunton, Mass.



RELIC OF THE CIVIL WAR.

Flange Lubrication.

Editor:

I notice the report of the committee on flange lubrication of the M. M. Convention, of which Mr. Haig was chairman. This is indeed a fine report and will show to the railway officials the benefit to be derived from the new appliance. There were several things that were omitted in the report which should have been added. The most important one was the lessening of the number of wrecks. This is a certain fact, for it has been thoroughly demonstrated with us.

We are operating a railroad in a mining district, and, of course, we have a number of curves on our road. We operate 55-ton six-wheel switch locomotives, and since we have taken up flange lubrication our wrecks have been lessened 50 per cent. This sounds like a strong statement, but it is a fact. Though it is possible, a flange coated with oil, it is impossible for it to climb the rail and it will also take the curve better, lessening the liability of turning over the rail and save the machinery much hard work it would otherwise get by the stopping motion of the engine in going around the curves.

We handle with these engines 550 to 600 tons, with the lubrication much easier than we can handle 500 to 550 tons without the lubrication.

We are getting out of tire service between turnings 40,000 to 60,000 miles, where before we only got 10,000 to 17,000 miles between turning, and the life of the rail is being prolonged in an equal ratio.

I notice some articles objecting to oil being used on the flange of a wheel. They claim that the oil will cause the engine wheels to slip. This is indeed a very wrong idea, as oil is the only successful way of lubricating the flange. We have tried grease plugs and find a lubricant of this nature gets coated with sand picked up by the flange, and finally becomes coated so that the lubricant does not touch the flange.

I think the readers of this paper will in the future see that I am right on the question of the kind of lubricant for flange lubrication.

L. J. Mally.
Copperhill, Tenn.

California Pioneer.

Editor:

I see in a recent issue of Railway and Locomotive Engineering an old and familiar illustration from Mr. L. H. de Lude—a locomotive with the caption, "California Pioneer." It reminds me of old times. He desires some old-timer to tell him what particular build of engine it is. I have fired and run that engine, and it is still in use, running somewhere in the middle States. The Nos. 56 and 57 on the Canadian Pacific are the same. The builders were the well-known firm—Rodgers, Kitchem & Grosvener, afterwards the Rodgers.

I have a photograph of an old-time Baldwin, built in 1844, still in service at Santiago, Cuba, or was two years ago when I was there. I like to see these old relics of earlier years. They are much appreciated by us in the Railway Home here. This is a grand place, and it is pleasant for old "broken rails" like myself to have a home like this, and an opportunity of seeing your journal.

W. W. Snodgrass.
Highland Park, Ill.

Efficient Locomotives.

Editor:

Efficiency and economy seem to be uppermost subjects in railroad operation. That this economy extends to human endeavor as well as to the expenditure of money is well emphasized in the operating results of the new freight locomotives now being received by the Baltimore & Ohio Railroad. These engines, which are the largest and most powerful type of freight engines excepting the Mallets, are being delivered at the rate of two a day, and immediately upon arrival were placed in service. The Mikados have been distributed, 55 on the Philadelphia & Baltimore, 25 on the Cumberland, 14 on the New Castle, 23 on the Chicago, and 18 on the Cleveland divisions.

These larger and more powerful locomotives are hauling trains of considerably heavier tonnage than is handled by the ten-wheel locomotive which preceded them in the service, and for years were looked upon as the maximum in railroad efficiency. A notable feature of the Mikado engines is that they handle this increased tonnage while economizing in the consumption of fuel coal per mile, which means a lessening of the manual labor of the firemen.

These facts are the consensus of a statement made by a fireman of one of the Mikado engines at the Riverside roundhouse in Baltimore a few days ago, just after his arrival from Philadelphia with a train of 2,300 tons. The fireman has been employed by the B. & O. for some sixteen years. He looked admiringly at the great piece of machinery and pronounced it the most satisfactory freight locomotive he had ever fired. He explained that on the 176-mile run from Brunswick to Philadelphia the Mikados consume about eight tons of coal, while the smaller ten-wheel engines burn ten tons of coal on the same trip. A shovel of coal weighs about 16 pounds, meaning that the fireman on the Mikado engine had 280 shovelfuls less to handle than would have been the case on the smaller engine with less tonnage. This is a saving, the most remarkable of its kind that I have ever observed.

J. H. Baumgartner.
Riverside, Md.

Big Nozzles.

Editor:

There is hardly a mechanical department official in the country and very few engineers that do not advocate as large a nozzle tip in locomotives as can be used in the service required and with the fuel that must be used.

The drafting of locomotives with up-to-date front end appliances is a matter requiring considerable study, a little philosophy and theory combined with practice. We must know how the engine handles her fire almost in detail, after this information has been furnished, the fuel must be considered, also the firing, handling of the engine and service performed; instead of these details we generally get a report that "engine don't steam." After getting the necessary report on the performance, an idea is generally formed of what the trouble is, however, on opening up the front end our idea may get a jolt, in that conditions are found to be just what we thought they were not. Then it is time to observe everything minutely and find out why the engine don't steam. The reasons for this are almost too numerous to dwell upon. It may be a steam leak, nozzle stand, stack or lift pipe out of line, flues stopped up, lift pipe or stack too large or too small; lift pipe may be too high or too low at either top or bottom or both; grates may be too close, ash pans too tight, not admitting enough air to fire; front end may be getting air; there might be a hole in blower pipe or air-pump exhaust; netting area may be too small; baffle plate or diaphragm may be choking the draft; "making her steam" is generally easy as soon as it is determined why "she don't steam."

Choked engines are more common than over-nozzled engines, and of course energy and coal are both sacrificed in such cases.

The engine may be blowing, cylinders may be too large, or steam being used too extravagantly, but these instances are not so common.

I have personally enlarged nozzles on different occasions, thereby improving the performance of the engine by relieving back pressure, reducing flue trouble and coal consumption, and had a decided improvement in steaming qualities.

The right size nozzle cannot be prescribed for all engines of the same cylinder volume, neither can the exact location and size of lift pipe be prescribed for all engines with the same dimensions; in different localities, under different conditions of service, fuel, etc.

If everyone is satisfied that everything else about the draft appliances, valves, cylinders, etc., are as good as they can be made, then the nozzle must be worked on; possibly it may be too small, but if it is too large it must be bushed or bridged, for we must have steam to pull the cars.

The illustration of the man blowing his nose, offered in your May issue on page 192, is an exemplification, in my mind, that the exhaust had to be choked in order to get the required results. X. Y. Z.

K. C. M. & O. Ry. of Texas.

Operating Trains on Very Sharp Curves.

Editor:

Will you kindly tell a constant reader of your valuable paper where to find a scientific discussion of the laws governing or limiting length of trains on account of sharp curvature?

If there is no such discussion in book or paper, will you or some of your readers discuss or answer the following question?

Given a road with, say, 20-degree curves and unlimited power to haul trains of unlimited length at any given velocity, how can you find out the safe length of trains so that in turning those curves at said velocity there may not be danger of some of the cars going over or getting derailed on the inside of the curve?

J. C. Fobasco.

Cali, Republic of Colombia, S. America.

[We do not think there has ever been a discussion of the problem given by our correspondent, and we appeal to our readers to supply the information called for. We do not know of any railway having 20 degree curves (286.5 feet radius), but there may be such lines, and it would be a real courtesy if some one connected with the train service of such lines would answer Mr. Fobasco's question.—Editor.]

Superheated Steam.

Editor:

In the September issue of Locomotive Engineering appears an article on "Superheated Steam" by Mr. A. J. Schmidt, in which he gives his "view of it."

In some ways he has the right of it, but in other ways he is greatly mistaken, as when he says. "If you would boil water at 212 degs. Fahr., let the steam go through a zigzag pipe through a furnace until those molecules had absorbed 377.352 degs. Fahr., you would find your gauge on the other end would read the same as the former one, 190 degs. Fahr. above vacuum, about 175 degs. Fahr. gauge such as used on a locomotive."

Steam is a vapor formed by heating water to a point when the molecules fly apart—changing a liquid into a gas.

RESULT OF DOUBLE HEADER STANDING ON TRACK, AND DOUBLE HEADER RUNNING THROUGH FOG AT 20 MILES AN HOUR.

Dry saturated steam is vapor that contains just enough heat to keep it in form of a vapor.

Superheated steam is vapor that has been heated above the temperature of saturation.

Now, in locomotive practice, with an engine working saturated steam, the pressure varies with the temperature, and also the temperature varies with the pressure; that is, when steam enters the cylinders and strikes the cylinder walls, which are cooler than the steam, the steam gives up some of its heat, and is condensed, consequently lowering the pressure against the piston.

By running the steam through a superheater, which is a device for heating the steam on its way from the dome to the steam chest, it may then give up heat, down to the temperature of saturation, before any condensation takes place, and thereby save pressure.

For example: The temperature of saturated steam at 175 lbs. pressure is 377 degs. Fahr. If we superheat the steam we do so without adding to the pressure. Now we add, say, 75 degs. Fahr. to the temperature, we would then have a gauge pressure of 175 lbs. and a temperature of 452 degs. This steam could give up heat down to 377 degs. without condensing or losing any pressure, and that is the advantage of working superheated steam.

How Mr. Schmidt figures that he can start steam in one end of a pipe at 212 degs. atmospheric pressure, and by adding 165 degs. of heat he could raise the pressure at the other end to 175 lbs. is more than I can understand.

I do not want to be understood that by heating steam it does not add to the volume because it does, and if the volume is confined it will add to the pressure. But with a locomotive when, there is an open connection from the boiler to the steam chest, the pressure will equalize.

If we were to fill a vessel containing 100 cu. ins. with steam at boiling point, 212 degs. Fahr., the pressure would be nothing on the gauge, 14.7 lbs. absolute or atmospheric pressure. We superheat this steam by raising the temperature 165 degs. up to 377 degs., the law that governs the expansion of gases would govern here; that is, gas, like air, increases in volume 1/490th for every degree Fahrenheit above freezing point, so that this steam at 377 degs. would fill a volume of nearly 110 cu. ins.

If we keep this steam, that would fill a volume of 110 cu. ins. in a space of 100 cu. ins., the law of gases known as Boyle's law, would govern, viz.: If the temperature is the same the pressure varies inversely as the volume. The pressure would then be 16.17 lbs. absolute, or we would have 1.47 lbs. gain and about 1½ lbs. gauge pressure, instead of 175 lbs., as Mr. Schmidt figures it.

I do not think that superheat is generally understood, and there is considerable for most of us to learn. I only wish here, however, to correct the view given out by Mr. Schmidt.

George H. Travis.
Battle Creek, Mich.

Chordal on Master Mechanics.

In one of his inimitable letters written in 1879, Chordal, who did so much to popularize the *American Machinist*, remarked:

"The Railway Master Mechanics' Association meets in May in Cincinnati You'll miss it if you ain't there. This is one of the few societies which really gets together and does something. There ain't a dead man in it. It is not a square root or hyperbolic society, but is an association of hard working, hard-headed men, who get together and hold an expressive meeting.

The reports of their meetings are worth gold to the practical man, for they contain no theory whatever, but simple, hard, solid experience of the solidest set of practical mechanics in the world. Master mechanics go to the meetings each year to gather the experience of hundreds of men, while members of other societies seek only an opportunity to tell something. I never saw a man who had taken a degree seeking information from another man. He always wishes to impart. The master mechanic keeps mum and is always looking for the man who knows."

Rapid Locomotive Building.

A correspondent wishes to know what was the shortest time in which a locomotive was ever built. We suspect that our correspondent has been listening to some of the tales circulated around the waiting room stove and that he has heard about engines that were built in a week or less.

In 1876 or 1877 there arose some rivalry among railroad shops as to which could build a locomotive in the shortest time and some amazing hustling was the result. The people who engaged in this line of industrial rivalry talked of building a locomotive in so many hours or days, but all they really did was to put the parts together after they had been finished in the various departments. Our note book contains a variety of items under the head of Lightning Locomotive Building, from which we select the following which has the date of November 1877:

"The most remarkable feat on record in connection with locomotive building has been performed at the shops of the Michigan Central Railroad at Jackson, Mich., where, it is alleged, two new engines were completely put together and set in motion in a few minutes less than *three hours* from the moment the naked boilers were hauled into the shop. The work was done by two gangs of fourteen men each, to each individual of whom great credit is due for skill and celerity, as well as to the master mechanic and his lieutenants. What is the more remarkable is that the new born engines started immediately into the full use of their powers, and being attached to a train load of the jubilant employees, hurried off on a run of seventy-six miles, which was accomplished without heating a journal or bearing. If this remarkable work can be beaten we would like to know it. Races on engine building are now in order."

Calling Upon Employees for Cooperation.

The general manager of the Chicago Great Western has issued a bulletin to all employees, composed on the text "A Penny Saved is a Penny Earned." Make it a personal matter to make a systematic inspection of all material on hand—tools, stationery forms, empty ink bottles, etc. Anything that is of no immediate use in your department, tag and send to the general storekeeper, or deliver to the supply car when it reaches your station, with exception of stationery and ink bottles, which are to be sent to the stationery storekeeper at Chicago.

"Scrap" should be picked up and assembled at some central point, where it can be conveniently and cheaply loaded for disposal. Tools when worn out have a certain value, and should be turned in. True economy is not parsimony, and when by our individual efforts each employee aids in thus "picking up" the company's money, as he would if he saw a penny, a nickel, a dime or a dollar in his way, we are sure there will be a good showing of *dollars saved* by our knowledge and practice of the principles of conservation.

The bulletin also gives a list of prices of things used by station agents, enginemen, trainmen, bridgemen and section men. This price list gives the new value, second-hand value and scrap value of each article. The startling difference in these values should serve as a great incentive to employees to conserve all material possible. For example, a coupler having a value of $9 new is worth $7.50 second hand, and $1.80 as scrap. A ball-bearing jack, which cost $12 new, is worth $11.10 second hand, and only thirty cents as scrap.

Silver Goblets as Prizes to Engineers.

Once upon a time, when what is now part of the Pennsylvania Lines was called the Little Miami, Columbus & Zenia Railroad, a series of prizes were annually competed for by the engineers of the road. The prizes consisted generally of silver goblets. The prizes were given first for the greatest mileage without accident; second, for lowest cost of engine repairs. Three prizes were given under each head. We wonder if any of these goblets are still to the fore. We refer the question to our older readers. We have a record of seven goblets having been awarded in 1854. Few men who were pulling the throttle that year are now on deck, but the goblets may still be prized by proud descendants, and it would be interesting to learn of any of their whereabouts.

Pacific Type of Locomotive for the Atlantic Coast Line

During the present somewhat dull season it is interesting to learn that the Baldwin Locomotive Works has recently built for the Atlantic Coast Line 15 Pacific and 20 Mikado type locomotives, which will be used in through passenger and freight service, respectively. Heretofore, the heaviest road engines built by the Baldwin Locomotive Works for the Atlantic Coast Line have been of the ten-wheel and Consolidation types; the former being used in passenger service and the latter in freight service.

The new engines clearly illustrate the increase in relative boiler capacity which can be provided when trailing wheels are used. In the case of the passenger locomotives, for an increase in tractive force of 23 per cent. there is an increase in total heating surface of 32 per cent. The freight locomotives show a more striking comparison, as for an increase in tractive force of 17½ per cent., there is an increase in total heating surface of 45 per cent. The grades are comparatively light, and the new engines, while not among the largest of their respective classes, are of ample capacity to meet the requirements on this road.

Of the 15 Pacific type locomotives, ten are equipped with Walschaerts gear and the remaining five with Baker Pilliod gear. The steam distribution in both cases is controlled by balanced slide valves. The cylinder heads and steam chests are of cast steel, and the same material is used for the main frames, principal frame braces, driving-boxes and wheel centers. The rear truck is of the Hodges type, and is fitted with a vertical centering spring which is thrown into compression when the truck is displaced on a curve. The driving and truck axles are of "Standard" oil treated steel.

The boiler is of the wagon-top type, with a tapered ring in the middle of the barrel. The firebox is radially stayed, and all the water space staybolts are flexible. The tube sheets are braced by 18 longitudinal stays, consisting of short sections of 2-in. tubes welded to 1⅛-in. rods. These are inserted from the front, the rods being threaded into the back tube sheet and riveted over. The firebox has a brick arch, supported on four water tubes; and three combustion tubes, 2 ins. in diameter, are placed in each side of the water leg. These tubes are approximately on a level with the bottom row of boiler tubes, and are open at all times for the admission of air.

The main and auxiliary domes in this boiler are both placed on the third barrel ring. The opening for the auxiliary dome is 15 ins. in diameter, and the longitudinal seam, which is placed on the top center line, is welded throughout its length and reinforced by a ⅝-in. liner, which extends the full length of the seam. The joint is stiffened by the dome flanges on the outside, and an exceedingly strong construction is thus provided.

The Mikado type locomotives are generally similar to those described above, and interchangeable details are used where practicable. The boiler of the Mikado type has a straight top, but the general features of construction are like those described, and the fireboxes of the two designs are practically alike in dimensions and design.

The tenders have water bottom tanks and steel channel frames. The freight and passenger tenders differ somewhat in the arrangement of the trucks and running gear, but their capacities for fuel and water are alike.

The principal dimensions of the Pacific type are as follows:

Gauge, 4 ft. 8½ ins.

Cylinders, 22 ins. x 28 ins.

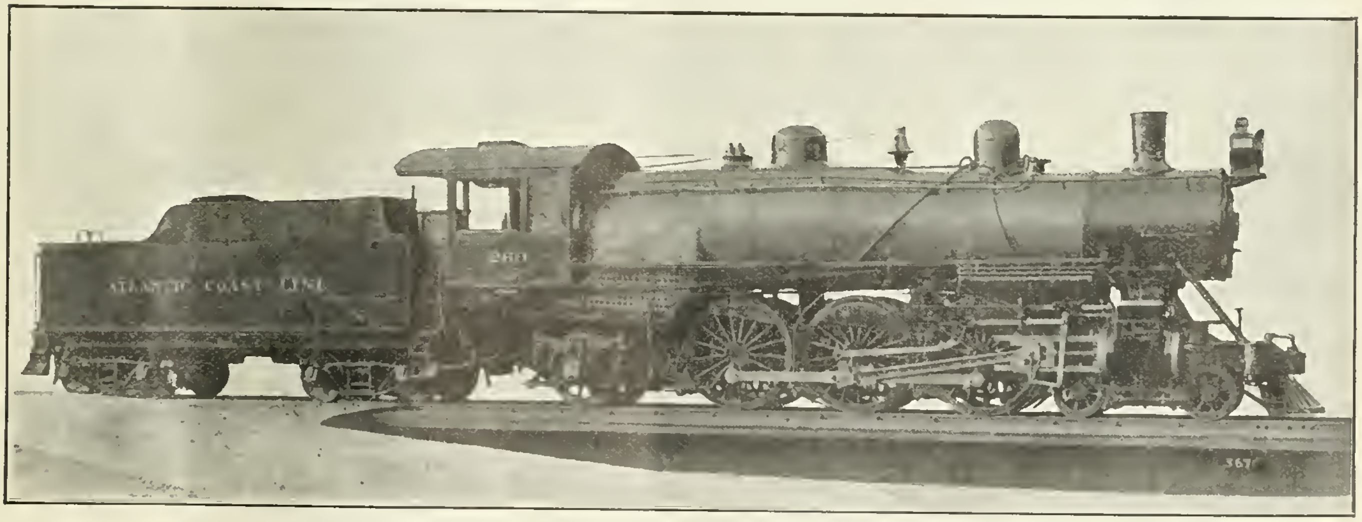
Valves, balanced slide.

Boiler.—Type, wagon top; material, steel; diameter, 66 ins.; thickness of sheets, 11/16 in. and ¾ in.; working pressure, 185 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 108⅛ ins.; width, 72¼ ins.; depth, front, 77½ ins.; depth, back, 69½ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water space.—Front, 5 ins.; sides, 4 ins.; back, 4 ins.

Tubes.—Material, steel; thickness, No. 11 W. G.; number, 310; diameter, 2 ins.; length, 20 ft. 6 ins.



PACIFIC TYPE OF LOCOMOTIVE FOR THE ATLANTIC COAST LINE.

R. E. Smith, Gen. Supt. of Motive Power.

Baldwin Locomotive Works, Builders.

Heating surface.—Firebox, 196 sq. ft.; tubes, 3,314 sq. ft.; firebrick tubes, 29 sq. ft.; total, 3,539 sq. ft.; grate area, 54 sq. ft.

Driving Wheels.—Diameter, outside, 72 ins.; center, 66 ins.; Journals, main, 10 ins. x 12 ins.; others, 9 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 31⅜ ins.; journals, 5¼ ins. x 10½ ins.; diameter, back, 50 ins.; journals, 8 ins. x 14 ins.

Wheel Base.—Driving, 13 ft.; rigid, 13 ft.; total engine, 33 ft.; total, engine and tender, 67 ft. 7¾ ins.

Weight.—On driving wheels, 138,950 lbs.; on truck, front, 39,550 lbs.; on truck, back, 42,350 lbs.; total engine, 220,850 lbs.; total, engine and tender, 365,000 lbs.

Tender.—Wheels, number, 8; diameter, 36 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 12 tons; service, passenger superheater.

Pleasant and Unpleasant Bosses.

There are sayings beginning: "Happy is the man who," etc. We have met many men who appeared always to be happy, and we have also met people who seemed to rejoice in being miserable. Various attributes and conditions contribute to people's happiness, but we do not know of anything that does so much to fill a person's cup of joy as having a faculty to make him or her work a pleasure. One's work is liable always to be with him, and if it is looked forward to with pleasing anticipations, the individual is certain to be happy.

We once knew two men who worked in a railroad machine shop on similar work. Brown carried about with him an air of jollity, good humor and contentment that had the happiest influence on all around him. Nothing ever happened to mar his perennial good humor. Smith was quite the reverse. No smile ever illumined his sour countenance unless something happened to hurt some one; then a grin of enjoyment would flash over his sombre face. Those who were intimate with Smith found that his favorite topic of conversation was the curse of work. He hated work from every standpoint, and took part in it merely because it was easier than starving. Brown, on the other hand, was free to tell that he became a mechanic from choice, that he liked the work, and always did his best on any job he was engaged upon.

In the course of time a foreman was wanted for the machine shop, and Arnold, the general foreman, who believed that "a man suited for a foreman's position must be ready to shoot around the rough edge of his jaw," got Smith appointed, although he was the poorest hand in the shop. Our regular stint of engines had been six a month, but a few months after Smith's appointment it dropped down to five. Blame was circulated concerning the cause of the shortage, and Smith spread the rough edge of jaw freely around to the effect that the mismanagement of Arnold was to blame. Reflections were freely made against the other foremen, but the general foreman got the worst from an industrious, wicked tongue.

The work turned out continued to diminish, and the master mechanic transferred Arnold to another division and appointed Smith general foreman. The rough edge of his jaw became tumultuous; but work output continued to lag. The various foremen received their share of the jaw, which was not received meekly, and a sort of quiet mutiny began to pervade the establishment.

The expenses of operating the shops were increasing, and the work turned out getting smaller, an undesirable fact that came to the notice of the general manager, who ordered an investigation. That resulted in Smith being fired. He went back to his lathe a year afterwards.

Changes kept going on, as they always do in such places, and one of the first moves made after Smith's downfall was the selection of Brown as erecting shop foreman. That happened ten years ago. Brown is now master mechanic of the road.

Soft Drinks for German Railroaders.

The Baden railway administration has organized canteens for the supply, at moderate prices, of non-alcoholic drinks to the railway personnel. Tea, coffee, milk, and mineral waters, as well as warm and cold food, may be obtained at these canteens, which are located at various stations, freight yards, and machine shops.

Though some of the older canteens sell wine and beer, the new establishments, of which there are now 68, supply only non-alcoholic beverages. The larger canteens make a special point of providing nourishing but cheap, hot dinners, and in some cases there is a special soda fountain.

Previous to the opening of the new canteens practically no lemonade or soda water was consumed by railway employees, but in 1908, under the new system, 734,846 bottles of soda water and 973,616 bottles of lemonade were sold at a very low price. At stations where no recognized canteen has been established the local caterers are compelled to supply non-alcoholic beverages, especially tea, coffee, milk, and mineral waters, as well as hot and cold food, to railway men at special prices.

Waste From Wheel Slipping.

Nearly all railway companies have adopted the policy of asking their employees to co-operate in saving expense of work and material wherever that can be done without impairing the service, and in most places the new policy is producing very satisfactory results. We notice, however, that small defects which cause much waste that could easily be remedied by engineers were sometimes neglected. On a road doing a heavy suburban business used by the writer, most of the engines have the waste pipes of the injector so secured that the drip falls directly upon the rail. This causes wheel slipping almost every time a train is started. When we consider the extra coal burned due to this wheel slipping and the unnecessary wear of tires, we conclude that the company pays quite dearly for what they no doubt regard as a defect unworthy of notice.

Savage French Railway Laws.

French railway employees seem to be notorious these days for acts that in other countries would be called violent insubordination, dictated by a spirit of anarchy. From what we know of French railway history, we think that the present sentiment of violent dislike cherished by the lower orders of French railway men to the government and to the managing officials is the result of long years of injustice, when the rank and file were ground to the earth by villainous laws and rules. Most countries visit accidents due to error of judgment with fair leniency, but the French laws for dealing with railway men used to be fiercely severe. One reads:

"Whoever shall have *involuntarily* caused personal injury by unskillfulness, imprudence, inattention or disregard of regulations, shall be punished by imprisonment of not less than one week nor more than six months, and by a fine not less than fifty nor more than one thousand francs. If he has caused death, the limits of the term of imprisonment are six months and five years, and of the fine, 300 and 3,000 francs."

Under such laws many men languished in prison for years because they had committed such crimes as running past a signal or for neglecting to send back a flagman.

Obstructing Prosperity.

The most prosperous class of people in the United States today are the farmers, and this good fortune has largely resulted from the easy means of transportation provided by railroads. Wisconsin has shared this betterment as much as any State in the Union, the value of farms and buildings having increased 80 per cent. in value during the last ten years. The value of railway property in the State has decreased in that time, and yet Senator La Follette keeps asserting that the interests of the State demand that railroad property be subjected to greater restrictions than they have hitherto endured. The persecution of railroad interests has frightened capital so that new railroad enterprise is prostrated, and all other lines of business suffer in consequence.

Our railways are the arteries through which the commercial life blood of the nation flows. The demagogues who agitate against railways obstruct the flow of the nation's life with resulting disaster. In all quarters we have the question repeated, why does the revival of business come so slowly? It revives slowly because the people with more jaw than judgment have dominated the nation's councils.

Developing Exact Measurements.

The world's work, which James Watt performed, was not confined to improving the steam engine. He worked zealously for the introduction of improved methods of measurements which were very inaccurate in Watt's time. The yard of Great Britain and the yard used in the American colonies were merely approximately the same. Having found out this confusing condition of the limit of measurement, Watt proposed to establish international standards to be intelligible and reproducible the world over. His views did not prevail, but others developed precise and uniform standards, which made possible the interchangeability of parts in machinery, which was first properly applied by Eli Whitney, inventor of the cotton gin.

Curious Bases of Lawsuits.

People having claims against railway companies have never experienced difficulty in finding laws under which railways can be sued; but the basis on which claims have been made for compensation for personal injuries inflicted by railways in Scotland are grotesque and illustrate the persistence of ancient laws in providing claims for justice.

At the period when the Romans first began to have intimate intercourse with the Scots, they were shocked to find that only pecuniary punishment could be inflicted for deeds of violence inflicted upon persons. A measure of value in these days was called the croo, and every person's life was valued by the croo and paid in croos, one cow being worth three croos. The King's life was valued at three thousand croos, the value of persons of lesser degree being estimated on that value to the community. Minor injuries were assessed on an established code the standing of the person regulating the value of the damage done.

The old Scots code maintains a distinction between God's law and Man's law. By the law of God a head for a head, a hand for a hand, a foot for a foot, etc.; by Man's law the life of a man thirty-one croos, for a foot a mark, for a hand a mark, for an eye half a mark, etc.

There has ever been in Scotland what is known as the law of assysthement, which counted that the slayer, if he might sometimes be a criminal, was always a debtor, and the adjustment of the debt to the life taken has been applied with new incites and variations in the charges to juries on questions of damages for railway accidents.

It is curious to hear lawyers in this twentieth century using the record of legal practices in use ten centuries ago, to assess the damages that ought to be paid by a railway company for the crime of killing an engineer.

When Locomotives Will Be Deprived of Water.

We have been for years thrown periodically into melancholy moods by reading the predictions of scientists of the comparatively short time that will elapse before the coal measures that contribute so much to the comfort of mankind will be exhausted, and now worse news has come to us in the scientific prediction that the supply of water may run short at no very remote period. The New York *Globe* has worried us by telling that Dr. McGee, a genuine scientist, who follows the form of investigation that uses weighing scales for testimony, scales that cannot lie, has found that the average individual uses directly or indirectly, about 4,400 tons of water every year. He drinks a ton. The vegetables he consumes require about 400 tons for their growth, and his annual meat supply of 200 pounds uses up no less than 4,000 tons of water. Using this figure as a basis, Dr. McGee shows that when the population of the United States has reached 1,017,000,000, which he thinks will occur about 2210 A. D., every drop of the annual rainfall will be required to maintain the food supply, and no further increase of inhabitants will be possible.

The present inhabitants of the entire world, estimated at about 1,500,000,000, can be increased to 20,000,000,000 if the total annual rainfall of the earth remains as it is today. That is, thirteen times the present population will crowd the earth to its limit. How far Dr. McGee's estimates will be accepted by other anthropologists and hydrologists we do not know. They leave quite out of account the question of tapping the oceans, which is at least a possibility. His speculation is an interesting one, however, and if no other necessity gives out before the water, that may prove to be, as he predicts, the ultimate limiting factor in population.

Responsible for Full Value of Baggage.

Many transportation companies have a self comforting way of making laws of how far they will be responsible for the value of packages assigned to their care; but when a test case comes before the courts their rules go for naught. An action was recently brought against the New York Transportation Company for $1,200 for loss of a trunk and the company pleaded that it was liable for only $100. The case came before the Court of Appeals, which gave a decision that the transportation company was responsible for the full value of the trunk. A similar decision has been repeatedly made against hotel keepers who claim that they are not responsible for loss of baggage.

Steel v. Wooden Cars.

The wooden walls of Old England, as the ships of oak were fondly called, did not yield without a struggle to the ideas of progress that brought into use iron and steel for shipbuilding purposes. The idea of building ships with substances that would not float was regarded as the height of absurdity, and the advocates of metal ships were for years abused as unsafe persons and semi-lunatics. After long years of experience with fragile, inflammable wooden cars the command has gone forth that the wooden car must go, as steel car builders immediately became so busy that nearly all leading railway companies have now several trains of steel passenger cars in service.

The advent of the steel car has brought its enemies into evidence, and the representatives of lumber interests are displaying wonderful activity in finding instances where the steel car got the worst of the shock when wood and steel came into collision. A few examples of this kind do not lead to conclusions worthy of serious attention, for every person who has been accustomed to clearing away wrecked trains has met with cases where certain cars were smashed to pieces, while others, acting the part of battering rams, suffered very little injury although no stronger in structure or material than the cars that were badly smashed. The amount of injury sustained by a car in a collision depends very much on the line in which the blow was delivered. If a car strikes another in the line of greatest resistance, which is in the line of the floor timbers, the damage is likely to be nearly even between the hammer and the anvil, but if either comes together on a weak spot, such as the side of the car, destruction will result.

A wooden car on steel sills can be made as strong as an ordinary steel car; but a wooden car is more dangerous in an accident because the wooden parts generally fracture into splinters which fly about and kill people, while the sides of a steel car cling together like a bruised tin can. Several years' experience with steel mail cars has proved beyond doubt that they are safer than wooden cars, and special pleading against the steel car by people interested in selling wood is not likely to prevent railway companies from favoring the safer material.

In 1856 the Erie Railroad advertised that the company was running express trains between New York and Buffalo, leaving New York at 7 a. m. Passengers were offered the option of stopping off for the night at any station between Corning and Binghamton, resuming the journey in the morning. The entire journey from New York to Buffalo is now made comfortably in eleven hours.

Mechanical Stokers Must Come.

Locomotive firemen are physically the hardest worked men in railway service. Trackmen have to bear the heat and burden of the day, but they do not labor under the constant spur that calls for the steam being continually kept close to the blow-off point no matter how fast the cylinders may be draining the boiler of its power supply.

We believe the day will come when mechanical engineers will look back with amazement upon the conditions which required firemen to toil like beasts of burden maintaining steam, when power was at hand to perform the work mechanically. This power will be eventually employed through the medium of mechanical stokers, which are certain to come, although their development has not been so expeditious as many of us expected.

Railroad companies are reported to have difficulty in finding men of sufficient physical stamina combined with the intelligence to accept the position of fireman; but we anticipate that the mechanical stoker will end this cause of embarrassment, and that within a very few years. When that form of apparatus comes to be perfected, the work of a fireman will be no more arduous than the work of the engineer. He will have a machine which will call for constant attention and some skill, but no drudgery. There are already in use five or six mechanical locomotive stokers that do the work of firing, as well as the injector, performed the work of boiler feeding for five or six years after it was introduced. If the injector had been left to the tender mercies of enginemen when it was first applied to the locomotive, it would have experienced a brief career. The secret of its success was that the manufacturers were influential persons who insisted that the instrument should have fair treatment. We do not assert that the mechanical stoker has been habitually abused or its value underestimated; but it has frequently gone to the scrap heap, when a little sympathetic attention would have kept it at work.

Seeing and feeling are two senses which are most important in aiding a knowledge of our surroundings than any others, and yet their education is nearly always neglected until the possessor begins to learn something of mechanics. By mechanics, in this connection we mean any attempt to construct, put together, design or change something by manipulation, things that girls turn to more readily than boys, for nearly all girls interest themselves in changes of garments.

Shop Test Rack.

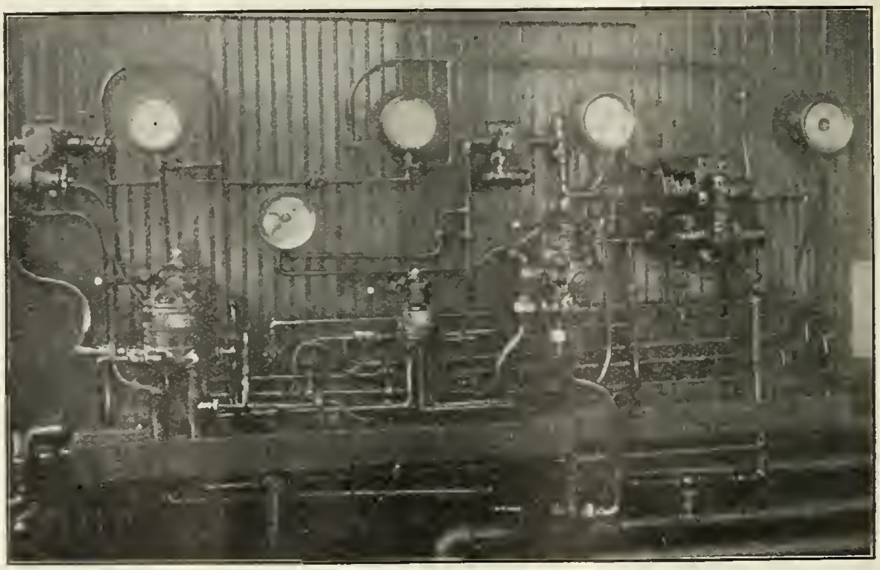
In this issue are reproductions of two photographic views of improvements in and additions to the shop air-brake test-racks, which were described in the January (1911) issue. That issue contains a complete code of tests for the cleaned or repaired distributing valve which will not be referred to at this time, except in a general way.

The illustration will show that a G 6 and S 3 brake valve have been added, and those types of valves, as well as the H 6 and S 6 can be tested on this rack.

Gauges registering the various pressures employed, are suitably connected and the storage reservoirs, supply and connecting pipes are on the opposite side of the wall against which the test-rack is installed. There are stop-cock arrangements, by means of which either large or small volumes of air pressure can be controlled by the different equipments, pressure, from the straight air-brake valve, passes through one end of the check valve, and pressure from the distributing valve through the other end, thus air pressure from either the distributing valve or straight air-brake valve must pass through two check valves before entering the brake cylinder, which serves as an automotic cut-out for all brake valves.

Stop cocks and valves are arranged in a manner that the triple valve can be operated by means of the H 6 brake valve or the distributing valve can be operated with the G 6 brake valve, but in order to operate the valves in this manner, the cut-out cocks must be turned by hand.

The duplex air-gauges, reading from left to right, register the following pressures: First gauge, main reservoir and equalizing reservoir, pressure for the H 6 brake valve; second gauge, straight air-



SHOP TEST RACK.

which permits of accurate leakage tests and also arranges an approximation of actual conditions encountered in train service.

All the brake valves can be operated at the same time and but one brake cylinder is used for all valves and all tests. By the use of two double-check valves and the piping arrangement, all equipments operate on the one cylinder without the necessity of cutting out or closing any stop-cocks, that is, the movement of one brake valve handle or rather the operation of any one brake automatically cuts out all the rest.

This is accomplished by locating one check valve so that air pressure from the triple valve enroute to the brake cylinder passes through one end while pressure from the distributing valve passes through the other; and the second check-valve is located between the straight air-brake valve and the distributing valve brake cylinder pipe in a manner that brake cylinder pressure, which is also reducing valve pipe pressure and distributing valve release pipe pressure. Third gauge registers brake pipe and brake cylinder pressure for the H 6 brake and the fourth gauge, main reservoir and brake pipe, pressure for the G 6 brake valve, while the fifth gauge shows pressure chamber and application chamber pressures in the distributing valve reservoir.

Release pipe pressure is shown at all times, so that any movement of the equalizing valve toward release position, while the automatic (H 6) brake valve handle is on lap position, will be instantly shown. which is often found to be of advantage during a distributing valve test.

The G 6 brake valve can be cut in to the distributing valve in an instant, and this is generally done when the graduating valve and quick-action check valve are being tested for leakage during the distributing valve test.

The reducing valve controls the pressure for both straight air and independent brakes, and standard one-quarter inch drain cocks are used to drain the application chamber and pressure chamber of the distributing valve, as it is often desirable to drain the pressure chamber previous to removing a tested distributing valve, or when repeating a charging or packing ring leakage test.

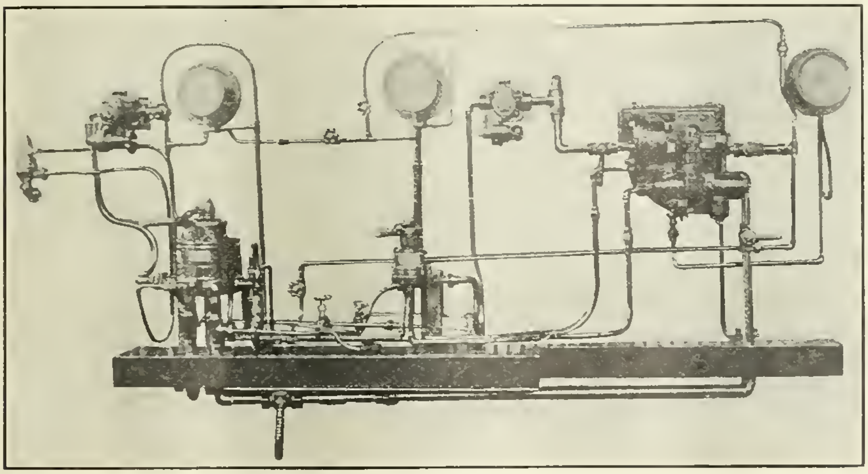
A quick recharge for the pressure chamber is also provided by means of a globe valve through which main reservoir pressure can be admitted direct, and similarly a globe valve and main reservoir pressure are used in adjusting the E 6 safety valve; consequently there is no opportunity for the equalizing valve of the distributing valve to assume service lap position during the operation and thus interfere with the adjustment. This also avoids the necessity for a change in the adjustment of the reducing valve or using the automatic brake valve in emergency position in order to adjust the safety valve to 68 lbs.

As the view of the rack will show, there are a number of globe valves located in the gauge pipes and in the branch lines between several connections, which can be used to connect different chambers and cavities of the valves, and, if used, will show the actual effects of the principal defects that are likely to be encountered if the distributing valve or other parts are neglected for a sufficient length of time.

By this method the effects of various disorders peculiar to the H 6 brake can be shown without any lengthy explanation, in which the individual's words, and sometimes his opinions, must be accepted.

While the rack piping arrangement, as shown, is not entirely necessary for shop use, it is very convenient at times when differences of opinion may lead to an argument that calls for a demonstration.

However, the parts of the rack that permit of a thorough test of the distributing valve before it is returned to service is essential to the shop in securing an economical maintenance of distributing valves, to say nothing of the advantage derived from having all the parts of an H 6 equipment in first-class condition and available for use at all times. This is important at points where specially trained air brake men are not on constant duty, as it insures that the valve to be applied to the locomotive is in good condition, which avoids guesswork and mistakes that result in tearing apart the wrong valves, resulting in delays and scarcely passable repair work when the operation is finally completed.



DISTRIBUTING VALVE TEST RACK.

Lubricant for Cutting Threads.

For cutting threads in copper and even steel, one of the best lubricants is common beeswax. Rub the partially finished threads with a lump of the wax and a clean thread will be cut, providing the tool is sharp.

Locomotive's Record Run.

Two new fast locomotives, to be named "King George" and "Queen Mary," have been built at the Crewe works of the London and North-Western Railway. One of them on trial accomplished an astonishing feat of traveling from Euston to Crewe, a distance of 158½ miles, in 156 minutes with a load of 400 tons.

This speed—a fraction under sixty-one miles an hour for the run—is a record for the distance, though over shorter distances higher uniform speeds have been attained. The run from Darlington to York, on the North-Eastern Railway—forty-four and a quarter miles—is made at an average speed of 61.7 miles an hour, and from Forfar to Perth, on the Caledonian, at a speed of 60.9 miles per hour for the thirty-two and a half miles. This is enough to make Mr. J. A. Middleton of the Lehigh Valley envious, but we expect to learn that this record will soon be beaten on American railways.

To Write on Metal.

To write inscriptions on metals, take half a pound of nitric acid and one ounce of hydrochloric acid and mix them well together. Cover the part you wish to mark with beeswax, then when cold, with a sharp instrument, write the inscription plainly on the wax clear down to the metal, then apply the mixed acid with a feather, carefully filling each letter. Let it remain from eight to ten minutes, according to the depth required; then wash with water and the job is done.

Zinc Treatment of Water.

Information has come to us several times lately of railroad companies experimenting with zinc in boilers to prevent corrosion, but the results were not satisfactory. This is a remedy which has been frequently tried for many years, but its effects have been by no means uniform, in some cases it would prevent both corrosion and the formation of scale; in other cases it seemed to have no effect whatever. Unless the zinc put into a boiler sets up galvanic action it is likely to do no good. The production of galvanic action will depend upon the character of the feed water. We advise people thinking of trying the zinc treatment to consult the Dearborn Drug and Chemical Company or some other concern skilled in water analysis to find out the probable effect of the treatment.

Duties of a Station Agent.

There is a popular saying that the duties of a housewife are never done. The same may be said of an efficient station agent.

A commercial training school for station agents in one of our large cities thus describes the duties of a station agent: "Be ambitious and not afraid to work; keep your office and freight house neat and clean, especially the windows and floors; keep everything in its proper place; be courteous to everybody you come in contact with; compare your accounts with previous year, and make special effort to increase your business; visit your customers as often as possible; make inquiry if their business is being handled satisfactorily; if they have any criticisms to make, try and better the situation. Be particular in making out your reports to the different officials; see that they are correct, written plainly and neatly, and forwarded to the respective offices on time. The last but not least relates to your personal appearance. Always wear a clean collar and keep your shoes polished; appear as neat as possible.

Questions Answered

TELL TALE HOLES IN STAYBOLTS.

94. R. S. B., Atlanta, Ga., asks: Is it more economical to drill staybolt tell tale holes before or after being screwed into boiler?—A. The question of economy as to the drilling of tell tale holes before or after bolts are applied is regulated largely by the extent of repairs and the quantity of staybolts made. In the larger shops several lengths of staybolts are carried in stock threaded and drilled. In smaller shops where there is no considerable stock carried the drilling is done after installation. Recently a riveting plug has been attached to pneumatic hammers, the plug being inserted in the tell tale holes during riveting, and leaving a chamfer which exposes the hole more clearly. The advantages in carrying a supply of stock and the use of the most improved tools is however a question that must necessarily be left to the requirements and capabilities of the particular shops where the operations occur.

LEAK IN BY-PASS VALVE.

95. S. F. A., Buffalo, N. Y., asks: What is the best method of testing for a leak in a by-pass valve?—A. Cover the steam ports by moving the reverse lever until the rocker arm is plumb, or move the engine until the ports are covered on the side to be tested. Then open the cylinders, cocks and open the throttle valve sufficiently to allow steam to pass through to the by-pass valves, and the leaking by-pass valve will allow the steam to pass through to the cylinder cock on the side in which the leaking valve is located. In case it should not be convenient to refit the valve, it may be closed by a blind gasket.

WEAR OF CYLINDERS.

96. J. B. H., Pittsburgh, Pa., writes: In the boring out of one of the cylinders of a locomotive I observed that the wear of the cylinder was mostly on the top. I had presumed that cylinders wore mostly on the bottom. What does this signify?—A. It is a clear proof that the guides were not properly lined up. The greater wear should be upon the bottom, owing to the weight of the piston and rod even when a sustaining rod projects through the front cylinder head. It is noteworthy, however, that some cylinders, on account of the variation in thickness of the parts, are of harder metal in the bottom than on the top and inner side. This arises from a more rapid cooling of the casting in the thinner parts.

STANDARD SCREW THREADS.

97. C. M. P., Wheeling, W. Va., writes: A group of shopmen were talking about standard screw threads and there was some diversity of opinion concerning the origin and the dimensions of United States Standard screw threads. One of the group who was well posted said that the standard screw threads were introduced in England by a man named Whitworthy and copied in this country by Pratt & Whitney, machine tool makers, who forced the standard screw threads into use by making taps and dies that conformed to the Whitworthy sizes. I have an idea that William Sellers had something to do with the establishing sizes of screw threads but I am uncertain about the facts. Can you enlighten us?—A. The United States Standard screw threads were invented by William Sellers and was first brought before the public in a paper read before the Franklin Institute and the system was for years known as the Sellers' screw threads. British manufacturers and engineers use what is known as the Whitworth screw threads, which are different from the Sellers or United States Standard. Dimensions of the screw threads can be found in the Master Car Builders' annual reports or in any good engineering hand book such as Kent's.

HORSEPOWER OF LOCOMOTIVES.

98. T. H., Belfast, Ireland, writes: In answer to a question recently published in your columns I observed that you gave a rule to find the horsepower of a locomotive as follows: Multiply the tractive effort by the speed in miles per hour and divide by 375. From whence does the figures 375 come? I figured out a few examples and the horsepower was 75 per cent too high. In getting the tractive effort 85 per cent. of braking power was used. Would this be the cause of horsepower being too high?—A. In the absence of T. H.'s figures we cannot state wherein he erred. The figures 375 are taken from tables of constants used by all the leading engineers and published in many standard works. The result could readily be proved by the common rule established by James Watt and modified in the latter part of the last century as follows: Multiply the area of the piston in inches by the mean pressure per square inch, and by the piston speed in feet per minute, and divide the product by 33,000, and the quotient will be the indicated horse-power. It should be borne in mind that the pressure of steam in the cylinder should not be reckoned from the pressure of steam in the boiler. The ratio of expansion and the point of cut-off determines the cylinder pressure. In locomotives 10 per cent. should be deducted on account of friction.

BROKEN SPRING HANGER.

99. H. L. Cerro de Pasco, Peru, writes: Please advise us as to the proper way to proceed if a spring or spring hanger breaks on the road, the springs being equalized to one another.—A. In breakages of this kind the frame will naturally fall to the top of the driving box and the first operation should be to raise the frame. This may be done either by jacking or running the wheels up on wooden wedges laid upon the rails. The jacking process is slowest but surest. In running up on wedges there is always danger of derailment. By either method a block of wood should be put over the rear box. The rear wheel may then be run up on the wedge, thus lifting the frame and relieving the front or main box of its load. The rear wheel may then be run down. Stirrups and hangers may be removed when necessary and blocking placed between the equalizer and the frame. Sometimes it may be necessary to block all of the driving boxes on one side. Much depends on the particular spring hanger that may be broken. The front wheel may be run up on a wedge as readily as the rear wheel, with the result that the adjoining driving box is relieved of its load. If the breakage occurs at the front or rear the main wheel should be raised.

FIRST LOCOMOTIVE IN AMERICA.

100. Apprentice, Buffalo, writes: To settle a dispute several of your readers would be obliged if you would answer the questions: What was the first locomotive to turn wheels on a railroad on the American continent? What railroad owned the engine and what was the form?—A. The first locomotive tried was the Stourbridge Lion, built in England, for the Delaware & Hudson Canal Company. The engine was carried on four wheels with vertical cylinders and was known as the "grasshopper" type. People looking for information of this character ought to consult Sinclair's Development of the Locomotive Engine.

REMEDY FOR BAGGY EYES.

101. Engineer's Wife, Kansas City, Mo., writes: It may not be exactly in your line to answer the question I am about to ask, but as I am a "constant reader," of RAILWAY & LOCOMOTIVE ENGINEERING, I am going to risk it. My husband, who is growing old, has grown to have small baggy swellings under his eyes and I notice that many train men suffer from the same defect. Can you tell of anything that will cure these swellings?—A. Rub the parts from the eyes outward with eau de cologne and afterwards anoint the spots with cold cream.

The Heroes We Worship.

No matter what may be said to the contrary and no matter how little we like it Americans are at heart hero worshippers of the most rabid type. The gullibility with which we accept the George Washington cherry tree story is sufficient proof of the fact.

In recent years we have taken supreme pleasure in muckraking the careers of our contemporaries. Lurid and hectic writers have shown us how some of our favorites have stolen cartloads of money and caused buckets of blood to be shed in the operation. It has pleased us mightily to see these petty heroes and demigods fall before the onslaught of the space writers. The chance to chuck our would-be great men in the ribs tickled us half to death. But the few brave men who have tried to show us the weakness of our national heroes have been treated as men and fools.

In reality, however, human nature is much the same whether disguised as a ditch digger or a statesman. There is an old French proverb which says that "No man is a hero to his valet," and the biographies of great men of all times and countries have borne out the truth of the assertion. Carlyle tortured his wife and Donizetti acted the brute to his family, while Rousseau abandoned his; Bacon trafficked with justice; Villon became a thief and Casanova was accused of swindling. Most foreign celebrities have been made to totter on their pedestals, but we hold up a warning hand to all who attempt to touch our own.

Building Railway Rolling Stock in Newfoundland.

The people of Newfoundland are becoming ambitious to make their mark as manufacturers of appliances that will make them independent of even Canadian products. As Mr. W. D. Reid and his sons have shown Newfoundland people how to construct railways they are now moving to instruct the people how to make the machinery required to operate the lines in operation.

Last month has been considered epoched in Newfoundland history because a new locomotive entirely built by the Reid Newfoundland Co., and the first ever built in the colony, pulled out a train, each car of which was also built by the same company. The train consisted of the engine, two first-class sleeping cars splendidly equipped, a mail coach, and baggage car. A run of 20 miles and return was made. The engine worked to the entire satisfaction of the company, and is considered by them equal, if not superior, to any of the engines on their road. It is the intention of the company to continue the construction of locomotives for their use, as well as more cars.

Steamer That Used Smoke Stack as Mast.

The development of steam navigation witnessed many curious inventions designed by people having more ingenuity than common sense. One of the first steamers operated upon the Clyde was the *Comet*, built by Henry Bell in 1811, a close rival of Robert Fulton. Among the curiosities of her equipment was a method of hoisting a sail on the smoke stack. She was also at first fitted with an arrangement of two distinct sets of paddles on each side, connected with each other, and with the engine by spur gearing. Her crew of eight included a piper, possibly to encourage the timid voyagers who were apt to desert the little steamer hurriedly at Bowling lest she should "blaw up and sen' them a' fleein' in the air."

The Miraculous Ell.

Once upon a time Edward First, King of England, was ordered by the Pope to explain why he was imposing English laws upon Scotland and tyrannizing over that country, which was an independent country. In the course of a laborious defense, King Edward said: "King Athelstane of England had under the auspices of St. John of Beverley, suborned a rebellion in Scotland. Having finished his work he prayed through the intervention of the same St. John, that it might be granted to him to receive a visible and tangible token by which all future ages might be assured that the Scots were rightfully subject to the King of England. His prayer was granted in this way: Standing in front of one of the rocks of Dunbar, he made a cut at it with his sword, and left a score which proved to be the exact length of an ell, and was adopted as the regulation test of that measure of length.

When this story was reported to his Holiness he remarked: "Give King Edward an inch and he will make an ell," asperating the miraculous measure.

Get Good Sand

We believe that no material purchased by railway companies receives so little attention concerning quality as sand. Yet the use of inferior sand is one of the most expensive mistakes that can be made, and in many cases increases the tendency to slip instead of restraining it. We believe that J. H. Watters, assistant M. M. of Georgia Railroad, Augusta, Ga., who handles the best sanding device on the market, has some good rules for the selection of sand. We advise people interested in this very important subject to communicate with Mr. Watters.

Tool and Mild Steel.

In a great many shops very little attention is given to the steel corner, rack or box. In some the most popular place is the floor. Very often machinery and tool steels are piled together in one heap, and when the machinist goes to secure a piece he has to guess which is which. There are any number of means for finding this out, but a quick way to test the metal is to touch the end lightly against a dry emery wheel and watch the sparks as they strike. A tool steel gives forth a spark which seems to burst into a bright point of light when it strikes against the frame of the grinder, while that from machinery steel is merely a dull red incandescent particle. All air hardened steels give forth bright red sparks.

Will Be Cold Days for British People.

In looking back over the life of a nation 175 years in a small section extending from the present time to 1736, the year James Watt was born, nine years before Bonnie Prince Charlie stirred Scotland in striving to gain possession of the Stuart crown. The president of the British Association, who is not likely to be guilty of making unreliable statements, has made public a calculation that the coal supply of the British Isles will be exhausted in 175 years. It will be cold days for people remaining in the British Isles when no more coal remains to be mined.

Wonderful Panama Map.

Mr. E. B. Leigh, president of the Chicago Railway Equipment Company, has visited the Isthmus of Panama and as a souvenir of his visit has published a relief map of the canal and surrounding country. The map represents what a man up in a balloon four or five miles above the Isthmus would see if he was endowed with a million magnified eyesight. The map gives a better idea of what the canal and its surroundings look like than any other method of illustration. It is called an Aeronautical View of the Panama Canal. Railroad people anxious to enjoy this view and possess the admirable map, should make their wishes known to Chicago Railway Equipment Company, saying that they are acting on our advice.

Polishes for Brass.

Sift coal ashes fine and mix with kerosene oil to a thick paste; add as much air-slaked lime as can be conveniently mixed with it. Apply this polish to the bright parts, rubbing hard; wipe off and polish with dry slaked lime.

Whiting and ammonia mixed to a paste is another good polish for brass. Apply and rub dry.

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State Operated Railways.

While touring in Europe last summer President W. C. Brown, of the New York Central Lines, devoted his attention between agricultural conditions and railway operations. He enjoyed a long tour through several countries of Continental Europe, with England and Scotland added. Like nearly all observing travelers, Mr. Brown found the state managed railways miserably operated, with the French state railways in the undesirable lead. We hear frequent predictions made by public speakers that it will be good for the people of the United States when state ownership of the railway system becomes an accomplished fact. We in the United States have had some experience of state managed railroads, and if the lessons of experience are worth anything, they teach that private ownership counts for efficiency and State ownership for mismanagement. Expensive and inferior service is what has come to people of European countries that have tried the experiment of railway operating. Australia has state operated railways, and the reports of people familiar with railway operating the world over inform us that there is little to choose between the railways of Australia and the worst managed in Europe.

The only exception to mismanagement accompanying state ownership of railways that we know of is Canada, the railways of which belong to the commonwealth, and are as well managed as any in the world. This happy state of affairs arises from the Canadian government having put the management of the railways into thoroughly competent hands, into the hands of first-class, practical railway men, and kept them there without the pernicious influence of political interference. Such a desirable condition of affairs could never be expected to be repeated in the United States, where grasping politicians are ever scheming for personal advantages.

Referring to the labor situation in Europe, Mr. Brown said: "They are just commencing the solution of the labor question. Labor is beginning to realize its power and mobilizing itself. Railroad rates there are much higher than ours, and wages average about 50 per cent. lower."

Heroic Action.

A friend having questioned the late E. H. Harriman about what he considered his greatest achievement, received this reply: "The most simple thing we did and which gave the most satisfaction was this:

"The Colorado River was flowing over, threatening thousands of irrigated acres in the Imperial Valley, which would have meant destruction to the lands and ruin to many settlers. The situation became more and more serious, the government's efforts to control the river proved unavailing, and finally President Roosevelt telegraphed me to ask whether the forces of men and engineers we had could and would undertake the work of saving the situation. I wired our representative and asked him how long it would take to dam the flood and change the course of the river and what the expense of the undertaking would be. He reported that it would take such and such a time, that it would be a race between us and the flood, with our having a margin for safety, provided he took every man within reach from all other jobs and put him on this one, and provided he was allowed to proceed regardless of cost. He estimated the total expense at a somewhat startling figure, and added that most of it would be lost if we did not finish in time. I gave direction to suspend all other work, and to give this job the right of way over everything else, regardless of disturbance of traffic or of expense, and I telegraphed President Roosevelt that we could and would undertake the task of saving Imperial Valley. And then we started on the race with the elements, and I used every ounce of driving power I possessed to hustle the job as I had never hustled any job before. We beat the flood and averted untold loss and suffering. That was the best single bit of work done on my authority and responsibility."

The Exhaust Pipe.

We are frequently in receipt of questions in regard to the size of exhaust nozzles and their relation to the size of cylinders, and while we invariably furnish the questioners with answers in regard to what is considered the best practice, it is very likely that the troubles which may occasion such queries may not be in the size of the nozzles, but in the relation of the exhaust pipe to the smokestack.

The dimensions are, properly speaking, the work of the constructing engineers, and unless very exceptional circumstances, should not be interfered with. Their proper adjustment is in the hands of the mechanics, and frequently do not receive the attention that their importance calls for. Not only should the exhaust pipe point exactly to the centre of the smokestack, but both should be set perfectly plumb when the engine is leveled. In new work the exhaust pipe should first be placed in proper position and the smokestack adjusted so as to be exactly over the centre of the exhaust pipe. It will be noted that the volume of exhausted steam in locomotive running is not always alike, and whether the draft on the fire is induced by a compact volume of steam filling the smokestack and producing a vacuum into which the air rushes, like water following a pump plunger, or whether the steam is merely a jet occupying only a limited portion of the circle of the smokestack and so inducing draft, largely by friction of the particles of air, it is in either case of the utmost importance that the blast or jet should be in the exact center. If the exhaust steam expands sufficiently in its upward progress to fill the smokestack at its base, a low pressure of exhaust steam will create a strong vacuum which will be equally felt in every part of the fire. On the other hand, if the exhaust steam strikes unevenly in the stack, leaving a portion of the stack untouched by the expanding jet of steam, the effect on the fire is of the most pernicious kind. The evil is increased if a portion of the exhaust jet strikes a side of the inner edge of the stack. This is often the case where low nozzles are used, and also in the case of double nozzles.

Not infrequently the form of the exhaust pipe is the cause of trouble. Exhaust pipes that have a bend or set in them in order to bring the nozzles in line with the centre of the smokestack invariably injuriously affect the steaming qualities of the engine. It has been repeatedly demonstrated that a straight exhaust pipe will cause the jet to retain a straight direction, whereas pipes of a bending form, even if straight for some short distance at the nozzle, have the effect of causing the exhaust steam to flare or spread. This is especially the case where the straight part of the exhaust pipe is short. The exhausted steam from such pipe spreads violently, as also in the case where short bushings have been inserted in the end of exhaust nozzles.

These defects are sometimes so radical that it might be marveled why they are not more readily discovered. Frequently the rapid condensation of the exhaust steam into water will show itself on one side of the netting, or one side of the smokestack, and when this is the case an uneven condition of the fire, and consequently lack of good steaming qualities, may be expected.

Indeed, the proper adjustment of the exhaust pipe in its relation to the smokestack may be looked upon as of vital importance in locomotive construction, and in investigating the causes of defective steaming qualities, it is well to begin by examining the alignment of the smokestack and exhaust pipe.

Railway Business Association Dinner.

"Temperate talk and sober public opinion helps business," is the sensible motto of the Railway Business Association. This association will enjoy its third annual dinner on the 22d of this month, and is certain to be a highly successful affair. Mr. George A. Post, the president of the association, has active management of the arrangements for the dinner, which means that nothing will be neglected calculated to make it a success. He has already engaged several eminent speakers who have sound ideas concerning the business needs of the country, which means that they can tell what is needed to make the country, and therefore railroad interests prosperous. We believe that the call for tickets is already sufficient to fill the largest dining hall in New York, and the occasion will be a memorable one to all who will have the honor of being present.

Prepare for the Examination.

In connection with The Catechism of Railroad Operation last month, we commented upon the necessity for those having examinations to pass to begin preparation in good time and not to procrastinate until the day of trial was near at hand. In the course of a recent tour, during which we met five road foremen of engines, they all manifested keen interest in the advice we had been giving about preparing our examinations, and the general sentiment was "keep up the good work." The good work we wish again to do over is, take up at once the studies that will enable you to answer properly the questions asked you by the examiner, and acquire the habit of applying the questions to the locomotive during your daily duties. A beginning of study is always hard for people who have not been accustomed to mental exercise; but we say, begin now and you will soon surprise yourself by the progress made. The reward is worthy of the effort to win the prize, and the man who persists in delaying preparation until the critical day is at hand deserves to lose.

It may seem a little egotistical for us to suggest that men having an examination in prospect read Railway and Locomotive Engineering carefully every month. We have had the most reliable testimony in many cases that readers of this paper seldom fail to pass the examinations. What happened in the past will come true again and apply to your case, so we say, listen to good practical advice.

To Help Sleeplessness.

One of our friends who runs the engine of a fast train says that he never feels nervous no matter how fast he may have to run in making up time but every time that has to be done he loses a night's sleep. He asks if we know any remedy for sleeplessness? We fear there is no remedy for nerves that are put under severe tension by the excitement of fast running.

A memorandum in our note book headed "Insomnia," says: "It has been found in most cases that insomnia is caused by disordered stomach. Between the stomach and the brain there is a close communion, and when one is out of order the other is not only apt, but sure to be. Worry will unsettle the stomach, indigestion will inflate the blood vessels of the brain. Recognizing this medical men are now ordering the use of hot water internally and externally. Before going to bed the persons so afflicted should bathe the feet in water as hot as possible. This is for the purpose of drawing the blood from the head, for when the blood vessels are inflated they press against the skull, and fears, apprehensions and dread of going to sleep result. But with the hot water application the blood is circulated and the pressure is relieved."

This may not apply to the trouble of nervous tension due to fast running but it is worthy of a trial.

Machine Racing.

A few years after railway locomotives began to prove reliable engines of transportation, a sentiment was worked up in favor of trying how fast selected locomotives could run with and without train loads. The racing sentiment, so strong in many Americans, commended the idea of promoting the racing of locomotives, and a few contests of the kind were held in New England. It did not require but a few accidents to put an end to that species of sport. Some sensible scientific journalist of that time made it understood that there was no sense in making machines race, for fleetness depended upon the amount of power put into action.

It is a pity that the same line of reasoning has not been brought home to the people who have been promoting automobile racing, and those who are now encouraging the practice of aeroplane racing. The number of lives lost in these idiotic sports puts the practices on the same plane as bull fighting and other sports that have long been forbidden among civilized peoples. There is no denying that the principal attraction of machine racing is the danger to life and limb involved. People who would scorn an invitation to witness a bull fight ought to be ashamed to be seen among the spectators of an automobile race.

Railroad Legislation.

Too much legislation is one of the characteristics of all forms of free government, and it is a regular condition of affairs that continues to present itself in regard to the transcontinental railways in America. The chief railroads are now passing through a series of discouragements requiring much fortitude to face. Government activity, which was begun for the purpose of regulating traffic and of keeping business within legitimate lines, has been taken up by the more or less irresponsible press and by demagogues of high and low degree, until a feeling of uncertainty and distrust has brought about a condition that is in some respects worse than the conditions which the legislation aimed to rectify.

One thing may be safely relied on, that the good sense of the American people will manifest itself eventually in this as in all other questions.

A halt will be called in meddling legislation. Politics will figure less, and common sense will loom more largely in regulating the commerce of the country. Good will come of it, and while we pray that it may come more speedily, knowing something of the average politician, we are not praying for miracles.

Power of an Injector.

So quiet and so effective is the work of the injector that the immense power it exerts is seldom taken into consideration. The larger kind of injectors will force 75 gallons of water per minute into a boiler. The amount of steam required to work the injector is also greatly in excess of what is generally supposed. It is safe to assume that 10 per cent. of the entire volume of steam generated is used in operating the injector, so that in the larger locomotives something over 100 horsepower is probably used in keeping up the supply of water.

Shutting off the injector on approaching a grade adds much to the power of the engine, and it is also a saving of power to work the injector when the engine is standing. Blowing off of steam at the safety valves is a much greater loss than is imagined, and unless the boiler is plentifully supplied with water, it is economical practice to apply the injector when the steam approaches the blowing-off point.

Seasoning Wood by Electricity.

The following item from a British technical paper concerns a new process of seasoning wood by electricity in France:

A large tank is filled with a solution containing 10 per cent. of borax and 5 per cent. of resin, with just a trace of carbonate of soda. In the bottom of the tank is a lead plate which is electrically connected to the positive pole of the dynamo. The timber to be treated is stacked on this plate, and when the tank has been filled another plate is superimposed and connected to the negative pole of the dynamo. When the current is switched on it passes through the stack of wood between the two plates, and in its passage it is said to drive out the sap in the timber and deposit borax and resin in its place, completely filling up all pores and interstices. When the process is completed the timber is removed and dried, after which it is ready for use. It is claimed that the timber submitted to this treatment, no matter how green it may be, becomes completely seasoned.

The cost is also said to be much less than any of the other methods of seasoning hitherto in use.

Book Reviews.

Electric Traction for Railway Trains. By Edward P. Burch. Published by McGraw-Hill Book Company, New York. 583 pages, cloth, with numerous illustrations. Price, $5.00.

This book is intended for the use of students, electrical and mechanical engineers, superintendents of motive power and others interested in the development of electric traction for railway train service, and is the most comprehensive work yet published on the subject. The substance of the work was delivered in twenty-four lectures on electric railway transportation at the University of Minnesota, and the author has had exceptional opportunities for collecting reliable data, having acted as electric engineer on the electric railways in and near Minneapolis and St. Paul.

The work is divided into fifteen sections, and is in some respects historical as well as analytical. There is an able review of the characteristics of steam locomotives, and a just comparison between the result of steam and electric traction. The technical descriptions of the direct-current, single-phase and three-phase electric locomotives are complete, and the method of procedure in railroad electrification is made plain. A resumé of the work done in that new and important department of railroad work fittingly closes a work of unusual merit.

An Introductory Manual and Catechism on the Automatic Vacuum Brake. By Chas. H. Gilbanks. Second edition. Published by the Scottish Industries Company, Ajmeer, India. Cloth, 138 pages, with illustrations. Price, $1.50.

This work, which has been revised and enlarged, has met with much popular favor among the railway men in India and Burma, and admirably fulfills its purpose as an elementary work on the vacuum brake, which is much in vogue among the lighter locomotives in Asiatic service. While we hesitate to admit that all wisdom cometh from the East, we cordially acknowledge the merit of Mr. Gilbanks's book. His style is simplicity itself. He wisely begins at the beginning and never loses sight of the fact that it is to the young and the inexperienced that he is writing, and he unfolds his story in a way that is engaging and interesting, and it would be well if some of our Western writers would imitate his style. The subject is treated on the question and answer method. The drawings are excellent.

Railway Shop Kinks. Compiled by Roy V. Wright. Published by the *Railway Age Gazette*, New York. 296 pages, with numerous illustrations; cloth. Price, $2.00.

As is common with nearly all publications claiming to be of a mechanical kind, contributions are sent to the editor describing new means and methods of shop operations, many of them of much merit, and, by reason of the rapid improvements and changes in machinery, many of them of merely passing interest. In the work before us, the author has made good selections and has covered an extensive field of mechanical operations, running from the machine through the various departments to the paint shop, in all seventeen different sections. The result is that there is a little of everything in the book. It is but justice, however, to say that the machine shop has the best of it, and the book as a whole is a valuable contribution to the railroad literature of our time.

Official Proceedings of the Western Railway Club for the Club Year 1910-11. Published by the Western Railway Club.

A substantial volume of nearly 400 pages is required to contain the proceedings of the Western Railway Club, and in point of interest, in variety of subjects discussed, and in the general excellence of the papers and lucidity in debate, the proceedings will compare favorably with that of any other club of the same kind. It would be invidious to compare the merits of particular papers, but as may be expected in a city like Chicago, where it is claimed that there are 530 tons of cinders deposited every day from the smokestacks of locomotives, the question of smoke-consuming is a burning one, and it appears on many pages of the club's proceedings. We trust that by the time the next volume is ready the air of the Lake City will be clearer. If not, it will not be the fault of the members of the Western Railway Club, who have thrown a flood of light on the subject.

Practical Mechanics for Shop Apprentices and others. By James Powell, Chief Draughtsman, G. T. R., Montreal. Second Edition, 71 pages, limp leather, illustrated.

Mr. Powell has done excellent work among the apprentices on the Grand Trunk System in Canada as an instructor in practical mechanics, and his book, now in the second edition, is already a text-book among the younger railroad men there. The work has been written and compiled with the object of laying a foundation and preparing the way for a better education and technical knowledge for apprentices and others in engineering shops, and presents in an interesting form what will actually be needed. For the young machinist it is one of the best books of its kind that we have seen, and it also contains much that will be of value to all railroad men.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series.

15.—What rules are an engineer required to observe before starting from the initial station?

A.—To report with the conductor to the train dispatcher for orders. If there are no orders most companies require that he receives a clearance card. He is also required to examine the special order book and bulletin board at the initial station and at all points on the road where it is practicable to do so.

16.—What train rules must be observed before starting from a station?

A.—Engineers of passenger and mixed trains are forbidden to start from any station without receiving the prescribed signal. Engineers of other trains are forbidden to start without receiving from the conductor the signal prescribed by the rules of the road.

17.—When the train is ready, how should it be started, and what should be observed?

A.—The reverse lever should be placed in the extreme forward notch, and the throttle valve opened gently, so as to start all the cars in the train smoothly and without jerks. A sharp look out for any switch targets must be maintained, and care must be taken to see that the whole of the train is following the engine.

18.—Why should the rails be sanded in starting; and why is it important that the sand falls on both rails?

A.—The rails should be sanded to prevent slipping. If the sand falls only upon one rail it puts tremendous strain upon crank pins and side rods if the wheels on the unsanded side tend to slip. Slipping when only one rail is sanded frequently causes breakages.

19.—Do your recognize any rules concerning the use of sand on the road?

A.—Never to use sand when passing over switches, frogs and interlocking appliances. It is also forbidden to permit overflow water of injectors to strike such places in freezing weather.

20.—After a train has been started how can the engine be run most economically?

A.—By regulating the steam admission to the cylinders by the reverse lever as much as practicable, so that the steam will expand while working in the cylinders. To do this properly the throttle valve should be full open, which puts full pressure into the steam chest, and steam admission from the steam chest regulated by keeping the reverse lever as far notched back as speed requirements will admit.

21.—What is meant by using steam expansively?

A.—Steam as it passes from the boiler is like a powerful spring under compression. When given the opportunity, that steam will expand and do much work in the cylinders. The usual plan is to admit a small portion of steam into the cylinders, cut off the supply and permit the operation to be finished by the expanding steam.

22.—How is this cutting off of steam performed?

A.—By changing the travel of the slide valve. When the reverse lever is in full gear, the valve has full travel and will not close the admission port until the piston has traveled almost the entire stroke. As the reverse lever is hooked up towards the center of the quadrant, the travel of the slide valve is shortened until it will close the admission port when about 25 per cent. of the stroke has been made. That is called the point of cut off. When that is done the steam does its work by expanding, an operation that effects great saving of steam.

23.—What general rules should an engineer of a freight train observe in working over a division?

A.—He is required to whistle for and receive signal from the rear of the train when commencing the ascent or descent of heavy grades, and when starting from water or other stations. He should look back frequently, especially when rounding curves to see that the train is all right.

24.—What rules must be observed concerning speed?

A.—He is required to maintain as far as practicable, regular and uniform speed, and to avoid sudden increase or checking of speed, except when necessary to prevent accidents. He is required to avoid excessive speed in descending grades, and to run with caution where the track is under repair, and at all points where there is reason to apprehend danger.

25.—How is it when pulling passenger or stock trains?

A.—He is required to avoid all violent or sudden movements or shocks to the trains likely to cause discomfort or annoyance to passengers or damage to live stock or passengers; and to approach all sharp curves carefully, reducing speed as much as necessary to cause the train to run smoothly.

26.—Suppose you were required to take a light engine over the road, what would be your duty before starting?

A.—I should report for orders and examine and check up the train register.

27.—Suppose you got out a few miles between stations and broke down. What should you do?

A.—Protect my engine from approaching trains in both directions.

28.—How should the water be supplied to the boiler?

A.—As nearly as possible at the rate it is being used, which can be found by keeping the water at the same level. Sometimes it is wise to have extra water to be prepared for a long, hard pull. At other times the injector may be freely used to prevent steam blowing off.

29.—What is the difference between priming and foaming of a boiler?

A.—Priming and foaming both mean that water is being carried by the steam from the boiler to the cylinders, a dangerous condition. Priming generally results from the water level in the boiler being carried too high, or through forcing the engine to its full power; foaming is caused by impurities, such as grease, soap or alkali, causing an aggregation of suds or bubbles that mix with the steam. Boilers that need washing out generally cause annoyance by foaming.

30.—What would you do on discovering that the boiler was priming through the water level being too high?

A.—Reduce the superfluity of water in the boiler.

31.—What would you do in case the boiler was foaming?

A.—The throttle should be closed sufficiently to show the real water level. Where a surface cock is provided it should be used sufficiently to blow the scum off the water. When scumming or blowing off is resorted to it should be done when the steam is shut off. Foaming can frequently be prevented by injecting a few ounces of castor oil into the boiler.

32. What danger results from a boiler foaming badly?

A.—When a boiler is foaming the steam is apt to carry away the water so rapidly that the crown sheet may be bare and exposed to the hot fire. The greatest danger from foaming or priming is, however, that water may enter the cylinder in sufficient volume to knock out cylinder heads, break piston valves or effect other serious damage.

33.—How can you usually detect

foaming, and what would you do if the boiler began foaming on the road?

A.—Foaming is generally indicated by water passing through the smoke stack, and if it is bad the piston will begin to knock. Then the valves become dry and pull at the valve motion, causing the reverse lever to jerk. Sometimes the valves and pistons would groan. On noting any of these indications of water passing through the cylinders, would shut off steam to ascertain if the boiler was foaming or had been too profusely fed. Would make the necessary remedy.

34.—What should be done in case you found that by accident or design oil, soap, or some foam producing substance had been put into the tank?

A.—Oil or other foam making substance mixed with the feed water might make it necessary to clean out the contents of the tank immediately; but it is generally possible to move the engine to the nearest water station, where the tank can be cleaned.

35.—Suppose on shutting off steam you found that the water in the glass dropped out of sight, what would you do?

A.—Open the throttle again, even if it was necessary to put the reverse lever in the center notch and put both injectors working at the highest capacity. If it was a real case of low water, would smother or quench the fire without delay.

36.—What attention should be given to boiler attachments, such as gauge cocks, water glass, blow off cock, etc.?

A.—Close attention should be given at all times to these attachments to keep them in good working order.

73.—Why is it necessary that front-end doors and joints of cinder hoppers be kept tight?

A.—To prevent the vacuum creating action of the exhaust from being interfered with. Also to prevent admission of air that might fan fire created by sparks.

38.—How does the size of exhaust tip affect the steaming and working of the engine?

A.—As all the steam from the cylinders must escape through the exhaust tip, its outward velocity will depend upon the size of the opening. The smaller the tip, the faster the steam must rush. When a tip is small some part of the steam will be prevented from escaping, and will remain in the cylinder, obstructing the return movement of the piston, causing back pressure.

39.—What effect on fuel consumption has a small tip?

A.—When the tip is small the velocity of exhaust steam is high, which induces a fierce rush of the fire gases through the flues, thereby wasting fuel.

40.—What precaution should be taken to prevent the locomotive from throwing fire?

A.—See that the spark arresting appliances are kept in perfect order, ash pan kept clean, and side dampers kept closed.

41.—Suppose something happened that prevented you from shutting the blow-off cock or it was broken off?

A.—Should dump the fire as quickly as possible. In case of failure to remedy the accident, would disconnect.

42.—What should be done in case that a flue got blowing very badly?

A.—Plug it.

43.—Suppose the whistle or one of the safety valves blew out?

A.—Would close the hole with a wooden plug.

44.—What would you do in case a check valve was knocked off?

A.—Would smother or quench the fire.

45.—How would you act in case a soft plug blew out of crown sheet on the road?

A.—Would smother the fire if water passing through the hole had not already quenched it.

46.—Does blowing out of a soft plug disable an engine?

A.—Under favorable conditions the plug can be taken out, a piece of lead hammered in and replaced.

47.—How can a locomotive boiler without steam be filled with water by towing?

A.—That can be done by pumping the air out of the boiler and permitting atmospheric pressure to force water into the boiler from the tender. The procedure is this: All openings where air could enter the boiler must be closed. These include relief valves, gauge cocks, cylinder cocks, the whistle valve and air pump steam valve. When these have been closed, place the reverse lever in full gear in the direction the engine is to be hauled, and open the water supply valve and injector throttle. A good supply of engine oil should be fed through the auxiliary oil caps to valves and pistons. The movement of the pistons in the cylinders will pump the air out of the boiler and the atmospheric pressure on the surface of the water in the tank will force a supply into the boiler.

48.—What is the result of having leaky steam pipe joints in the smoke box?

A.—It interferes very seriously with the steaming of the engine.

49.—What should be done if grates are broken or burned out on the road?

A.—Move the fire off the broken or burned portion and place thereon pieces of iron, such as fish plates, to make up temporary grates and renew the fire.

Babbitting Boxes.

Instead of using putty or clay for plugging up the ends of the boxes while the babbitt is being poured, some old asbestos pipe covering is ground up and mixed with cylinder oil to the consistency of a stiff putty. This mixture has these advantages: It is proof against the softening influence of heat, sticks far better to the box than either putty or clay, never "blows" when the hot metal comes in contact with it, and can be used over and over without loss or hardening.

A Double Hack Saw.

For cutting soft metal, place two blades in the saw frame, one in the usual way and the other reversed so that the teeth will point back toward the handle. One blade will cut while the saw is pushed forward, and the other makes its cut when drawing the saw back. While one blade is dragging, it will prevent the other from taking too deep a cut in the metal.

A Rust Preventive.

To keep iron goods of any kind, and especially those parts of machines which are made of steel or iron, from rusting, take one-half ounce of powdered camphor, and melt it before the fire in one pound of good lard. To give it a dark color, add as much fine black lead as is necessary to produce the desired effect. Clean the iron work and smear it over with this preparation. After this it should be allowed to remain untouched for twenty-four hours, when the grease should be removed by wiping the ironwork with a soft cloth.

Soldering Cast Iron.

Make an amalgam of tin filings and mercury. What is not used at once can be kept in a wide-mouthed glass bottle for future jobs. The joint is first cleaned thoroughly, then a clean rag is dampened with commercial muriatic acid and some of the tin mercury amalgam is rubbed well into the cleaned joint. Soldering is then proceeded with in the usual way, using Yeager's soldering salts as a flux.

To Temper a Chisel.

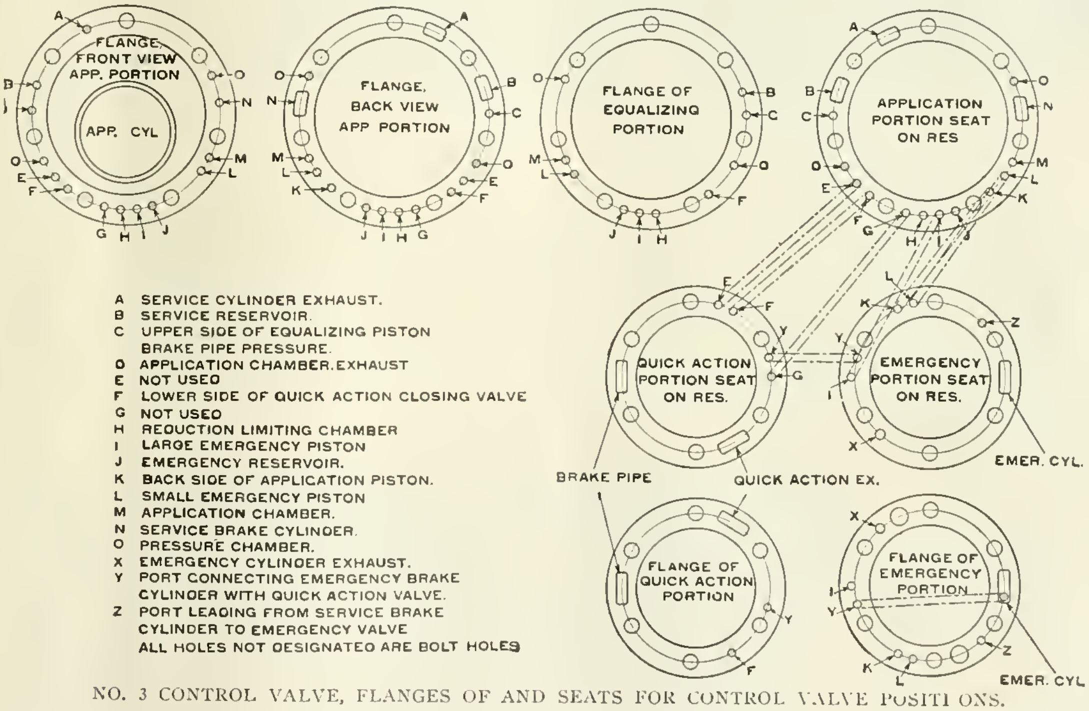
Heat the chisel about 1½ in. up from the cutting edge to a dark cherry red, then cool the edge in water and rub it with an emery stick or a whetstone. Let the heat run down to a dark straw color, then cool the edge again and brighten as before. Let the heat draw to the color of pigeon blue, then cool the entire chisel. Chisels tempered this way will stand much better than those tempered in the ordinary way.

Air Brake Department

Conducted by G. W. Kiehm

Increasing Our Air Brake Department.

The Air Brake Magazine of Meadville, Pa., being defunct, we intend materially to increase the space in Railway and Locomotive Engineering devoted to the discussion of air brake matters. We can assure those who became subscribers to the Air Brake Magazine that they will receive as much information from our Air Brake department as they ever obtained from the journal exclusively devoted to air brake subjects. Our air brake editor and experts are thoroughly competent to deal with any subject raised, and they will answer any questions asked. We cordially invite every person interested sufficiently in air brakes to write about them, to send us their letters or questions.



NO. 3 CONTROL VALVE, FLANGES OF AND SEATS FOR CONTROL VALVE POSITIONS.

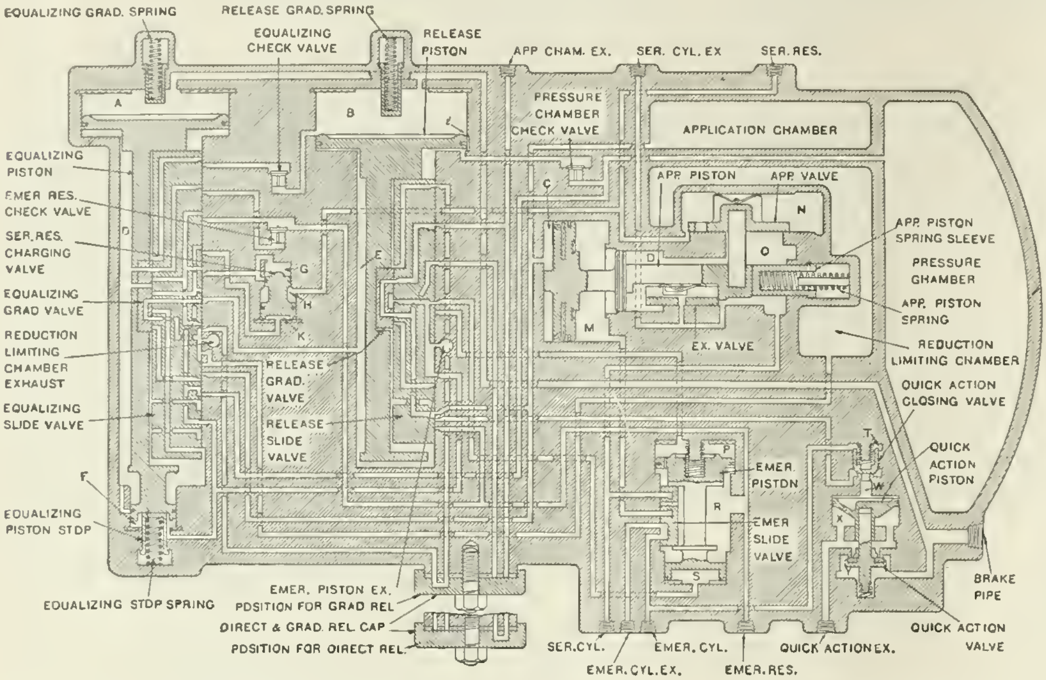
The No. 3-E Control Valve.

Presenting the diagrammatic views of the No. 3-E control valve for passenger service, it will be noted that the various parts and pipe connections are named in each view of its different positions, and the view of the normal position, which is assumed when free from other than atmospheric pressure, all parts, ports and passages are shown, while in other views only the ports and passages used in that particular position are shown. This makes possible a very brief and comprehensive description of its operation, which can be more readily followed than if all connections were shown in each view, and it enables the interested reader to trace the movements of the various parts without any confusion or continual reference to a first figure. As this valve assumes fifteen different positions all told, a number of which are but momentary, it is evident that a view and detailed account of each position would require entirely too much space, and would not be necessary, as any reader familiar with the operation of a triple valve will readily understand that this valve also is operated entirely by the creation of differentials in pressure, and that when any of the positions shown in the illustrations are assumed, a cessation of reduction or the attainment of a point of equalization in pressure results in the inevitable return to lap position, while the restoration of the volume of brake pipe pressure used during the operation results in the movement to release position.

Beginning with the charging position, compressed air from the brake pipe enters the control valve reservoir at the point indicated, and is free to enter the chambers back of the two pistons of the equalizing portion forcing them to the positions shown, at which time their slide and graduating valves have made connections that will permit the following flow of compressed air:

Brake pipe pressure, passing through the feed groove, charges the chamber in which the release slide valve operates, while a much larger volume enters the chamber occupied by the equalizing slide valve, through the non-return equalizing check valve. From this chamber air pressure is free to flow through the emergency reservoir check valve, charging the emergency reservoir, and at the same time air from this chamber can also flow through the service reservoir charging valve and charge the service reservoir. From the same port that supplies those reservoirs there is a flow that can be traced through the graduated release cap and release slide valve to the chamber E, which adds to the volume that would otherwise enter through the feed groove, thence through a suitable port, pressure from chamber E reaches the equalizing slide valve and branches off in two directions, to the pressure chamber and to the under side of the service reservoir charging valve, and as the small chamber under this charging valve can be charged faster than the service reservoir, the valve is held in the position shown; thus all chambers mentioned are charged to the pressure carried in the brake pipe.

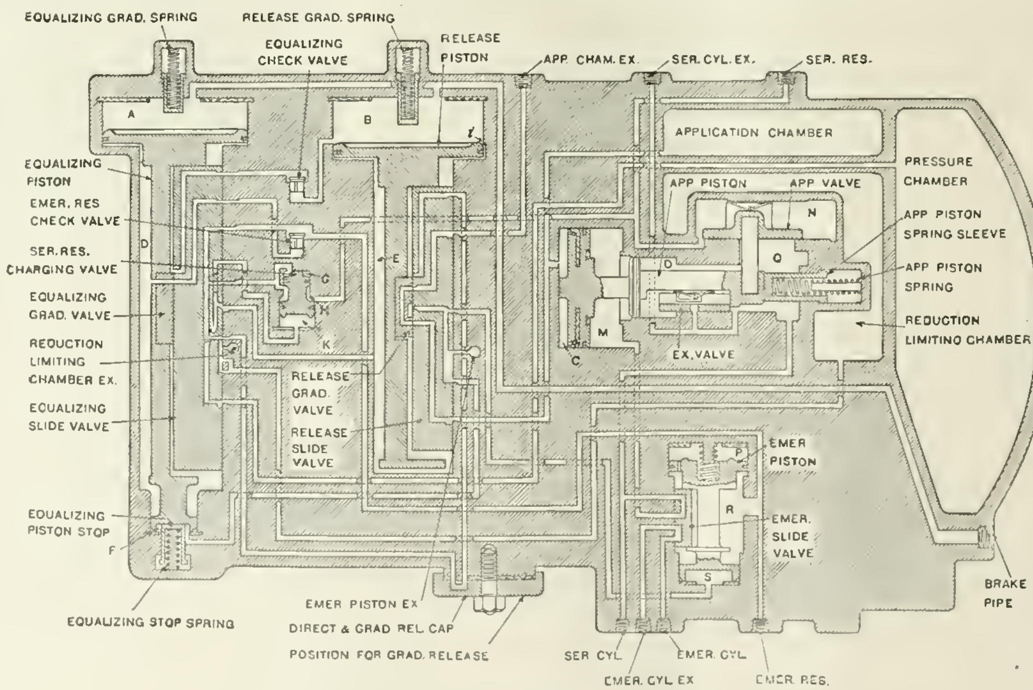
There is an additional and direct passage from chamber E to the pressure chamber, but the pressure chamber check valve prevents any charging of the pressure chamber save by the way of the equalizing slide valve, but pressure cham-



NO. 3 CONTROL VALVE, POSITION NO. 1 OR NORMAL.

ber air can flow in the opposite direction to chamber F, and the reason for this becomes obvious when the application position of the control valve is considered.

Emergency reservoir pressure is always present between the two pistons of the emergency portion holding the emergency slide valve to its seat and is also in constant communication with the outside of the large piston through a small passage through the piston.



NO 3 CONTROL VALVE, POSITION NO. 2 AND 12, RELEASE.

The application chamber and chamber C are open to the atmosphere through the release slide valve and graduating valve and the reduction limiting chamber is open to the atmosphere through the equalizing slide valve.

The service brake cylinder is open to the atmosphere through the exhaust valve of the application portion and its separate exhaust port, while the emergency brake cylinder is open to the atmosphere through the emergency slide valve and its separate exhaust port.

The equalizing piston and the emergency piston are double ended and the outside ends of the small pistons are open to the atmosphere through the release slide valve, but a raised portion on the ends makes an air-tight joint on a leather seat, this is to the intent that neither piston can move away from its release position until the action is desired.

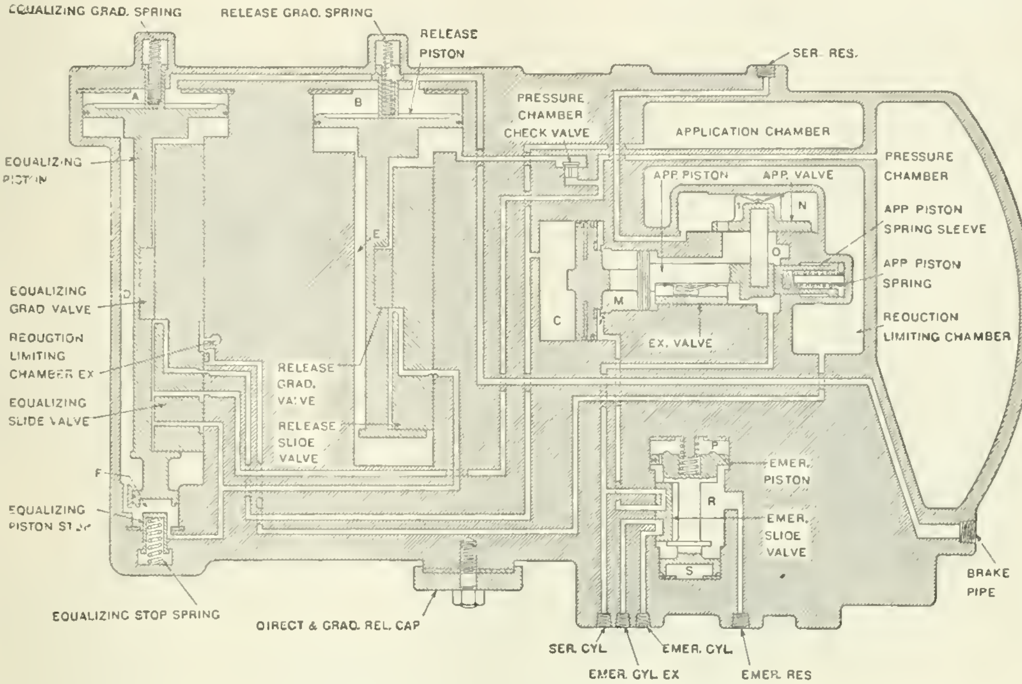
Now when an application of the brake is desired a reduction of brake pipe pressure lowers the pressures in chambers A and B because the equalizing check valve prevents any backward flow of air from chamber D and the pressures in chambers D and E will force the equalizing and release pistons to the service position shown.

The first movement cuts off the feed groove in the release piston bushing and the release piston moves first because of the difference in pressure acting on the equalizing piston due to the smaller end being open to the atmosphere, and when the release piston and slide valve have moved, the chamber at the small end of the equalizing piston is cut off from the atmosphere and pressure from chamber E is admitted, by the release slide valve, thus balancing the pressure on both sides of the small end of the equalizing piston, and it then moves in accordance with the difference in pressure already existing between chambers A and D.

When the equalizing piston, slide valve and graduating valve then move a connection is momentarily made from the emergency reservoir through the equalizing slide valve to the chamber D which restores any loss of pressure due to displacement of the equalizing piston in the small chamber and makes positive the movement to service application position.

Thus the equalizing portion has successively passed through what is termed the preliminary service and secondary service to service application position, and while this is designed to require a 6 lb. brake pipe reduction it will be remembered that those positions are but momentary, and while watching the piston stems operating in a glass case very little difference in these movements is noticeable, nevertheless this action is sufficient to prevent the undesirable "creeping on" of brakes.

The graduating springs then hold the pistons in service position, provided of course that brake pipe pressure does not fall fast enough to produce quick action, and in the service position it will be noted that the pressure chamber and chambers D and E are connected, the release slide valve has blanked the application chamber exhaust port, and pressure chamber air is flowing through the equalizing slide valve to the application chamber and chamber C, and is effective on the application piston, forcing it to the position that cuts off the service brake cylinder exhaust and admits air from the service reservoir to the service cylinder.



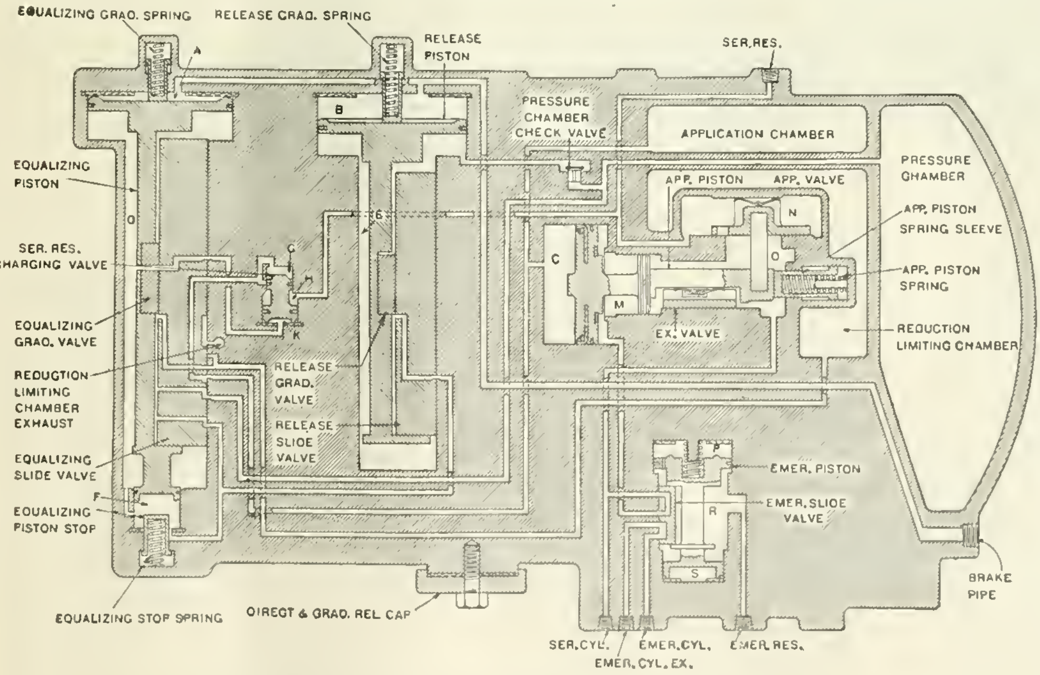
NO. 3 CONTROL VALVE, SERVICE POSITION.

If the brake valve is now lapped before the point of equalization between the pressure chamber and application chamber is reached, the equalizing piston and graduating valve assume a lap position, admitting no more pressure to the application chamber, and the action of the application portion is identical with that of the application portion of the distributing valve, which will require no explanation at this time; therefore it is evident that the brake pipe reduction yields the same service brake cylinder pressure on all cars regardless of piston travel or moderate leakage, and maintains this leakage up to the capacity of the service reservoir.

If the brake pipe reduction is continued beyond the point of equalization, pressure chamber air can no longer expand, and when the difference in pressure exceeds the tension of the equalizing graduating spring, which is somewhat weaker than the release graduating spring, the equalizing piston and attached valves will move to over-reduction position in which pressure and application chambers are separated, and pressure chamber air expands into the reduction limiting chambers.

While the pressure chamber air is expanding into the reduction limiting chamber and application chamber pressure is remaining constant, suitable connections are made through the equalizing slide valve, whereby the under side of the service reservoir charging valve is connected with the pressure chamber, while application chamber pressure is admitted to the chamber on top of the valve, thus the charging valve is held to its seat and application chamber leakage would be supplied from the service reservoir by leakage past the packing ring which would then divide those pressures.

If the reduction of brake pipe pressure ceases over-reduction-lap position will be assumed with all other parts practically unchanged, but if the reduction is continued beyond the point at which the pressure chamber and the reduction limiting chamber will then equalize, about 60 lbs. from an original 110 lbs. brake pipe pressure, the pressure chamber air can no longer expand and the resistance of the release graduating spring will be overcome, the release piston will travel its full stroke, and the emergency portion will be thrown into operation.



NO. 3 CONTROL VALVE, OVER REDUCTION POSITION.

After ordinary service operations an

increase of brake pipe pressure for releasing the brake results in the two pistons and slide valves making several momentary connections which cause the equalizing piston to hesitate an instant and pass through what is termed the preliminary release and secondary release positions to the final release and charging position already explained.

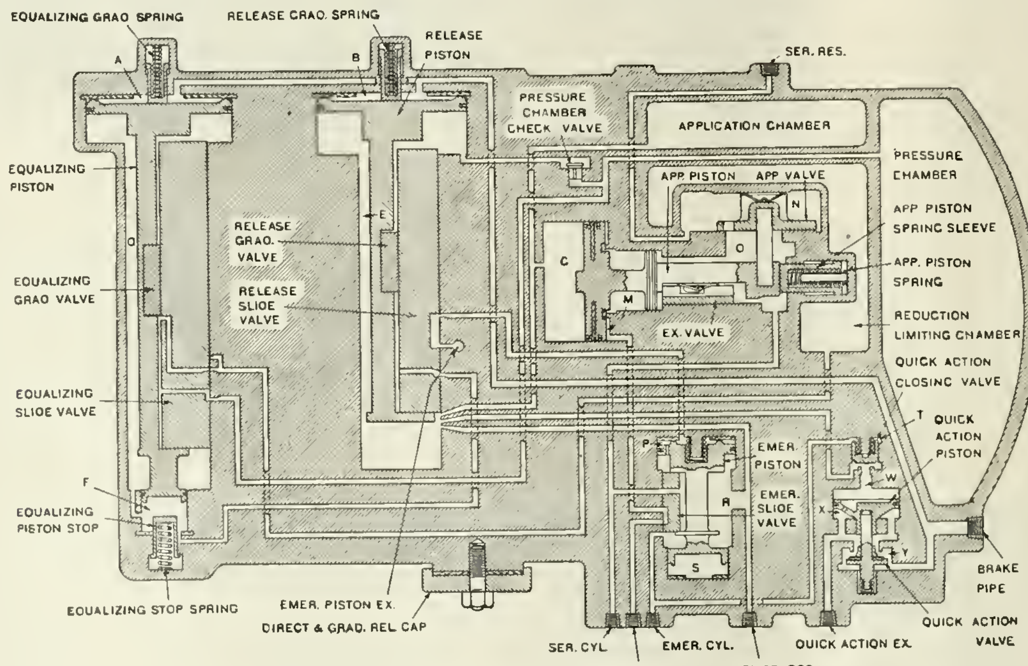
Upon the ordinary rate of rise in brake pipe pressure the equalizing piston and valve are designed to move a trifle in advance of the release piston, and in so doing make a momentary connection from the chamber E through the equalizing slide valve to the atmosphere, causing a drop in pressure and consequently a prompt and positive return of the release piston, which has for an instant admitted pressure chamber air to the chamber F, which in combination with the equalizing stop spring has insured that the equalizing piston hesitates an instant in preliminary release position.

The return of the release piston to the end of its stroke, however, again opens the chamber F to the atmosphere through the emergency piston exhaust port, as shown in release and charging position. An increase of 1½ or 2 lbs. in brake pipe pressure is sufficient to accomplish this release, and it will be noted that the valves after being started, return each other to release position, where the same connections as in release and charging positions are made, and the release piston will exhaust application chamber pressure, and the application portion will exhaust service brake cylinder pressure, releasing the brake, provided that brake pipe pressure is maintained or that direct release is cut in.

It will be remembered that during this service application, emergency reservoir pressure has not been materially disturbed, and instead of receiving air from the brake pipe will be holding down the service reservoir charging valve, keeping the service reservoir from absorbing any brake pipe air, and under ordinary conditions the service reservoir cannot be charged until brake pipe and pressure chamber are charged to within 5 lbs. of the pressure remaining in the emergency reservoir, then the service reservoir charging valve will be lifted and service and emergency reservoirs will equalize and the work of charging will take place as shown.

In this way the brake pipe pressure cannot be absorbed by reservoirs until a release of all brakes is accomplished, and if the graduated release feature is cut in there is also a connection from the emergency reservoir, through a small port, to chamber E that will build up pressure and force the release piston toward application position far enough to cut off the escape of application chamber pressure, the flow from the emergency reservoir being cut off the instant the release piston and graduating valve are forced to the graduated release position, thus the same graduated release as with L triple valves can be obtained and in the same manner, that is, by bringing the brake valve handle back to lap position when the exhaust of brake cylinder pressure is to be stopped.

This graduated release is one of the desirable features of an automatic brake, but during a transition period it might, under certain conditions, be desirable to operate without the graduated release feature, which can be cut out and direct release provided by loosening a bolt and turning the graduated release cap, which will prevent the back flow of air from the emergency reservoir to chamber E and the pressure chamber; thus if the graduated release feature is cut in, the pressure chamber is charged from the emergency reservoir, but with the cap in direct release position the pressure chamber is charged from the brake pipe through the feed groove in the release piston bushing, and in either event the service reservoir charging valve cannot be lifted until the brake pipe and pressure chamber are charged to a point very nearly equal to the pressure remaining in emergency reservoir, at which time all portions will be charged from the brake pipe, as shown in release and charging positions.



NO. 3 CONTROL VALVE, EMERGENCY QUICK ACTION VENTING.

If the brake pipe reduction is continued beyond the predetermined point or if the reduction is somewhat faster than pressure chamber, air can expand from chambers D and E, the pistons of the equalizing portion will be driven to their full stroke against the resistance of the graduating springs, and quick action or emergency will occur. Referring to this position, it will be observed that the release piston has connected the outside of the large end of the emergency piston to the atmosphere, which has caused this piston to be driven to the position shown, allowing a free passage from the emergency reservoir to the emergency cylinder. The emergency reservoir is also connected, past the end of the release slide valve, with the application chamber and chamber C, while the emergency slide valve has opened chamber M to the atmosphere to facilitate a prompt response of the application portion.

The emergency slide valve has also connected the service brake cylinder with the emergency reservoir and cylinder. This action is instantaneous and the various connections will show that equalization of pressure results in all reservoirs, cylinders and chambers, even to the reduction limiting chamber and chamber F.

A sudden reduction of brake pipe pressure is at this same instant transmitted to other control or triple valves in the train, by the connection past the end of the release slide valve to the under side of the quick action closing valve, which operates the quick action portion to exhaust brake pipe pressure to the atmosphere.

Upon equalization of pressures, the spring above the closing valve returns the valve to its seat, and the remaining brake pipe pressure and the quick-action valve spring will return the quick-action valve to its seat. The release after this operation will be the same as shown in release and charging positions.

Questions Answered

On Air Brake Subjects.

BRAKES FAIL TO APPLY.

102. P. F. F., New Orleans, writes: While pushing eight freight cars over a steep incline, the cars broke away from the engine and while the brake applied and stopped the engine, it did not stop the cars, which were wrecked at the bottom of the incline, and upon investigating the cause of failure of brakes to stop the cars, it was found that the air hose on the uncoupled end of the first car was twisted and wrapped around the train line pipe tight enough to prevent the escape of enough brake pipe air to apply the brake. I understand that a past issue of Railway & Locomotive Engineering contains an article that states why and how this can occur; can you tell me which issue contains it?— A. This accidental closing of the brake pipe may have been mentioned in our columns, but there is nothing mysterious about the manner in which it can happen, as the compressed air rushing from the pipe tends to straighten the hose instantly, and it does so quickly that the momentum imparted to the coupling end of the hose swings it beyond a straight position of the hose and causes it to describe a rapid and forcible circular movement, and it frequently strikes the coupler or end sill. While there is, at times, a possibility of the hose being wedged and the escape of air shut off, it is such a rare occurrence that it can be termed a practically unavoidable accident.

AIR PUMP TEST.

103. E. R., Plattsburgh, N. Y., writes: I have recently tested two 9½-in. air pumps and will give you the results and ask you to figure the pump's per cent. of efficiency. Test No. 1: Air pressure maintained at 100 lbs., size of opening, ⅛, strokes per minute, 90. Test No. 2: Air pressure 100 lbs., size of opening ⅛, strokes per minute 85?—A. Assuming that you have made no mistake in the number of strokes per minute, the pump must have been in first-class condition to have maintained pressure at 100 lbs. against a ⅛ opening with only 85 strokes per minute; but, accepting your figures as they stand, we will first find the theoretical capacity of the pump at 85 strokes per minute. The air cylinder being 9½ ins. in diameter and the stroke 10 ins., we have $9.5 \times 9.5 = 90.25 \times 7854 = 70.88$ ins., the area of the cylinder, which, multiplied by the stroke, equals 708.8, which is the number of cu. ins. of space in the cylinder. $708.8 \times 85 = 60.248$, the number of cubic ins. of free air that could be compressed in 85 strokes if the cylinder could be cleared on each stroke, but in this no allowance is made for the dead space in the cylinder or for the space taken up by the piston rod. $60248 \div 1728 = 34.2$ cubic feet, the theoretical capacity of the pump at 85 strokes per minute.

From a gauge pressure of 100 lbs., a ⅛-inch circular opening will expand approximately 25.8 cubic feet of free air per minute. $25.8 \div 34.2 = .75$. Thus the pump's efficiency under the condition you cite is 75 per cent., meaning that its actual capacity is 75 per cent. of its theoretical capacity, the latter being a cylinder full of free-air compressed on each stroke.

DRIVER BRAKE RELEASES.

104. K. T. W., Sutherland, Tenn., writes: In making a heavy service application the brake sometimes goes into the emergency, and the engine brake will release at once while the brake valve is on lap position, and in order to get it to stay applied it is sometimes necessary to move the valve handle to emergency position two or three times.

What could be wrong with the brake on a locomotive to cause it to act in this manner?—A. If you have a quick action triple valve on your tender the brake going into the emergency may be due to any one of about 40 different causes that contribute to undesired quick action.

A table or chart showing the causes of undesired quick action was printed in the July, 1910, issue of Railway and Locomotive Engineering.

The principal causes are a sticky triple valve piston or slide valve, a very weak graduating spring, a broken graduating pin or a restricted service port in the triple valve, while the principal causes found in the brake valve are: A sticky equalizing piston, a reduced equalizing reservoir volume, an enlarged preliminary exhaust port or possibly leakage in the equalizing reservoir connections.

The brake releasing after an emergency application may be due to returning the valve handle to lap position too quickly, which would result in a slight increase in brake pipe pressure from the equalizing reservoir, but the usual cause of the driver brake releasing is a leak from the auxiliary reservoir to the atmosphere or to the brake cylinder or a leak from the main reservoir into the brake pipe.

You may, however, be mistaken in getting what is termed the emergency, as the driver brake triple valve may be sticky or have a very tight fitting packing ring that will not permit it to move upon light brake pipe reductions, but when it does move it jumps, applying the brake pretty severely, and when there is finally enough differential in pressure to move the valve toward lap position it moves with a jerk, jumping to release position instead, which may be the entire cause of your trouble.

EQUALIZATION OF PRESSURE.

105. K. T. W., Sutherland, Tenn., writes: If it takes 20 lbs. reduction from a 70-lb. train line to equalize the auxiliary reservoir and brake cylinder pressure when the piston travel is 8 ins., will the same reduction equalize a 10-in. piston travel?—A. No. If the piston travel is 10 ins., about 46 lbs. brake cylinder pressure will be obtained and a brake pipe reduction of about 21½ lbs. will be required. The longer the piston travel, the lower the point of equalization which naturally requires a further reduction of brake pipe pressure to produce the equalization.

STRAIGHT AIR AND AUTOMATIC.

106. M. C. M., Manhattan, Nev., writes: Do modern locomotives use both straight air and automatic on the engine and tender? If straight air is used kindly state where, as we live many miles off the main line and have no way of seeing modern locomotives.—A. Yes. Many locomotives have the combined automatic and straight air brake; the straight air being connected by means of double check valves. The brake is used principally for alternating the engine and train brakes on descending grades and in bunching the slack in the train and holding it bunched when desired, and it is also convenient for use in handling the lone engine. A later brake equipment contains an automatic and independent brake known as the E. T., and with this

brake the engine and tender brake can be released and reapplied any number of titmes without disturbing the train brakes regardless as to whether they are applied or released; also a predetermined brake cylinder pressure is maintained with either brake regardless of piston travel or brake cylinder leakage.

SIGNAL WHISTLE SOUNDS.

107. J. D., Jersey City, N. J., writes: What causes the signal whistle to sound every few seconds when there is no one near the engine? Engine equipped with the E. T. brake. A.—There must be some leak in the signal pipe in order to create a difference in pressure in the signal valve that is necessary to operate it, however, the reducing valve should be in such a condition as to sensitiveness that it will promptly supply any slight lowering in signal pipe pressure. Comparatively slight variations in signal pipe pressure will also cause the whistle to sound if the diaphragm stem is too neat a fit in the bushing.

BLEEDING OFF BRAKE.

108. C. J. M., Montgomery, W. Va., writes: If an engine is cut off from a car with the brake equipment charged and the angle cock on the car is opened, allowing all brake pipe pressure to escape, the auxiliary reservoir can then be bled, which will release the brake. Now, what causes the triple valve to go to release position? A.—The triple valve is not moved to release position until air pressure again enters the brake pipe. Under the conditions you mention the auxiliary reservoir's bleeding bleeds the brake cylinder also, as they are connected while the triple valve is in emergency position, which it must have assumed when the angle cock was opened, but when the auxiliary pressure is finally reduced to a point a trifle less than the tension of the graduating spring, the triple piston and slide valve will be forced toward lap position as far as the graduating spring and stem can force it where it will remain. After the compression in the auxiliary is then almost entirely exhausted, brake cylinder pressure will lift the slide valve off its seat against the tension of the slide valve spring, and by the time the spring can again seat the slide valve against the weakening brake cylinder pressure, the brake cylinder piston will have returned to a point so near the end of its stroke that any remaining cylinder pressure will escape through the leakage groove.

FITTING PISTON RINGS.

109. J. L. P., Corbin, Ky., writes: 1. The Westinghouse Air Brake Co. state that an air pump piston ring 5/1,000 of an inch thinner than the width of the piston groove affects the efficiency of the pump, please explain why. 2. In fitting main piston rings in the pump will springing the rings to a fit in the cylinder serve the same purpose as filing them? A.—1. Evidently the W. A. B. Co.'s recommends have been misquoted to you, as they go so far as to recommend the use of second-hand rings removed from a somewhat larger cylinder even if they are as much as 5/1,000 of an inch thinner than the width of the groove in preference to the use of a ring of such thickness that necessitates filing the sides. This should not be taken to extremes or beyond 5/1,000 of an inch, as the use of very loose rings wear the grooves very rapidly, causing packing ring leakage with a tendency to break the rings. While filing the sides of a ring almost invariably causes ring leakage the rings must be kept reasonably near the fit in the piston groove. 2. If the proper sized packing ring is not available, springing the ends of a somewhat larger ring to fit the cylinder is good practice, and any slight error can be corrected with the file.

BRAKE SHOE FRICTION.

110. W. W. U., Oakland, Cal., writes: In the progressive questions and answers of the Air Brake Association, 1910, revision, page 194, in reference to co-efficient of friction of brake shoes, the following appears: "The co-efficient of friction of the brake shoe decreases with an increase of pressure; that is, the co-efficient of friction of a cast iron brake shoe acting under a load of 3,000 lbs., against a wheel moving at 30 miles per hour, averages 28 per cent., whereas with the same shoe applied with a load of 6,000 lbs. against the wheel at 30 miles per hour is only 23 per cent." Why is it that the co-efficient of friction decreases with the increased pressure on the shoe, and why will the retarding effect be less with a higher shoe pressure than when a lower percentage of braking power is employed, all other conditions being equal? A.—This does not mean that the higher brake shoe pressure gives less retarding effect than the lower brake shoe pressure, as in the first instance, the co-efficient of friction or the actual force tending to check the rotation of the wheel is 28 per cent. of 3,000 lbs. or 840 lbs., while in the second case the co-efficient of friction is 23 per cent. of 6,000 lbs., or 1,380 lbs. Owing to the composition of the brake shoe and the increase of temperature due to the increase in the force pressing the shoe against the wheel, the co-efficient of friction does not attain the same proportionate rate of increase that is obtained with the lower shoe pressure. The co-efficient of friction is the per cent. of brake shoe pressure in effect on the wheel.

REPAIRS TO FEED VALVE.

111. J. L. P., Corbin, Ky., writes: 1. If properly fitted to a new bush will a difference of 1/64 of an inch from the original size of the supply valve piston of a slide valve feed valve make any difference in the operation of the valve? 2. What is wrong with a feed valve working against a 3/64 inch leak that causes a fluctuation of the gauge hand for a short time and then ceases, no oil being used on the piston? A.—1. Certainly not. With the piston properly fitted a variation of an eighth of an inch would make no noticeable difference in the operation of the valve. 2. After working a short time a leak may have started past the slide valve seat or the regulating valve seat, which would tend to prevent the fluctuation of pressure, but if these parts are found to be entirely free from leakage, with all other parts apparently in good condition, the supply valve piston must be a trifle loose in the bushing or the fluctuation would continue.

BRAKES APPLYING.

112. W. W. S., Sumter, S. C., writes: Some time ago I noticed a switch engine coupled to four cars, and every now and then the brakes would apply and release, I ventured the opinion that as the independent brake was mostly used in switching service, that the piston and slide valve of the feed valve had likely become gummed up from disuse and permitted variations in brake pipe pressure during which time the variation applied the brake and would release as the feed valve opened to supply the leakage. Is this correct? A.—You are no doubt entirely correct in this assumption.

Compensation Law.

The blundering of State legislatures in trying to frame laws to deal fairly with railway men who have met with accidents has moved railroad organized labor to make a systematic attempt to help themselves. For this purpose an automatic compensation law, providing fixed amounts for loss of life and injuries, will be presented at the next session of Congress by the Eastern Association of Railroad Conductors and the Brotherhood of Railroad Trainmen.

Plain on the Face of It.

Plaisantin offered in payment of a bill a gold piece which had a supicious ring. "Here, you've given me one of those false coins that the counterfeiters have just been arrested for making," said the merchant. "Impossible," answered Plaisantin. "It is dated 1863; if it were false surely it would have been found out before this." —*The Literary Digest.*

If we like a man's dream we call him a reformer; if we don't like his dream we call him a crank.—*W. D. Howells.*

Electrical Department

The Development of the Electric Motor.

By A. J. Manson.

(*Continued from page 442.*)

In our previous articles we have outlined the history of the electric motor from its beginning up to the year 1890, when the City and South London Railway, England, was electrified, the trains being hauled by electric locomotives fitted with gearless motors. The electric railway was a commercial success in the year 1888, when Sprague opened the Richmond Road, and which was followed by electric roads all over the country. We mentioned the most important of these in our last number, and described the work done by Sprague and the Thomson-Houston companies in Boston. We described also the motor designed by the Westinghouse Electric Company, which was placed on the market at this time, as it was a motor which embodied many improvements quickly followed by the other railway motor manufacturers. The methods of controlling the speed of the motor used by the Sprague, Thomson-Houston and Westinghouse companies were described.

Motors built up to this time ran at very high speed, so that it was necessary to provide an intermediate shaft to reduce this speed to one suitable for street railways. The disadvantages of this are obvious, and the railway manufacturing companies had been working to develop a slower speed motor, and do away with this intermediate shaft. The first company to bring out a slow-speed motor, in this country, was the Thomson-Houston Company. They had two of these motors in test service on the West End Street Railway Company, Boston, during January, 1891. This motor had, however, only two poles, as had all of the previous motors.

It was only a month later that the Westinghouse Company had a single reduction motor in test service on the Pittsburgh Railways. The motor was very little, if any, larger than the previous motor built by this company, and was designed so that it could be mounted on the same trucks. By March this motor had been redesigned so that it was more compact than the test motor and more suitable for railway service. Fig. 11 shows the outline, mounted on the truck. Two spiral springs, one on each corner, supported the end of the frame (F) on the truck. As shown, this was a four-pole motor, which is the number of poles in all street railway motors of today. These four poles extended inward, and the field coils were slipped on over the pole pieces, and held in place by bolts passing through the frame. The upper half was hinged so that same could be swung back and the armature easily removed. The armature was wound so that only two brushes were required, which is the present practice. If the regular winding on the armature had been used four brushes would have been required, one for each pole. Eliminating two of these four brushes was an important step, as the remaining two could be placed on top of the commutator, where same were accessible and

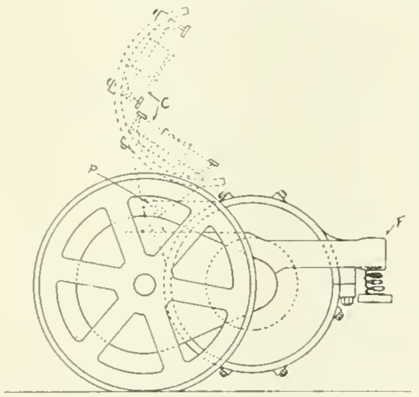


FIG. 11. WESTINGHOUSE SLOW SPEED MOTOR. 1891.

easy of inspection. The dotted section in Fig. 11 shows the upper half swung around the pivoted point (P), illustrating how easily the armature and field coils (c) could be removed for repairs. As mentioned above, the Thomson-Houston single reduction geared motor was built with two poles, whereas the Westinghouse Company's motor had four poles. Increasing the number of poles decreases the speed so that the slower speed was obtained without special design of fields and armature, and the motor had as wide a range of service as the two-pole double reduction motor, and was much better than the two-pole single reduction motor.

The Short Electric Company of Cleveland, Ohio, which recently commenced the manufacture of electric machinery had obtained a contract for equipping one hundred cars in Rochester, N. Y., with 2-15 h. p. motors per car. A double geared motor was used, the armature of which was entirely different from the type of armature used today and the type used by the Thomson-Houston and Westinghouse companies. It was made up of an iron ring with coils or bobbins of wire placed at regular intervals around the ring, each coil connecting to the commutator. This armature rotated between two sets of oval-shaped pole pieces, which were wound with wire forming the fields.

The Short company was very energetic, and by April, 1891, they had a gearless motor, the first in this country, in test service on the Cleveland street railway. The armature, of the same type as the ones in the motors for the Rochester street railway, was mounted in the center of a hollow shaft, six inches outside diameter, and five inches inside diameter, through which the axle passed. The commutator was also keyed to this shaft, and at either end, near the wheels, was keyed a heavy crank disc. A crank pin was fitted to the outside of each disc, and a corresponding crank pin was placed on the inside of either wheel, the two fastened together by a stiff spiral spring, which served as the method of drive. The rotation of the armature was transmitted to the wheels through these springs, one for right hand and the other for left hand rotation, thus forming a flexible connection. Just inside of the crank discs were placed bearings running on the hollow shaft and to which was clamped the motor frame, made in two parts. In other words, the motor was the same as previous ones, except that the armature shaft, which was carried by two bearings in the frame, was hollow, and the driving axle passed through the center. The motor frame was provided with four arms which rested on the truck frame, and when the motor was mounted in place on the truck, there was no dead weight on the axle, all the weight of the motor being transmitted to the journal boxes. Any deflections due to rough track, etc., was taken care of by the one-half-inch clearance from the axle to the inside of the hollow shaft.

This gearless motor of the Short Company was quickly followed by a gearless motor manufactured by the Westinghouse company. The single-geared motor of the latter company had proved such a success that a gearless motor was designed and two were built.

A hollow shaft was not used, and instead the armature was built up directly on the axle.

The frame of the motor was in two halves, split vertically and clamped around the armature. This arrangement was not as good as the hollow shaft of the Short motor, as dead weight was carried by the axle.

Short modified his original gearless motor, changing his armature to the form used by the other manufacturing companies, and by September, 1892, his latest type of gearless motor, which used the hollow shaft, but which had six poles instead of four poles, had been built.

The General Electric Company, incorporated in January, 1892, has brought out a double reduction geared motor and was developing a single geared motor before the end of the year. This company had been the Edison General Electric Company, but had absorbed the Thomson-Houston Company, which in turn had taken over the Short patents previous to this date.

The year 1893 was that of the World's Fair at Chicago. An electric

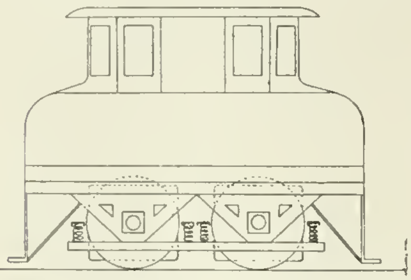


FIG. 12. LOCOMOTIVE BUILT BY GENERAL ELECTRIC CO. 1893.

railway, called the Intramural Railway, was constructed, and passenger cars fitted with four motors each were used to haul three trail cars. This distribution of motors under the car was indorsed by those in charge, although at that time the electric locomotive was in favor. Current was collected from a third rail by means of a flexible sliding shoe, similar to that used on elevated railroads today. This was the first time a sliding shoe had been used, although current had been collected from a third rail several years before by means of a wheel or a sliding copper brush, as described in previous articles.

In February of this same year the Liverpool Overhead Railway was operating two car trains, each car having one motor mounted on one of its trucks, these two cars being kept together as a unit. Cables through which the main current flowed connected the motors and also connected to the hand regulators or controllers, located one at the end of each car. Mounting motors on passenger cars and using same in groups as on the Liverpool Railway, or to pull trailers, as on the Intramural Railway, was strongly advocated instead of using an electric locomotive and was the forerunner of the multiple-unit system invented by Sprague, which we will describe in detail in its proper sequence.

By July, 1893, the General Electric Company had built at Lynn, Mass., an electric locomotive which was the largest high-speed electric locomotive in the world. An outline of this locomotive is shown by Fig. 12. Two electric motors of the Short six-pole gearless type were used, one mounted on each axle. These motors were connected to the drivers by a universal coupling, which allowed for motion between the motor and the drivers. They were supported on spiral springs resting on the side frames of the locomotive truck. Following are various dimensions and data applying to the locomotive:

Weight	30 tons
Diameter of wheels	44 ins.
Length	16 ft. 6 ins.
Height	11 ft. 6 ins.
Width	3 ft. 4⅛ in.
Draw-bar-pull	6,000 lbs.
Speed	30 m.p.h.

(To be continued.)

Treating Railroad Ties.

While some railroad systems have resorted to creosoting for the treatment of railroad ties, the Southern Pacific has engaged in a different sort of experiment for the same purpose. It has just removed from the Great Salt Lake 10,000 ties that have been in pickle in that highly mineralized body of water for three years. These have been shipped to Hazen, Nev., and will be placed in a roadbed of the Hazen cut-off, for test purposes.

The experiment is not altogether new, for there are ties in the old Promontory line of the Southern Pacific that were pickled in the same salt formation, and though in the track for forty years, have not shown deterioration.

The test to be made on the Hazen cut-off will be a severe one, owing to the soil of Nevada being of an alkali character. The ties, it is believed, have become so thoroughly impregnated with salt that they will act as a "ground" to the electric current in the block signal service. It is this condition, on the other hand, that makes them unfit to be used on the main line. It is thought that the preserving of ties and piling in Salt Lake may become an important industry, if tests now being made work out satisfactorily.

Apparatus designed to develop ozone are coming largely into use in office buildings and banks in the United States. The mixing of ozone with the stifling air of offices is said to produce excellent hygienic effects.

Iron.

Iron is a metal found in nearly all parts of the world. Its specific gravity is .7632, being, with the exception of tin, the lightest of all metals; and it differs from them all in the fact that, while they are made brittle by the action of heat, its malleability is thereby greatly increased.

Iron shrinks so much in cooling that a pattern for castings should be made an eighth of an inch larger per foot than the piece is required to be when cooled. It is heated so as to appear red in the dark at 752 degs. Fahr., and, in twilight, at 884 degs. It is made visibly red hot by day at 1,077 degs., and is thoroughly melted at 2,754 degs.

Cast iron expands 1/162,000 of its length, in each direction, for every degree of heat; and its greatest expansion is 1/1,170 of its length in the shade, and 1/1,000 of its length when exposed to the sun. It will bear an extension of 1/1,200 of its length without permanent or serious alteration.

Wrought iron expands 1/143,000 of its length for each degree of heat. It will bear an extension of 1/1,400 of its length, and a pressure of 17,800 lbs. to a square inch, without injury. Its cohesive power is diminished 1/3,000 by every degree of heat.

The resisting power of cast iron has been greatly overestimated. The best experiments show that a force of 93,000 lbs. to a square inch will crush it, and that it will not bear more than 15,300 lbs. without visible alteration.

The tensile strength of wrought iron rods has been tested in a variety of ways. It has been decided that no particular amount can be named as the actual strain a rod will resist, as it has been repeatedly proved that no rod is to be depended upon as uniformly perfect throughout, a lesser strain often parting a rod of large diameter. The cohesive power of cast iron is set down by most authors at 40,000, and of wrought iron at 60,000 lbs. to a square inch. A vertical rod, having a weight suspended at the lower end as in the case of rods supporting a tie-beam, not only supports the weight at the end, but must, in addition, sustain its own weight from the point at which it is suspended; so that a long rod will part near the upper sooner than the lower end. A perfect rod, therefore, decreases in strength as it is longer, and vice versa.

Where oil will not act as a cooling agent on a drill working in hard metals, turpentine used instead will permit the drill to take hold and retain its temper.

Let your discourse with men of business be short and comprehensive.—*Washington.*

General Foremen's Department

Organization—How Can Shop Foremen Best Promote Efficiency?

Paper read before General Foremen's Convention:

The Toledo Terminal Railroad under the able leadership of Master Mechanic C. L. Acker, the foremen of different departments are attending stated meetings and discuss on all subjects concerning their part of the work, each foreman gathering views and ideas from men under him, regardless of position, whether mechanic or apprentice, and thereby gaining many points and kinks, which, when sorted out in the above meetings, are bound to show the true situation. The master mechanic is enabled through the results of these meetings to put out weekly shop lists of all work expected out during the week, each department receiving a copy of the list, which is posted in some conspicuous place in the shop, accessible to all employees. This method enables each department to know just what the other department is aiming at and giving it all the assistance possible without friction; the men in the rank will do their best to help get these results without much supervision.

The ambitious official with winning ways and diplomatic handling of men will accomplish better results than the man that rules with an "iron hand" and wants everybody to be of his own way of thinking, listening to no man; this man will surely be crossed in the work done "when he is not looking," nor can he keep men any length of time; where, on the other hand, the man with strong personality, push and energy, diplomatic and winning ways, is a winner everywhere, and the men behind him will work with a good will and help him show results. He may be absent the greater part of the time without being disappointed in the result.

Men should be paid according to their merits, not all men giving the same service to their employer, hence should not be compensated alike; the lower paid man will strive to get higher wages and the higher man will try to keep above the rest, and in order to do that they must all show it in output and deportment; all are benefited by this method.

This method has been followed by the Toledo Terminal Railroad for some years with very good results. You will find by granting the employees some privileges, such as transportation, outings in a body, sympathy in case of need and, if necessary, assistance; privileges to attend monthly meetings; these meetings include lectures on airbrakes, locomotive running, car troubles, handling of drawbridges, interlockers, gasoline engines, telephone service. Lessons in mechanical drawing are given twice each week during school year; in fact, any subject on railroad running being discussed. In this we are substantially supported by our general manager, Mr. T. B. Fogg, and master mechanic, Mr. C. L. Acker, both gentlemen taking the liveliest interest in all employees, regardless of rank or position.

We find by this organization it is not necessary to go outside for foremen, as each employee has that feeling that he will be taken care of when opportunity offers, and the relation between employees and officials are always pleasant and harmonious. Where harmony exists there is sure to be results for the benefit of all concerned.

J. Schlageter,
Toledo Ter. R. R. General Foreman.

Electric Motor Axle Linings.

Apart from what may be termed the general repairs of electric motors on the Interborough Rapid Transit Company's roads, which include the Elevated and Subway railroads in New York City, and on which there are at the present time more than 3,000 motor cars, there are several special mechanical appliances which, until recently, have been supplied from foundries and factories, but which the company's mechanical department is now producing with a degree of perfection hitherto unattained, and, at a cost that is in marked contrast, in point of economy, with previous prices.

Among these perhaps the most important is what are known as motor axle linings. In a motor truck there are in addition to the two outer bearings of the truck axle, two inner bearings attached by housings to the motor, and by which the motor is supported or attached to the truck axle. The motion of the truck axle is received through a large spur wheel containing over 60 teeth, while the pinion on the armature shaft is a much smaller wheel containing 16 teeth. The armature axle is supported in suitable housings in the motor shell, the motor axle linings referred to form the bearings for the motor on the main axle. These motor axle linings are subjected to great stresses, as the strain of acceleration as well as the quick acting braking forces all find a common point of resistance with consequent wear and tear on the motor axle linings.

These bearings must necessarily completely encircle the axle, and for the convenience of being placed in position as well as being withdrawn for repair or replacement, must be at least in two sections, each half being the exact duplicate of the other. In fact the chief trouble in refitting these axle linings has been found to be in the slight variations that occur in the linings as hitherto supplied to the company's stores. It will readily occur to mechanics of even the widest experience, that it is no easy matter machining parts of the kind alluded to and producing each part perfectly alike in every detail, and that even with the most careful calipering and adjusting of tools the tendency to variations are very great. The common method used was a planing the contacting surfaces of the two castings and after soldering them together adjust them in a lathe as correctly as possible and finish outside and inside, after which the parts were readily separated by being slightly heated. The inaccuracies were such that many of the segments were useless.

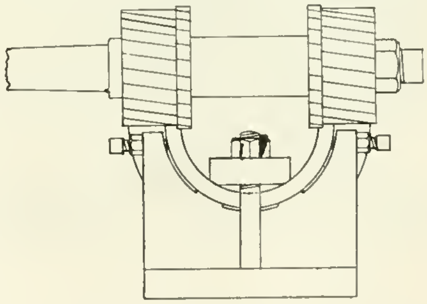


FIG. 1.

In describing and illustrating the improved method, the dimensions of the motor axle linings as at present in use may be stated—length, 11 ins., outside diameter, 6¼ ins., inside diameter, 5¼ ins., flange diameter, 8 ins., flange thickness, ¾ in. The broadened flange bearing is next to the wheel, and there are two pairs of these bearings or linings on each motor. When worn they may be rebabbited and afterwards rebored, while the flanges that wear rapidly may be also faced off and reinforced, by such thickness of patches as may admit of being machined to the standard size.

Figs. 1 and 2, illustrate the first operation. The castings are freed from sand and burs and one-half of lining is placed in a cradle adapted to milling machine or lathe. The castings are held in place by a strap secured by two studs, in addition to which there are four set-screws passing through the cradle near its upper edge, the points of the screws securely preventing the casting from springing outwards during the milling operation.

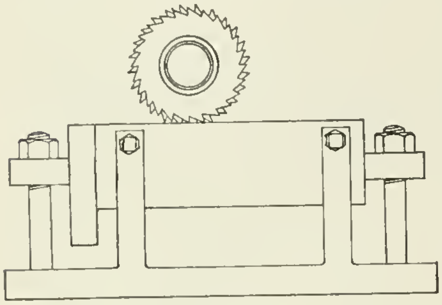


FIG. 2.

It will be noted that the milling cutters are so arranged that a recess is cut in the inner edge of the linings. This recess is adapted to hold the castings in place in the succeeding operations. The two linings being reduced to two equal halves, with the addition of the amount necessary for turning off outside and inside. In castings of the size we are describing ⅛ in. all around will be found sufficient.

Fig. 3, shows section of mandrel used for holding linings and clamp for retaining them in place upon the mandrel.

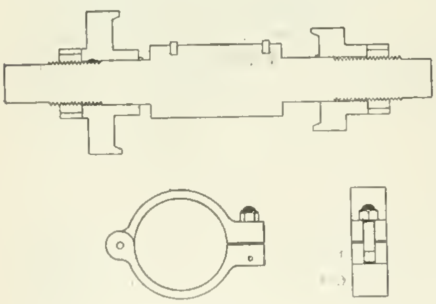


FIG. 3.

There are two keys that project from the outer edge of the mandrel, and are adapted to fit into the indented grooves produced in milling the linings, and together with the binding clamp keep the linings securely in place upon the mandrel. It will also be noted that there are two retaining heads slidably engaged upon the mandrel furnished with tapering projections adapted to engage the two ends of the linings. Adjustable nuts readily tighten or relieve the linings as desired, and, it may be added, the threaded part of the mandrel has the threads slightly reduced or flattened so that the retaining pieces may slide securely and readily upon the mandrel. The nuts securing the sliding pieces are slotted and adapted for spanner wrench. The details of the retaining clamp are also shown. It will be observed that the stud by which the clamp is tightened is flexibly held by a pin so that the clamp may be readily opened or closed.

Fig. 4 shows linings on mandrel securely held in place by clamp with grooves meshing on keys on either side and end of mandrel as already described. Sufficient space may be left between retaining heads and linings for lathe tool to finish both ends of linings to required length. At this time the flange may also be reduced to the finished outside diameter, and the other end of lining may also be finished an equal length along its outer surface. When this is completed the sliding retaining washers may be moved against the ends of the linings and secured in place by the nuts provided on the mandrel.

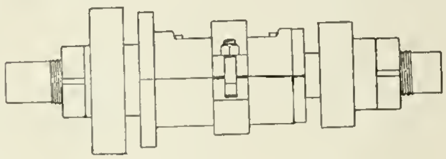


FIG. 4.

Fig. 5 shows retaining heads and washers in place securely holding linings when clamp is removed, when the outer surface of the linings may be finished to the correct size. It will be noted on Figs. 4 and 5 that the upper lining is indented some distance along its center. This opening is cut through, and this lining is known as the open half, the space being filled with woolen waste saturated with lubricants when in service. The two projections shown in the indented parts are pins fitted in two holes in the casting and penetrate into two holes in the motor and act as guides lengthwise in holding the linings in place.

Fig. 6 shows linings with outer surfaces finished and placed in jig adapted to securely hold the linings, and is of the same internal diameter as the outer diameter of the linings. The upper part of the jig is split so as to receive the linings readily and when the adjustable bolt is tightened the linings are securely held in place. A boring-bar fitted with tool adapted to cut the proper size may be readily run through the inner face of the linings, the amount cut off entirely clearing away all traces of the two indented grooves used in the first operations. In addition to the boring tool an extra cutter may also be used in cutting a fillet on the flanged end as desired.

The axle linings machined in this way are not only rapidly finished, but have a degree of exactness that could not be surpassed, so that the important element of being readily interchangeable is complete. The mechanical details of this fine method of

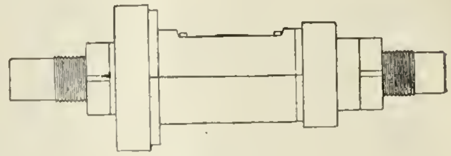


FIG. 5.

machining the motor axle linings has been perfected by Mr. Edward Thomson, assistant machine shop foreman, who together with Mr. William L. Calver, the accomplished and gentlemanly foreman, have perfected many mechanical devices that greatly facilitate the growing requirements of the Interborough Rapid Transit Railroad. We are indebted to them for many courtesies shown in regard to the details of electric motor work, and for the benefit of our readers we hope to enjoy a continuance of their favors.

Fast Time.

In a running time of eighty minutes, a special Pennsylvania test train re-

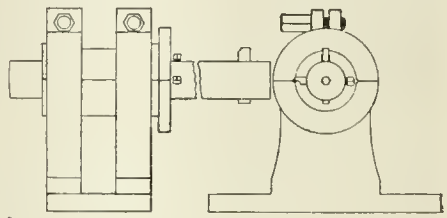


FIG. 6.

cently covered the 105 miles from Valparaiso to Ft. Wayne, Ind. The real time was eighty-four minutes, but a four-minute delay was caused by a milk train at Hamlet.

The train was drawn by a monster stoker equipped engine and consisted of ten coaches, each weighted down with 40,000 pounds of rails to bring them to standard weight.

The run was but one of many which have been held and will be held by the Pennsylvania in the most extensive tests the operating department has made.

A nation cannot last as a money-making mob; it cannot with impunity—it cannot with existence—go on despising literature, despising science, despising art, despising compassion and concentrating its soul on pence. . . . He only is advancing in life whose heart is getting softer, whose blood warmer, whose brain quicker, whose spirit is entering into living peace.—*Ruskin.*

Items of Personal Interest

Mr. Robert G. Garden has been appointed superintendent of the Missouri Pacific, with office at Atchison, Kan.

Mr. David McKenna, foreman of the car department of the International & Great Northern at Palestine, Tex., has resigned.

Mr. Fred A. DeWolf has been appointed acting shop superintendent of the United Railways of Havana, with office at Havana, Cuba.

Mr. Horace V. Harris, general foreman of the Tampa Northern, has been appointed master mechanic, with office at Tampa, Fla.

Mr. R. J. Williams has been appointed superintendent of shops of the Cleveland, Cincinnati, Chicago and St. Louis, at Beech Grove, Ind.

Mr. J. W. Roberts has been appointed superintendent of the car service of the Vandalia, with office at Terre Haute, Ind.

Mr. H. A. Henshaw has been appointed assistant general manager of the Salem, Falls City & Western, with office at Dallas, Ore.

Mr. C. L. Maybe has been appointed superintendent of the Southern Kansas division of the Missouri Pacific, with office at Coffeyville, Kan.

Mr. George H. Campbell, assistant to the president of the Baltimore & Ohio, has been elected president of the Kentucky & Indiana Terminal.

Mr. J. J. Corcoran, trainmaster of the Cincinnati, Hamilton & Dayton, has been promoted to be superintendent of the Toledo division of the same road.

Mr. Russell Underwood, son of Mr. F. D. Underwood, president of the Erie, has been appointed manager of the Baltimore & Ohio's new Mt. Jewett route.

Mr. George H. Gray has been appointed assistant superintendent of the Northern division of the Colorado & Southern, with office at Denver, Colo.

Mr. Charles H. Moore has been appointed principal assistant engineer of the Erie, with office at New York. Mr. Moore is an engineer of fine training and wide experience.

Mr. F. W. Schulz, master mechanic of the Missouri Pacific at Atchison, Kan., has been made general foreman of the Union Pacific shops at Cheyenne, Wyo.

Mr. H. E. Bennett, general machine foreman of the Monon shops at Lafayette, Ind., has resigned, and Mr. F. M. King has been appointed to succeed Mr. Bennett.

Mr. H. E. Richards has been appointed assistant superintendent of the Union Pacific, with office at Ellis, Kan., succeeding Mr. F. M. Jones, who has been transferred.

Mr. R. E. French has been appointed master mechanic of the Liberty-White Railroad, with office at McComb City, Miss. Mr. French succeeds Mr. Honea, who has resigned.

Mr. William Wainwright, formerly second vice-president of the Grand Trunk and Grand Trunk Pacific, has been appointed senior vice-president of the Grand Trunk.

Mr. Newman Erb has been elected president of the Minneapolis & St. Louis and the Iowa Central, succeeding Mr. T. P. Shonts, resigned. Other officers have been re-elected.

Mr. H. R. McLaughlin, superintendent of the Monongah division of the Baltimore & Ohio, has been transferred to Baltimore, and will have charge of the discipline reports.

Mr. C. D. Burrows, purchasing agent of the Maine Central, has been appointed also purchasing agent of the Sandy River & Rangeley Lakes, with office at Portland, Me.

Mr. W. R. Duff, who resigned as general foreman of the Trinity & Brazos Valley, has been appointed master mechanic of the International & Great Northern at Palestine, Tex.

Mr. M. M. Reynolds, formerly third vice-president of the Grand Trunk, has been appointed vice-president of the Grand Trunk and third vice-president of the Grand Trunk Pacific.

Mr. I. H. Luke has been appointed superintendent of the fourth division of the Denver & Rio Grande, with office at Alamosa, Colo., succeeding Mr. S. H. Barnes, who has resigned.

Mr. W. F. Ray has been appointed superintendent of the Concord and Southern divisions of the Boston & Maine. The two divisions have been consolidated into one division.

Mr. J. W. Higgins has been appointed acting general manager of the Missouri Pacific, Mr. A. W. Sullivan, manager, being granted leave of absence. The main office is at St. Louis, Mo.

Mr. W. R. Stafford has been appointed chief engineer of the Grand Trunk, with office at Montreal, Canada. Mr. Stafford was for many years engaged in the engineering department of the Illinois Central.

Mr. Theodore O. Sechrest, general master mechanic of the Queen & Crescent, has resigned and will be succeeded by Mr. J. Quigley, master mechanic of the Alabama Great Southern.

Mr. J. J. McCann, formerly superintendent of the Scranton division of the Delaware, Lackawanna & Western, has resigned, and is succeeded by Mr. F. M. Nowell, with office at Scranton, Pa.

Mr. C. D. Young, assistant engineer of motive power of the Pennsylvania Lines West, at Pittsburgh, Pa., has been appointed engineer of tests of the Pennsylvania, with office at Altoona, Pa.

Mr. Morris McDonald, vice-president and general manager of the Maine Central, has been elected also president and general manager of the Sandy River & Rangeley Lake, with office at Portland, Me.

Mr. Frederick Kirby, road foreman of engines on the Philadelphia division of the Baltimore & Ohio, has been transferred to a similar position on the Chicago division, with office at Garrett, Ind.

Mr. Grant Hall, superintendent of motive power on the western lines of the Canadian Pacific has been appointed assistant general manager, and Mr. Charles H. Temple succeeds Mr. Hall.

Mr. J. W. Gibbs, foreman of locomotive repairs of the Southern Railway at Asheville, N. C., has been appointed master mechanic of the Virginia & Southwestern, with office at Bristol, Va.-Tenn.

Mr. C. E. Carson, superintendent of the Western division of the Chicago Great Western at Clarion, Iowa, has been appointed superintendent of the Northern division, with office at St. Paul, Minn.

Mr. W. P. Hobson, master mechanic of the Cincinnati division of the Chesapeake & Ohio, at Covington, Ky., has been appointed superintendent of motive power of the Kentucky and Indiana division.

Mr. W. B. Cronk has been appointed superintendent of the Grand Trunk Pacific, with offices at Regina, Sask., and Mr. I. A. MacPherson has been appointed general assistant, with office at Winnipeg, Man.

Mr. R. H. Baker purposes resigning the presidency of the Texas Central, and will be succeeded by Mr. A. A. Allen, president of the Missouri, Kansas & Texas, of which the Texas Central is now a part.

Mr. L. L. Tallyn, superintendent of water service of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed division engineer of the Scranton, Bangor & Portland divisions, with office at Scranton.

Mr. J. C. Baxter, division engineer of the Oregon Trunk Railway at Portland, Ore., has been appointed division engineer of the Oregon Electric Railway, and is in charge of the line between Salem, Ore., and Albany.

Mr. N. A. McKee, formerly assistant foreman of the Lake Shore & Michigan Southern shops at Collinwood, Ohio, has been appointed superheater inspector for the Locomotive Superheater Company, New York, N. Y.

Mr. J. Foster, master mechanic of the St. Louis & San Francisco at Kansas City, Mo., has been promoted to mechanical superintendent of the second district on the same railroad, with offices at Springfield, Mo.

Mr. E. E. Alexander, formerly shop engineer at the Cooke works of the American Locomotive Company, Paterson, N. J., has been appointed chief draughtsman of the Taylor Iron and Steel Company, High Bridge, N. J.

Mr. H. W. Stanley has been appointed assistant general manager of the Seaboard Air Line, this office having been created last month, and the office of general superintendent of transportation, lately held by Mr. Stanley being abolished.

Mr. Thomas J. Freeman, president of the International & Great Northern, has removed his headquarters from Houston, Tex., to New Orleans, La. His many personal friends took the occasion to present him with a silver service.

W. A. Garrett, vice-president of the T. H. Symington Company, will retire to reenter railroad service. Mr. Garrett was formerly president of the Seaboard Air Line, and earlier in his career in railroad operation he was connected with the Wabash and the St. Louis Terminal.

THE OLD GUARD, WESTINGHOUSE AIR BRAKE COMPANY.

First row reading from left: E. L. Adreon, H. H. Westinghouse, John D. Miller, S. T. Kidder, S. D. Hutchins.

Second row reading from left: Charles Higham, F. M. Nellis, C. P. Cass, F. B. Farmer, J. H. Brown, A. B. Brown, T. A. Hendendahl.

Mr. F. A. Linderman, formerly supervisor of boilers of the New York Central Lines at West Albany, N. Y., has been appointed district superintendent of motive power on the same railroads, with headquarters at Oswego, N. Y.

Mr. W. L. Kellogg, superintendent of motive power of the Cincinnati, Hamilton & Dayton, has resigned to take service with the Pere Marquette at Detroit, Mich., and Mr. H. H. Hale has been appointed master mechanic of the same road at Cincinnati to the vacancy caused by Mr. Kellogg's resignation.

Mr. George J. Berry, general manager of the Canadian Pacific Western Line, succeeds Sir William Whyte as vice-president and general manager. Mr. Berry is a native of Montreal, and began as a clerk in the purchasing department of the Canadian Pacific.

Mr. M. J. McCarthy, superintendent of shops of the Cleveland, Chicago & St. Louis, the Peoria & Eastern and the Cincinnati Northern, at Beech Grove, Ind., has been appointed superintendent of motive power, with headquarters at Beech Grove, Ind. Mr. R. J. Williams succeeds Mr. McCarthy.

Mr. H. C. Gillespie, general foreman of the Chesapeake & Ohio shops at Russell, Ky., has been appointed master mechanic of the Chicago division, with office at Peru, Ind. Mr. Gillespie succeeds Mr. C. H. Doebler, who has been appointed master mechanic of the Huntington division, with office at Huntington, W. Va.

The following appointments have been announced at the headquarters of the Union Pacific: Mr. T. M. Orr, assistant general manager, has been made assistant to the president. Mr. J. A. Munroe, general freight traffic manager, becomes vice-president, in charge of traffic, and Mr. W. B. Scott, assistant traffic director, is appointed vice-president and general manager. The offices are in Omaha, Neb.

A circular has been issued by G. J. Ray, chief engineer of the Lackawanna, announcing the following changes: L. L. Tallyn appointed division engineer of the Scranton and Bangor and Portland divisions, in charge of engineering and water service, succeeding R. M. White, assigned to duties in another department; office at Scranton, Pa. George E. Boyd appointed superintendent of bridges and buildings, vice W. B. Hixson, deceased. Mr. Boyd will have jurisdiction over bridges and buildings on the Scranton and Bangor and Portland divisions, and bridges and buildings and water service on the Buffalo, Syracuse and Utica divisions, with office at Scranton, Pa.

Mr. L. H. Bryan, the very efficient secretary of the Railway General Foremen's Association, has left the position of general foreman of the Duluth & Iron Range shops at Two Harbors, Mich., to enter the employ of the Chicago Pneumatic. Mr. Bryan has been a very energetic secretary, and the present prosperous condition of the International Railway General Foremen's Association is largely due to his alluring work in drawing in new members. The personal popularity of Mr. Bryan will make him a valuable asset for the Chicago Pneumatic Tool Company. Mr. Bryan possesses the qualities that come from experience in positions where tools were scarce, and his inventive faculty was displayed on many occasions, so that in his position he may be said to be the right man in the right place.

Mr. John F. McIntosh, the able locomotive superintendent of the Caledonian Railway, has received from King George V an unexpected honor, the first given to a railway man. Mr. McIntosh has been in the habit of riding on the locomotive pulling the royal train, and was performing that duty on October 9. When the train stopped that day at Perth, the King called Mr. McIntosh into his carriage and conferred upon him the honor of Member of Victoria Order, a civilian order similar to the military order of the Victoria Cross. Mr. McIntosh is a wonderfully popular railway official, and the honor conferred upon him has raised the stature of all Caledonian men about a full inch.

Mr. B. D. Caldwell, for the last nine years vice-president of the Lackawanna, has left railroad life, having been elected president of Wells, Fargo & Co. Mr. Caldwell, who was born in California in 1858, entered railway service in 1873 as clerk in the auditor's office of the Vandalia Line at Terre Haute, Ind. Besides having the physical activity that makes a good golf player, Mr. Caldwell was an active student of all railroad problems bearing on the business he was engaged upon, and soon commended himself for advancement, which reached him in due course. A paper on "Progress," which he read before the New York Railroad Club several years ago, was one of the most thoughtful productions ever submitted to that organization. The paper begins: "Progress is based on principle, not policy; it moves forward, never backward; always toward the right and against wrong." That was a good text and seemed to form the inspiring keynote of Mr. Caldwell's career, and, doubtless in his new sphere of action he will continue to give proof of the same qualities of head and heart.

Obituary.

JOHN SOUTHER.

There are few men alive today who ran Souther locomotives which were built under the supervision of John Souther in the Globe Locomotive Works, South Boston, away in the 40's. Yet that same John Souther has just passed away at Newton, Mass., in the ninety-sixth year of his age.

John Souther was born March 1, 1816, in South Boston. At the age of fifteen he was apprenticed to the carpenter trade, he mastered it thoroughly so at the age of nineteen he was put in charge on the construction of a large building with thirty-five men working under him. From the beginning he proved himself a master workman skilled in handling men, but also an inventor of commanding ability. He was a man who inherited mechanical skill from a line of ancestors who had been leaders in the industrial development of New England.

Like many other first-class carpenters, John Souther became a pattern maker, which gave wide scope to his inventive and constructive tendencies. The first pattern-making work which he did was at Alger's Iron Foundry in South Boston, where he was engaged making patterns for cannon and other ordnance.

A financial panic having struck the United States in 1837, Mr. Souther went to Cuba and was engaged in a foundry that made a specialty of sugar machinery. This business he took up on returning to the United States a few years later. In 1839 Hinkley & Drury began building locomotives and John Souther went to work for them as pattern maker, and under lock and key made all the patterns for their first engine, the Lion. Three

JOHN SOUTHER.

years later he started the Globe Locomotive Works in South Boston and went vigorously into the business of locomotive building. He had been thus engaged when the Tredegar Works of Richmond prevailed upon him to join them in locomotive building, and accordingly he moved most of his machinery and a large force of men to Richmond. That line of work was carried on until the war broke out, which ended Mr. Souther's career as a locomotive builder.

John Souther invented the first successful dredger, also the first steam shovel, effecting many improvements upon these devices and bringing them up to present-day appliances. From Mr. Souther's factory in Boston a steam excavator was sent to Peru to dig gold, which was the beginning of a good trade in that line, a trade that embraced Great Britain, Japan, the Amoor River, Russia and the Trans-Caspian. Another important invention of his was the automatic fire extinguisher.

Mr. Souther was one of the most influential promoters of medical education for women, as he was the first employer of labor in New England to establish a ten-hour work day. Before that was done twelve hours or more formed the labor day. He was also particularly interested in the better training of young men and did much to bring about the marked improvement in the apprenticeship system which has been taken up by nearly all of the leading railroads.

ROBERT MATHER.

Robert Mather, chairman of the Westinghouse Electric Company, and past president of the Chicago, Rock Island & Pacific Railway, died at New York October 24. His life is a shining example of triumphant self-help, combined with success due to persistent industry. Mr. Mather was a railway man who, by unaided perseverance, forced himself upward from the lowest to the highest grade of railway life. In 1872, when thirteen years of age, he went to work in a factory, and a few years later in the master mechanic's office of the Chicago, Burlington & Quincy at Galesburg, Ill. While there he learned telegraphy and rose to be a telegraph operator. This rise did not satisfy his ambition. By working overtime he secured sufficient money to enter college, from whence he graduated in 1885 as A. M., after overcoming many difficulties. Then he studied law and was admitted to the Illinois bar. After laboring three years as a general practitioner, he was appointed attorney for the Chicago, Rock Island & Pacific, rising rapidly to the position of president of that road. Genuine merit, a naturally clear grasp of business details and grim persistent labor were the forces that won to Robert Mather the exalted positions reached.

F. H. SCHEFFER.

Mr. F. H. Scheffer, superintendent of machinery of the Nashville, Chattanooga & St. Louis, at Nashville, Tenn., died last month at Chicago, Ill. Mr. Scheffer was a graduate of the Polytechnic Institute at Munich, Germany. At the age of twenty-five he emigrated to America and worked as a machinist on the Pennsylvania Railroad. In 1883 he was appointed draughtsman on the New York, West Shore & Buffalo. He worked as draughtsman on several railroads, and in 1887 he went to the Nashville, Chattanooga & St. Louis Railroad as chief draughtsman. In 1903 he was acting as general foreman, from which position he was latterly appointed superintendent of machinery. He was in his fifty-seventh year.

JAMES WATSON.

Mr. James Watson, the oldest locomotive engineer on the Lackawanna Railroad, died of pneumonia at Binghamton, N. Y., October 20. He was one of the veterans who began work sixty years ago on the first track of the great Pennsylvania system, the Camden & Amboy. He ran the famous John Bull, now preserved in the Smithsonian Museum at Washington. The Camden & Amboy was a sort of training school for railroad men, and Mr. Watson left the road after seventeen years' service to join the Lackawanna & Western Railroad, where he remained to the end of his career. He was a leading member of the Brotherhood of Locomotive Engineers at Binghamton, and was a delegate to several of the annual conventions, and was much esteemed by all who knew him, especially among the active railway men in the Eastern and Middle States and Canada.

WILLIAM DANA TAYLOR.

Professor William Dana Taylor, who filled the chair of Railway Engineering in the University of Wisconsin from 1901 to 1906, died at his residence in Chicago on August 26, 1911. He withdrew from his university duties in February, 1906, to take up active work as chief engineer of the Chicago & Alton Railroad. In 1907, through a reorganization of railway properties, he was made chief engineer of the Toledo, St. Louis & Western Railway, and two years later, of the Iowa Central and the Minneapolis & St. Louis Railroads. He continued in active discharge of his professional duties practically to the time of his death.

HENRY W. FULLER.

Mr. Henry W. Fuller, passenger traffic manager of the Chesapeake and Ohio, died at Washington, D. C., on October 13. Mr. Fuller was a native of New York State, hailing from Corning, and began his railway career as a brakeman. He was in the employ of the Chesapeake & Ohio in various capacities for over thirty years.

ALONZO R. BLAKESLEE.

Mr. Alonzo P. Blakeslee, formerly division superintendent of the Lehigh Valley and general manager of the Mauch Chunk, Summit Hill & Switchback, died last month, aged 64 years.

JOHN W. JONES.

Mr. John W. Jones, a pioneer railroad builder, died recently at Wichita, Kan., aged 77 years. He was for several years a superintendent on the Pennsylvania.

Symons on Scientific Management.

The absurd claims made by certain lawyers and quack engineers before the Interstate Commerce Commission and widely spread through magazines and newspaper articles to the effect that with "scientific management" railway companies could save one million dollars a day has never been exhaustively refuted until Wilson E. Symons took up the pretentions and subjected them to scientific analysis. The result of Mr. Symons' labors was made public in a paper read by him at the Franklin Institute, Philadelphia, on October 18.

It would be difficult to find in the country a man better equipped by experience and knowledge to perform the work Mr. Symons has put on record. He is a man possessed of mature experience as an engineer, a general foreman, master mechanic and superintendent of motive power, besides acting for years as specialist investigating and estimating the value of railway property.

The plan of investigation adopted was to show all revenues and expenditures; the salaries and wages paid to the different classes being noted with the possibilities of effecting savings by the so-called scientific management. The conclusion worked out was that a large proportion of the working forces cannot be touched by any expense saving scheme. The entire force of officers and employees was divided into eighteen classes and the remuneration given to each class stated. The total number of persons employed is 1,502,823, and the entire remuneration was figured to be $988,323,604; yet the theorists pretend to reduce this one million a day, or $365,000,000 a year.

Of the eighteen classes of employees, only about three classes could be touched by a wage-reducing process, those involving the largest expenditures being protected by contracts that no railway company would attempt to violate. The only classes susceptible of wage reduction are concluded to be telegraph operators and dispatchers and shopmen. Should this line of paring down be pushed to the utmost the greatest saving possible would aggregate $78,242 a day instead of one million dollars. This would involve dangerous conflicts, for most of the shopmen are organized and thoroughly aggressive. The proposition to apply the plan of scientific management to all running repairs of railway equipment, especially to locomotives, is not only impracticable, but strongly emphasizes its advocates as lacking in the elementary knowledge of locomotive operation and maintenance essential in advising or directing others.

As the current repairs to railway equipment are of a character calling for treatment by competent, experienced mechanics, the possible economies from the adoption of scientific management must necessarily be confined to several shops entirely separate from running repair shops, and based on manufacturing operations.

Mr. Symons then proceeds to illustrate a variety of shop operations by means of reproduced photographs, the work being upon broken frames of various kinds and a broken fire box ring. Repairs of that character, he holds, require special treatment by first-class mechanics. In addition to these examples, the paper says, with truth, that there are numerous other operations in the repairing of locomotives that seem the same to a superficial observer, but require entirely different treatment, facts familiar to every shopman of experience.

The scientific management advocates have boasted lustily about the saving their system has effected on the Santa Fe, claims that Mr. Symons has proved to be utterly unfounded.

Mr. Brandeis having stated in a magazine that our railroads waste $2,000,000 a year by purchasing lubricating oil from the Standard Oil Company, Mr. Symons analyzes the assertion, and shows that the companies are saving $10,000,000 a year by their system of contracting for lubricating oil.

We shall do ourselves and our readers the satisfaction of publishing more of this paper in future issues.

Conventions of railroad men are now so common that our readers may be interested in what brought about the first meeting of the kind. When railroad operation was about twenty-four years old, in 1854, a convention was called of all railroads in Ohio and Indiana to meet in Columbus, Ohio, for the purpose of considering a variety of questions that had arisen concerning transportation of freight and passengers. The most important business transacted was cutting of free passes to people without railroad affiliations. The "deadhead" was publicly denounced for the first time.

At the Traveling Engineers' Convention, Mr. E. L. Sawyer, of the H. G. Hammett Company worked hard to have a resolution passed calling upon the association to recommend that all travelers who now waste 25 cents upon sleeping car porters, to have the money given to the engineer who brings the train safely into the terminus. Mr. Sawyer had many sympathetic listeners but he failed to bring them up to the voting point. Better luck next time, he says.

Mikado Type of Locomotive for the Missouri Pacific

One of the most encouraging signs of the times is the fact that the leading railroads are nearly all increasing their equipment of locomotives and rolling stock, and nearly all of them are procuring engines and cars of a heavier type than formerly in use. The fine equipment of the Missouri Pacific Railway system, which has been distinguished by the best class of Consolidation locomotives, is being replenished with a large consignment of locomotives of the Mikado type. The American Locomotive Company has just delivered the first of these, and the Schenectady Locomotive Works have not been so busy in several years as they are at the present time, and it is expected that a large number of these fine locomotives, an illustration of which accompanies this brief description, will be in service before the end of the year.

The principal features of this type of locomotive have been frequently described in our pages, and it will only be necessary to peruse the table of dimensions and the description of material to form an estimate of the fine quality and great tractive power of these powerful locomotives. Those who are familiar with the long stretches of the Missouri Pacific, especially from Kansas City to Pueblo, will know that the elements of durability is a very essential requisite to such service. The distances required to be run by one locomotive would seem incredible to those who are only familiar with Eastern service, and the result of the operations of these locomotives will be watched with interest, as the tendency toward heavier locomotives seems to keep pace with the requirements of the service.

The following are the principal dimensions of the new type of locomotives from the data on hand at the locomotive shops at Schenectady, N. Y.:

Cylinder—Type, simple piston; diameter, 27; stroke, 30.

Track gauge—Valve, 4 ft. 8½ ins.; tractive power, 50,000.

Wheel base—Driving, 11 ft. 6 ins.; rigid, 16 ft. 6 ins.; total, 34 ft. 9 ins.; total, engine and tender, 67 ft.

Weight—In working order, 275,000; on drivers, 209,500; engine and tender, 431,100.

Heating surface—Tubes, 5⅜ ins., 692 sq. ft.; 2 ins., 1,922 sq. ft.; firebox, 254 sq. ft.; arch total, 2,868 sq. ft.

S. H. surface, 558 sq. ft.

Grate area, 49.5 sq. ft.

Axles—Driving journals, main, 11 x 12 ins.; others, 10 x 12 ins.; engine truck, journals, diameter, 6½ ins.; length, 12 ins.; trailing journals, diameter, 8 ins.; length, 14 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.

Boiler—Type, conical conn.; O. D. first ring, 75¾ ins.; working pressure, 170 ins.; fuel, soft coal.

Firebox—Type, wide; length, 108⅛ ins.; width, 66 ins.; thickness of crown, ⅜ ins.; tube, ⅝ ins.; sides, ⅜ ins.; back, ⅜ ins.; water space, front, 4½ ins.; sides, 4½ ins.; back, 4 ins.

Crown staying, radial.

Tubes—Material, see below; number, 224; diameter, 2 ins.; length, 16 ft. 6 ins; gauge, 11 B. W. G.

Boxes—Driving, main and others, C steel.

Brake—Driver, West. Amer. outside; equalized on back of drivers; tender, West.; air signal, West.; pump, 8½ ins. C. C.; reservoir, 1-22½ x 1-20 ins., 1-22½ x 72 ins.

Engine—Truck, radial; trailing truck, A. L. Co.'s latest type, outside bearing; exhaust pipe, single; nozzles, 7⅛ ins, 7⅜ ins., 7⅝ ins.; grate, style, Ry. Co.'s style, rocking; piston rod, diameter, 4½ ins.; piston packing, C. I. rings; smokestack, diameter, 18 ins.; top, above rail, 15 ft. 7⅝ ins.

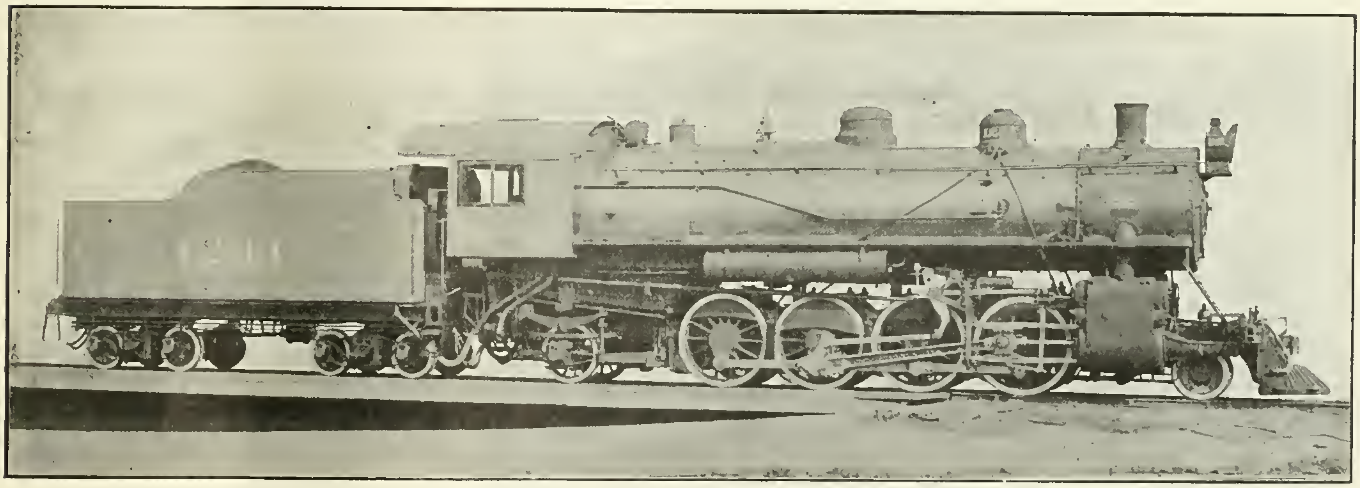
Tender—Frame, cast steel.

Tank—Style, hopper type; capacity, 8,000 gallons; fuel capacity, 14 tons.

Valves—Type, piston; travel, 6 ins.; steam lap, 1 in.; exhaust lap, line and line.

Setting, 3/16 in. lead.

Wheels—Driving, diameter outside tire, 63 ins.; centers, diameter, 56 ins.; material, main and others, cast steel; engine truck, diameter, 33½ ins.; kind, Midvale; trailing truck, diameter, 42 ins.; kind, spoke center; tender truck, diameter, 33 ins.; kind, Midvale.



2—8—2 TYPE OF LOCOMOTIVE FOR THE MISSOURI PACIFIC.

J. W. Small, Supt. Machinery. American Locomotive Co., Builders.

5 engines, seamless steel tubes.

43 engines, spellerized steel tubes.

1 engine, hot rolled seamless steel tubes.

1 engine, coal drawn, seamless steel tubes.

30 boiler flues 5⅜ ins. diameter, No. 9, B. W. G.

Locomotive Superheater Co.'s fire tubes superheater applied.

Extending the Grand Trunk.

Track laying on the main line of the Western division of the Grand Trunk Pacific has been extended from Wolff's Creek to Fitzhugh, west of the Atthabask River, in Rocky Mountains, which is 1,027 miles west of Winnipeg, and will be the divisional point for that section. Construction work is under full headway to Tete Jaune Cache, on the Fraser River. It is expected that track laying will reach this point, 1,094 miles west of Winnipeg, before the close of the year.

Conventions Will Meet in Atlantic City.

The Joint Committee of the Railway Master Mechanics and of the Master Car Builders' Association met in New York October 24, for the purpose of selecting a place for holding the next annual conventions. Early in the proceedings the startling proposition was brought up for discussion that the practice of having manufacturing exhibits be abolished to reduce the number of people attending these conventions and so enable the meetings to be held in any place capable of providing moderate hotel accommodations. A vote was taken on the place preferred should the new policy be adopted, and it resulted in New York being temporarily favored.

Mr. J. H. Manning, S. M. P. of the Delaware & Hudson Company, submitted a proposition to erect a building in Saratoga, N. Y., suitable for the accommodation of conventions if certain conditions were complied with. These the committee declined to guarantee.

Mr. Geo. D. Stafford, president of the Railway Supply Men's Association, made a statement relating to the accommodation available for the members at various places. After some discussion the members of the Joint Committee voted to hold the conventions at Atlantic City, beginning on June 12.

The members of the Joint Committee engaged in a lengthened discussion on the practice of accepting entertainment from the railway supply interests, and decided inclination was manifested to stop having receptions, balls, chair rides and other forms of diversions in the past given for the amusement of the ladies. Chair riding was grimly cut out, and agreement made that the members would pay half the expense of any entertainment provided. The meeting was of the most interesting and progressive kind.

Minerals in British Columbia.

A report recently made by the Bureau of Mines of Victoria states that there are a number of important unworked fields which contain large coal reserves, and that the contents of the various known coal areas have been estimated at 39,674 million tons of bituminous coal, 61 millions of anthracite, and 490 millions of lignite. The number of accidents which occurred in the various collieries during 1910 amounted to 189, of which 28 were fatal, 95 serious, and 66 slight, equivalent to 24.36 accidents per 1,000 men employed. In metalliferous mines the accidents numbered 38—13 fatal, 3 serious, and 22 slight—equal to 12.23 accidents per 1,000 men employed.

The Austin Disaster.

Our readers are doubtless familiar with the details of the Austin flood—the breaking of the dam, and the appalling disaster to the peaceful Pennsylvania town nested in the dark hills. Sad as it is, it is gratifying to note that the State is making ample provision for the survivors so that the horrors of the calamity are softened as far as human sympathy and assistance can soften the effects of such a disaster.

Our personal sympathy goes out very strongly to a dear friend, Mr. A. B. Harper, of the Buffalo and Susquehanna Railroad. In common with the other men employed in the company's shops at Austin, he had a narrow escape when the mighty wall of water with its accumulation of wreckage rolled down the valley. Mr. Harper describes the front of the wave as being sometimes fifty feet in height, and occasionally flattening itself out in swift fury, carrying everything before it. His fine home in the town, and in it his dear wife and a beautiful thirteen-year-old daughter were swept away in the torrent, leaving four motherless children. Mr. Harper is meeting his great loss with manly fortitude. He has the warm sympathy of all who have the honor of his acquaintance. He has been particularly interested in the better education of railway men, and we are confident that out of the terrible affliction that has come to him new hope and strength will arise, and that he will be consoled by the reflection that, "It is better to have loved and lost than never to have loved at all."

Development in the Philippines.

During the course of an address to a distinguished body of Manila citizens, the Hon. W. Cameron Forbes, Governor-General of the Philippine Islands, said that since the American occupation 445 miles of railroad have been added to the miles in operation, or a total increase of 366 per cent. The railway served a population of 698,300 in 1898. The population now catered for is 2,000,000. The Government's contracts with steamers have resulted in a regular and better service, and the rates for merchant marine are more reasonable. Unfortunately, the present method of handling freight leaves much to be desired. The connection between the existing warehouses, retail stores, and the river wall is poor, and will remain so until the railroad is got in. He had many times publicly and privately expressed the attitude of the Government toward the coming of capital. They not only welcome it, but are willing to go out of their way to attract it by expressing the friendly attitude of the Government. The progress made so far was highly creditable, and the future was full of the richest possibilities in the development of the Philippine Islands.

Railroad Notes.

Actual headquarters of the New Haven will be located in Boston immediately following the completion of the $500,000 addition to South Station.

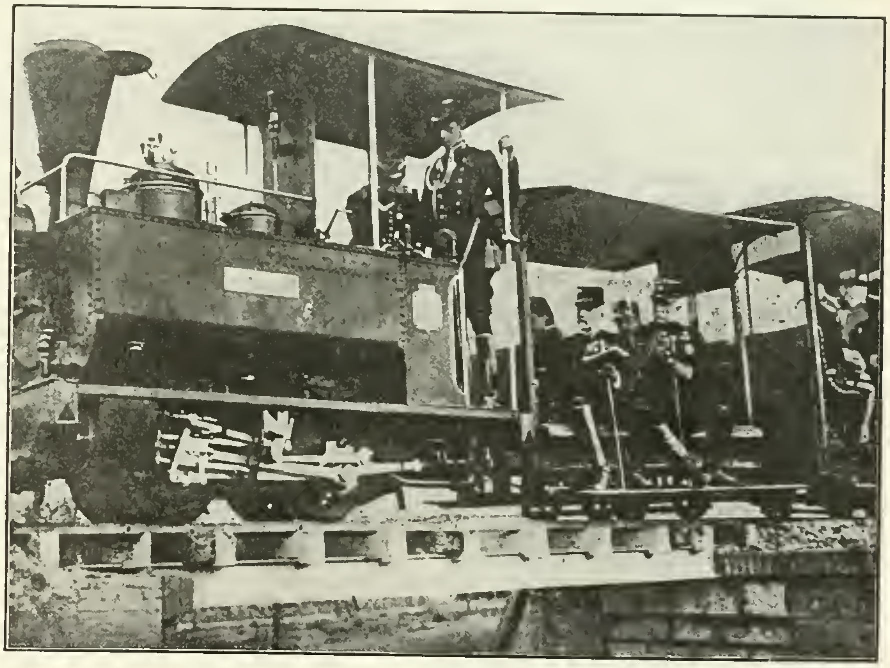
The Northern Pacific is laying rails from Mandan, N. D., to Hensler, 40 miles. This road two years ago was completed with the exception of laying rails.

The Traders' Dispatch, operating over the Lehigh Valley, has put on a package car between St. Louis and Jersey City, which will carry without transfer merchandise shipped to a number of important intermediate points.

The G. T. R. has ordered twenty-five locomotives from the Canadian Locomotive Company, Kingston, Ont.

The Board of Railway Commissioners has appointed twelve fire wardens to investigate the spark arrester and other appliances with which locomotives are equipped, with the view of deciding what further, if anything, must be done so as to minimize the danger of fires being started in forests and elsewhere along the tracks.

It has been announced that through a gift of $50,000 by Mrs. E. H. Harriman, a bacteriological and pathological laboratory of the Southern Pacific Company, the laboratory to be located at San Francisco.



KING ALFONSO OF SPAIN.
On a locomotive during recent military manoeuvers.

The Pennsylvania has ordered 1,100 all-steel freight cars from the Cambria Steel Company at a cost of about $1,000,000. The order is for replacement and not for additions to the freight equipment.

The Westinghouse Electric & Manufacturing Company has received an order from the New York, New Haven & Hartford Railroad Company, of New Haven, Conn., for four alternating-current, single-phase railway motors.

On June 30, 1910, there were 1,699,420 persons in the immediate employ of the railroad companies of the United States

The G. T. R. is asking tenders for four mogul locomotives for its Detroit and Toledo shore lines. Business has improved rapidly in that locality during the spring and summer months.

A concession has been granted to the French Railway Company for a meter gauge line in Santa Fe Province, Argentina. The contract for work is to be signed within six months of the promulgation of the law, and construction must be completed within eighteen months after beginning the work. The Argentine Government has given permission to the Pacific Railway to open, provisionally, to the public the first 3½ miles of the new line from Bahia Blanca to Patagones.

Some changes have been made on the Lackawanna under which J. N. Shaw, who for several years has been private secretary to W. A. Truesdale, president of the company, becomes general storekeeper at Scranton, Pa.

The Lake Union Belt Line, with offices at Seattle, Wash., have begun construction work between Fremont and Ballard. A bridge will be built over the Lake Washington Canal, and there will be reconstruction of piers at Seattle. The work will be completed within one year.

Owing to the successful results of its school at Oelwein, the Chicago Great Western will arrange for another course of lectures, and has given employment in its service to thirty-seven graduates of the school.

The Cerro de Pasco Mining, Smelting and Railway Company, of Peru, is a New York company. The railroad connects with the Peruvian Central at Oroyo. From Oroyo to Cerro is 80 miles, and a branch to Goyllarisquisgo coal mines, 24 miles. There are in service four Baldwin locomotives of the 2-8-2 type, two Rhode Island locomotives of the 2-8-0 type, and at the smelting works, seven miles distant, two Baldwin tank engines of the 0-4-0 type, besides four smaller locomotives. There is every assurance of a great future for the company.

An active railway construction programme is projected for the Dominion generally and for Saskatchewan particularly, in the present fiscal year. In Saskatchewan over 1,000 miles of new line will be laid. Last year, this province led the others with total new track amounting to 476 miles. According to the plans so far announced by the three principal railways of Canada, the Canadian Northern will construct 330 miles in the province, the Grand Trunk Pacific about 342 miles, and the Canadian Pacific about 350 miles, making a total of about 1,120 miles. In addition to this new construction work, about 1,350 miles of new grading will be done.

An electric railroad is to be built which will run in three countries, Italy, Switzerland and Austria, and it will greatly shorten up the distance by rail from Milan to Munich. On the Italian side it starts from Tirano, which is the terminus of the Valtellina electric road, and crosses the Swiss frontier by a five-mile tunnel through the mountains, reaching the Munster Valley. It then crosses into Austria to Mals, and this point will be connected to Landeck by a line which the Austrian Government is to build. This latter point lies on the railroad leading to Munich. It is probable that an electric section will be also run from Landeck to Munich.

The roadbed of the Pan American Railroad has been constructed from Las Cruces to the River Las Animas, 6½ miles, and timber has been cleared to the end of the nineteenth mile, nearly to the village of Coatepeque, Guatemala. Rails have been laid for 3½ miles. Work is progressing rapidly from Las Animas, 600 men being employed in grading. In some places a hydraulic system has been used.

The director-general of the Roumanian Railways, Mr. Alex. Cottescu, has made a thorough inspection of the system, and reports that the lack of rolling stock and trackage is causing the delays in transit of goods. He asks for $14,000,000. In addition to new engines and cars, an increase in the number of repair shops and the improvement of those existing are urgent. Would-be sellers of railway equipment should address the Director of Railways at the Gara du Nord, Bucharest.

The report of the general manager of railways, just issued for 1910, points out that South Africa produces almost every product necessary to its sustenance, although in insufficient quantities to render the country self-supporting. The year had shown an unprecedented development, especially in passenger and general goods and coal traffic, but it would be inadvisable to base future policy upon that. Railways open to traffic on December 31 last totaled 7,041 miles, and revenues had increased by $9,244,404, as compared with 1909.

Mr. Dugald Drummond, chief locomotive engineer to the London & South-Western Railway Company, has designed and built a new type of "Atlantic" engine, which is believed to be the most powerful of any running in the United Kingdom. It has 18 wheels and is capable of pulling a heavily laden passenger train of 13 bogie carriages at over 60 miles an hour. Five engines of this type are being built at the Eastleigh works and they are intended for the fast passenger traffic between Waterloo and Bournemouth.

Distribution of material and supplies is being made in Denver by W. S. Hodges, purchasing agent of the Santa Fe, preliminary to extending and building sidetracks on the line to Pueblo. The work to be done will be practically double tracking of the road, a distance of 119 miles, and the plans call for a siding every five miles of sufficient length to accommodate the longest train. It is said the work will cost $1,000,000.

Fire Test of Pennsylvania Steel Car.

The Pennsylvania Railroad Company take no chances. When they think of adopting any improvement they take particularly good care to find out that it has all its reported merits and no unrevealed weakness. One of the strong recommendations for steel cars is that they are practically fireproof. To test how far this claim is well founded the company's officials at Altoona placed shavings and other combustible matter in one of the steel passenger cars, set fire to the mass, and let it burn. The fire promoting material burned itself out and left the car very little worse from the ordeal. The fire was sufficient to scorch the inside lining and fittings, but nothing took fire. Our illustration shows the kind of blaze the shavings produced.

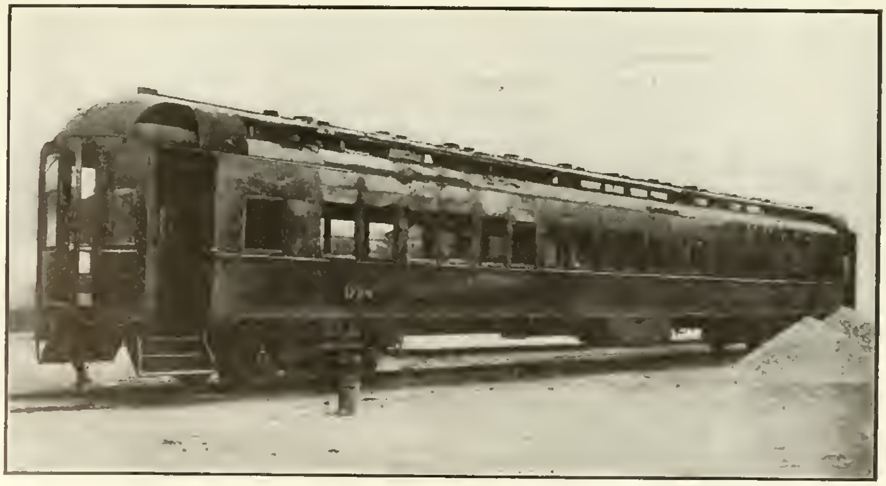
PENNSYLVANIA PASSENGER STEEL CAR DURING FIRE TEST.

To Sharpen Chisels.

Often one has chisels of awkward shape, and no stone with which to sharpen them. If a piece of wood is cut to fit the chisel, it can be used in place of a stone, by dipping it in a mixture of oil and powdered emery, and then manipulating as an ordinary stone.

Soldering Galvanized Iron.

Raw soldering fluid is generally used on the soldering copper when it is desired to solder galvanized iron. However, before commencing to solder, it is desirable to dip the soldering copper while hot in a solution of salammoniac and water. This will retain the tin on the point of the soldering copper, which would otherwise soon disappear.



PENNSYLVANIA PASSENGER STEEL CAR AFTER FIRE TEST.

To Be Ready for the Exposition.

The Southern Pacific will soon commence the erection of a $1,000,000 passenger terminal at the foot of Market street.

The company has been buying lands for the right of way during several years. The building is to be finished in time for the exposition traffic.

The Corrugated Bar Company have announced the removal of their headquarters from St. Louis, Mo., to Buffalo, N. Y. The change has been decided upon as their plants and stock warehouse are located near Buffalo. Their district offices will be maintained as formerly at St. Louis, Chicago and New York.

Too Much Leisure.

The Central American republics do not constitute favorable spheres for railway enterprises. Those who feel inclined to waste valuable efforts in these regions would do well to ponder over an incident related in the Boston *Record*:

"The late Sylvanus Miller, civil engineer, who was engaged on a railroad in Central America, and while seeking local support for one such road, he attempted to give the matter point. He asked a native:

"'How long does it take you to carry your goods to market by mule-back?'

"'Three days, señor,' was the reply.

"'There's the point,' said Miller. 'With our road in operation you could take your goods to market, and be back home in one day.'

"'Very good, señor,' answered the native. 'But what would we do the other two days?'"

Easier Than Chopping Wood.

Jim Forrest was a literary conductor who used to write "Railroad Observations" for a Chicago publication. He happened to get moved to a Southern division of the Illinois Central and found a new and fertile field for observation. One day he saw a darkey lying under a tree holding a fishing rod over a pond. Jim paused and watched the fishing. After watching for half an hour without seeing the least sign of a bite, he asked how the fish were biting. The fisher looked surprised.

"'Why, bos', he exclaimed, 'dere ain't no fish in dis yere pond. Dere never was a fish in it.'

"'Well, what do you fish for?' the conductor wanted to know.

"'So's my old woman can see dat I ain't got no time to chop wood for de fire,' the negro answered."

A bulletin issued by the Bureau of Railway Economics at Washington presents statistics of operating revenues and expenses for the fiscal year ended June 30, 1911, the returns covering 93 per cent. of the railway mileage of the United States, the average operated being 225,067 miles. The data were obtained from reports filed with the Interstate Commerce Commission. Operating revenues for the period mentioned aggregated $2,700,232,308, or an average of $11,997 per mile of line, and the total operating expenses were $1,855,253,049, or $8,243 per mile, leaving net operating revenue of $844,979,259, or $3,754 per mile. Compared with the preceding year, this record shows a decrease per mile of $70, or 0.6 per cent., in operating revenues and an increase of $236 per mile, or 2.9 per cent., in operating expenses.

Exhibition of Railway Appliances.

Preparations are now being made for the annual exhibition of railway appliances used in the construction and maintenance of steam and electric railways, which will be given by the National Railway Appliances Association, at the Coliseum and First Regiment Armory, in Chicago, March 18 to 23, inclusive, 1912. This is the week during which the American Railway Engineering Association will hold its thirteenth annual convention, and the Railway Signal Association will hold its spring meeting. The Railway Appliances Association has been incorporated under the name of National Railway Appliances Association, with offices at 537 So. Dearborn St., Chicago.

The arrangement of the main floor space in the Coliseum will be practically the same as last year, but the balconies will not be used. The first allotment of space will be made on or about November 1, 1911, by the Executive Committee of the Association. Therefore it is advisable to have all applications for space in the hands of the Secretary, Bruce V. Crandall, 1400 Ellsworth Bldg., 537 So. Dearborn St., Chicago, before that date.

Swedish Steels.

The New York Railroad Club at its last monthly meeting listened to A. R. Roy, Ph. D., read a paper on "Swedish Steels" in which he reviewed the history of the discovery and use of iron from the time that research data concerning it became available. As to the Swedish product he showed that in 1853 England recognized it as the best base for making the highest grade of steel. France employed it three years earlier, and as far back as 1750 this truth had been slowly forcing itself into the minds of steel manufacturers. No other substitute has been found, Dr. Roy declared, for this product of Sweden. No country, at least in Europe, equals Sweden's wealth in iron, and of like quality, and which accounts for the fact that that country has made manufacture of iron one of her main industries since the fourteenth century.

A lively debate followed, several of the members vigorously combating Dr. Roy's claims. Next meeting a paper on "Tool Steel" will be presented, and another lively debate may be expected.

The central railway office of Berlin, Prussia, is about to commence negotiations with German mechanical construction establishments for the supply of 525 locomotives of various types. Of these engines, 510 are to be put upon Prussian state lines and 15 upon the German Empire lines. Deliveries are to be made before the close of September, 1912. The locomotives will be the largest ever used in the railways of the German Empire.

How to Succeed in Life.

A great many people chronically short of cash have tried to raise the wind by telling how to become rich. A real authority has now been heard from. John D. Rockefeller lately volunteered a little advice as the best means of becoming wealthy. He said, "Stick to one thing, stay with it until you succeed. Don't change your occupation, but work hard at it and you are bound to succeed."

Andrew Carnegie makes a similar recommendation. The Laird of Skibo says, "Put all your eggs in one basket and watch the basket."

Matter of Fact.

A gentleman, the son of a well-known M. P., was riding recently near Edinburgh, when he overtook an agricultural laborer driving an empty cart. Thinking the opportunity favorable for soliciting the man's views on political matters, he asked him several questions, but found little encouragement. "Do you go in for politics about here?" he at last asked in despair. "No," said the man; "A'm gaun for gaspipes."

What They Would Do.

A member of a certain school board was a crank on the subject of fires, and when visiting a school invariably limited his remarks to asking the pupils what they would do in case the building caught fire. Knowing this little peculiarity, the teacher coached his pupils as to the answer which they should give. This was the result. A government inspector made his usual official visit. "You boys have listened so attentively to your master's remarks," he said, "that I wonder what you would do if I were to make you a little speech?" To the consternation of the master a hundred voices shouted in unison, "Form a line and march down stairs!"

An Easy Selection.

Johnny Carr was a Scots boy, noted for the ingenious devices he employed to avoid doing work. His parents had many discussions as to what they would do with Johnny so that his laziness would not prevent him from making a living. They finally decided to make him a minister and he was duly entered in Glasgow University.

Shortly after Johnny's installation in the seat of learning, he was visited by his mother.

"Well, my dear," she said to him, "what languages have you decided to take up here?"

"I have decided to take up Pictish," he replied.

"Pictish?" said his puzzled mother. "Why Pictish?"

"Only five words of it remain," said he."

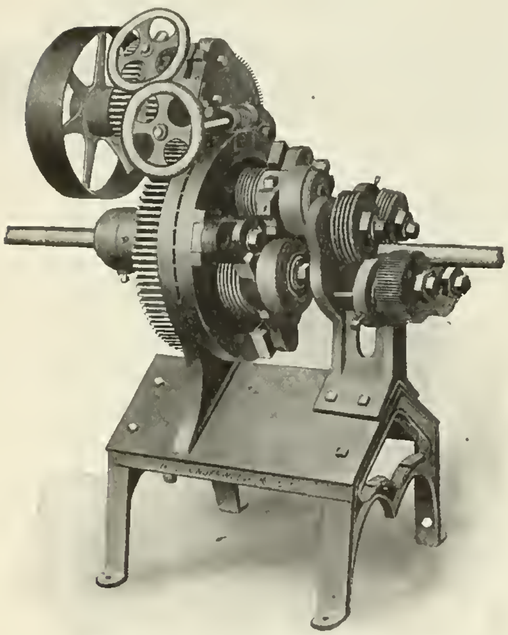
The Man.

"Give me the man," says Kipling, "who can hold on when others let go; who pushes ahead when others turn back; who stiffens up when others weaken; who advances when others retreat; who knows no such word as 'can't' or 'give up': and I will show you a man who will win in the end, no matter what opposes him, no matter what obstacles confront him."

New Catalogues.

PORTABLE TOOLS.

Among the new catalogues of the season, that of H. B. Underwood, Philadelphia, is a notable one on account of the number and variety of portable tools for use in locomotive and other repair work. These embrace boring, turning and facing machines, valve seat boring and facing machines, pipe bending, and circular planer tools for planing locomotive boxes, and locomotive cylinder or dome facing machines. There are also special portable milling machines, crank pin turning and reboring machines, and machines for facing pedestal legs of locomotives and truck frames. There are also special boring bars for Corliss engine valve seats, and boring bars adapted



UNDERWOOD'S PORTABLE FLUE CLEANER.

for engine guide. These tools have been in use for many years, but are constantly being improved until they have arrived at a degree of perfection that leaves little to be desired.

Among the more recent additions to their list of new tools, the most notable, perhaps, is an improved rotary flue-cleaning machine. This machine is designed for removing the crust of lime from boiler flues. Very little power is required to run the machine. It is operated by a laborer, who enters the flues in the machine, the flues being revolved and fed through like a screw, and dropping off on the opposite end without assistance..

It is so constructed that no countershaft is needed. It is provided with a double clutch gear, which enables it to be reversed in case of special need, and sets the pulley free, to avoid counter-shaft.

Three revolving shafts, provided with circular blunt edged steel cutters, are set obliquely in adjustable boxes, the central line of the flue passing between them; these boxes are connected with a movable ring, governed by a worm screw, which is operated by the lower hand-wheel, and each of them is provided with a small adjustable circular assisting cutter with cross teeth, which cuts the lime lengthways; after being cut crossways by the circular cutting plates on revolving shafts, the scale is consequently reduced to square particles in a rough manner; the same process is repeated by four circular finishing cutters revolved by the flue, two of them being provided with length teeth and two with cross teeth, and placed adjustable on the same inclined plane to the extending plate. Having the circular cutters on the revolving shafts on the same inclined plane, the first and second cutters on each shaft will not come in contact with the flue, but will afford an easy entrance, acting like a mill, preventing the machine from choking; there is no sticking, as the cutters are all revolving. To overcome oval places or uneven diameters, the cutters are arranged to give a little, and when this is passed, immediately come back to the original position. Many flues are not perfectly straight, but as any part of them within the machine is held central in line, the projecting ends are at liberty to swing.

The speed of the machine is optional with the user; the pulley can be run as high as 400 revolutions per minute, when about eight to ten feet per minute will be cleaned.

Mica Lantern Globes.

The Storrs Mica Company, Owego, N. Y., have recently perfected a new style of globe that can be furnished at a very low price, and gives the most efficient possible form to the flame of the lantern. The mica is the most durable yet obtained by this enterprising company, and is absolutely proof against breakage from heat, cold, drops of rain, or snowflakes. It is indestructible by any possible degree of heat in a lantern, and the flexibility of the mica is such that the lamp striking or falling remains uninjured. The globes are furnished in the natural white or ruby, blue or green. The price is less than glass of corresponding colors. The new designs have already met with much popular favor among railway men. Particulars and price lists may be had on application.

You can lead a boy to the doors of a university, but you cannot make him think.—*Mr. Dooley.*

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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In the Royal Gorge.

GRAND CANON OF THE ARKANSAS, COLORADO.

The Denver & Rio Grande Railroad, although confined almost entirely to the States of Colorado and Utah, intersects these States, particularly Colorado, with a network of branches that has opened up vast territories of great agricultural and mineral wealth. The railroad now extends to nearly 3,000 miles, and the scenery is marked by a rugged magnificence that is at once

DENVER & RIO GRANDE TRAIN PASSING UNDER THE HANGING BRIDGE IN THE ROYAL GORGE, GRAND CANYON OF THE ARKANSAS, COLORADO.

the wonder and admiration of the visiting traveler. One of the most remarkable features of the mountainous region, so rich in scenic wonders, is what is known as the Royal Gorge. This vast cleft in the Rocky Mountains is evidently of volcanic origin. The utter absence of any kind of soil precludes the possibility of the head waters of the Arkansas ever cutting such a chasm in the rocks, which are of an igneous kind, mostly of a reddish granite, with layers of gneiss, felspar and mica interspersed, the whole forming a rocky region of the most durable and impenetrable kind.

Cañon City, a thriving town with a population of about 6,000, is nestled among rich orchards at the gateway of the Royal Gorge. The entrance into the cleft of the rocks is sudden in its bold abruptness. The approach is through a country slightly undulating, rich in a luxuriance of vegetation, comprising fruit trees, berry bearing bushes, and every kind of garden produce. Presently the rocks tower aloft, rising from crag to crag until the sky becomes a mere thread, almost obliterated by the jagged ramparts. The railway, of course, follows the line of the tumultuous river, which is sometimes not more than thirty feet in width. At the deepest points of the gorge, which exceeds half a mile, the region is one of almost everlasting darkness. The stars are visible at all hours, except when the sun, high in heaven, shoots through the gloom like a lantern's eye, and the train follows the tortuous curves into the darkness again. For eight miles this marvel of nature continues. The gorge is full of tortuous bends and sudden curves, along which the river boils and foams, and at every turn the train seems destined to rush headlong on the enclosing rocks. The changes are incessant. Smaller gorges and cañons open on either side, and flashes of sunshine gleam aloft here and there like flames of fire in a turretted city.

They were brave men who first passed through that great gorge. The gloom is awful. The thundering waters seem welling from hidden regions beneath. The passionate exhaust and clanging machinery of the locomotives make a thousand weird echoes among the dizzy cliffs, and the appalling tumult is terrible as a thunderstorm. The rocking and swaying of the train, together with the darkly-gleaming and widely-wallowing waters hemmed in by the fiercely-frowning crags form a combination that is not likely to be forgotten, and there is a feeling akin to joy when one bursts suddenly into the glad, golden landscape again, and, still following the foam-flecked Arkansas, the trains roll into the richest regions of Colorado.

Our illustration of the entrance to the Royal Gorge shows one of the Denver and Rio Grande locomotives with a train of cars passing under what is known as the Hanging Bridge. We may add that the difficulty of taking a photograph of that particular view of the gorge was a work of no easy matter, involving a piece of engineering work to secure a proper position in the opening of the projecting cliffs. The trip through the Royal Gorge is now one of the most popular in the West, and during the summer months observation cars with open roofs are attached regularly to the trains. It need hardly be said that there is little or no animal life visible in the wild region, the only exception being an occasional specimen of a kind of wild sheep, and while one set of travelers are wondering how these wooly wanderers ever reached such dizzy heights, another kindlier set of sky gazers are wondering how the sheep were ever going to get down again.

A Good Locomotive Engineer.

By John Alexander.

I am one of the few engineers who are perfectly willing that their boys should follow their own calling. My wife converted to my belief, I am proud of my occupation and the responsibilities I assume, I cannot think of anything I would care more to hear of one of my sons than for some man who knows what he is talking about to say: "That young man is a first-class locomotive engineer."

Enginemen of America, what does that remark mean? to a workingman it means a skilled mechanic, capable of earning from two to four times as much pay as a laborer. To the railway officials of the country, a man in whom they can safely trust the trains and property of the road, safe in his decisions, cool in emergencies and faithful to his trust. To the thinking public, a hero whom it will be perfectly safe to trust with the lives of the dearest ones on earth. To his family it means sobriety, thrift, manhood; to his friends, kindness, benevolence, honesty, honor and a good example; to society, a man and a gentleman, intelligent, grimy-handed and square. A fireman's position bears the same relation to an engineer's as does a lieutenant's to a captain's—eventually he takes his place.

I have made my boys understand that the only way to be an engineer is to be a good fireman. I have three, and they are all as engine-crazy as I was myself. I made a rule that when they graduated from the city school they could go into the shop as helpers to machinists; then, after serving one year, they could make their choice of occupations. If they still wanted to go on the road, I would help and not discourage them. My father kept me off the road until I was of age, just because he disliked the business. My second boy is in the shop, and the third in school.

Engine running is hard work, calls for muscle as well as brains. So is plowing hard work, driving team, keeping books, clerking, or moulding gumdrops. The sooner the young men of today, who are blessed with that great incentive to work up—poverty—settle this fact in their minds, that to advance hard work is necessary, the better for all.

Men who aspire to be good mechanics must go through several years of hard apprenticeship. There are too many young men who would make good blacksmiths that try to be bookkeepers. They dread the sweat, and their parents are foolish enough to think there is a disgrace in wearing a leather apron at $3 per day, that is not found in a pen behind the ear at $2.50.

If I had a boy that was a natural doctor, liked to study, would rather help cut my leg off than go over the road with me, how foolish I would be to force him to go on to the road as a fireman. Yet how many engineers do this very thing—up side down. A boy that wants to be an engineer will make ten times better engineer than he will a doctor, and when we use every influence we can to make him what his nature says he is not and cannot be, we simply fight against nature. Nature always wins, or the boy is spoiled. I would rather my boys should be day laborers than botchers at any business.

There is another thought that I want to air. Many a boy only thinks he wants to learn a certain trade or business. He may have an eye for machinery and think he must be an engineer; a few trips in the night and storms may show him that he was not intended for an engineer; lacks the nerve, caution and confidence, but he may turn his attention to the machine shop and find his forte. I always gave my boys a chance to look into the details of any business they took the least notice of or interest in, but they have come back to a locomotive just as a lost dog smells out his own master.

Workingmen, even skilled mechanics, can leave their children little more than sound bodies, a fair education and a good example—and this is enough. Josh Billings was sound when he said: "It would be better for the country if there were more kits of carpenters and tools and less legacies left to our young men."

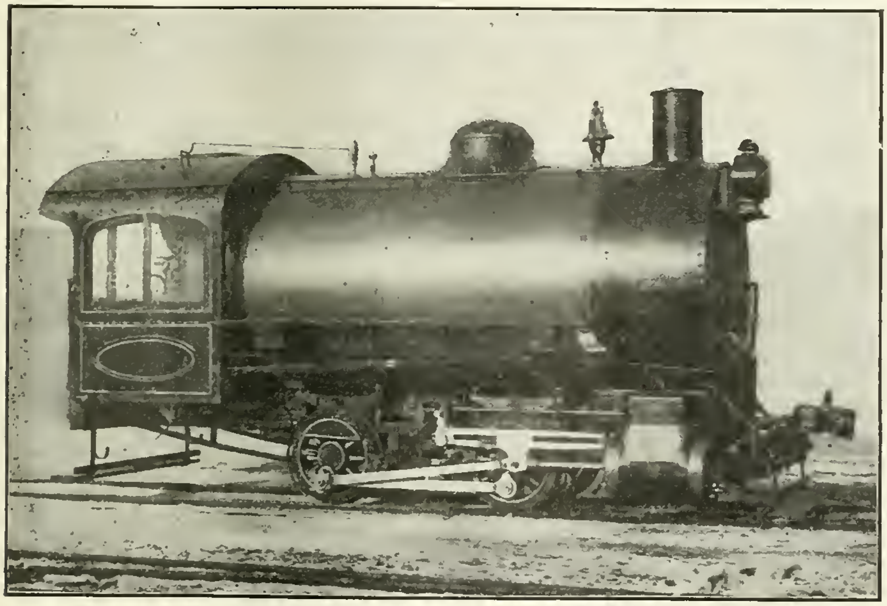
Locomotive engine running is bound to be a noble, honorable and remunerative calling; it will grow in importance and dignity in the future more than it has in the past. It is bound to be filled by a class of intelligent men, who will be men in every sense of the word. I am proud of my calling, and if my boys want to follow in it and excel their father, I am not going to fight against their natures, as I know many an engineer is doing today.

Lima Steam Storage Locomotive.

The Lima steam storage locomotive, as shown in the accompanying illustration, consists of a large tank, large cylinders, and other machinery similar to common locomotives. The tank is filled about half full of water, and is then connected by adjustable steam hose to a stationerv boiler, and when the pressure in the tank is equal to the pressure in the stationary boiler, the hose is uncoupled, and the locomotive is ready for service. As the steam in the tank is used the pressure decreases, but with the gradual decrease part of the water becomes steam, and the continuation of the pressure is always a surprise to the unitiated. If the tank pressure is as high as 150 or 200 lbs., per square inch, the pressure is reduced to 60 lbs. by an adjustable valve. The cylinder diameter is increased so that the tractive power may be maintained to the limit of adhesion. The enlarged cylinders afford space for a piston of such dimensions that will readily move the locomotive from place to place when the pressure has been reduced to 3 or 4 lbs. per square inch.

Under ordinary circumstances the tank will not have to be charged oftener than an ordinary locomotive has to be supplied with water. Varying with the work desired, it will run from two to ten hours with one charge, two charges per day being a fair average. This type of locomotive possesses many advantages for work in industrial plants, powder mills, lumber yards, cotton mills, tanneries, wharves and the like. Recently two of them were placed in service in the works of the National Cash Register Company at Dayton, Ohio, and the results have surpassed the expectations of the company.

It will be readily understood that in inflammable localities a locomotive of this type is absolutely safe. There is no risk of any kind, and the engine can be left at any time, and the loss from radiation is only from 3 to 4 lbs. per hour. In point of economy where there is a stationary engine, there is no cost for apparatus excepting such simple couplings as may be necessary, and in the maintenance, it is also evident that the tank will require little or no repairs, no boiler washing is necessary as any scale that may accumulate inside the tank is rather helpful than otherwise in preventing radiation. The machinery is of the simplest kind, the gauge and the signals being the only mechanical appliances that require observation.



LIMA STEAM STORAGE LOCOMOTIVE.
Built by the Lima Locomotive and Machine Co., Lima, Ohio.

Railway Tool Foremen's Association.

The American Railway Tool Foremen's Association, which consists mostly of men having charge of railway shop tool rooms, appears to be dominated by a set of energetic men who understand organization and the subjects most worthy of investigation and discussion. For the 1912 convention reports will be submitted on the following subjects: "Milling Cutters and Reamers," "Care of Shop Tools," "Checking Systems," "Treatment of Steel and Electric Furnaces." We commend the attention of members of the Railway General Foremen's Association to the work their tool foremen are carrying on, and request their co-operation and encouragement.

Native Invention Promotes Our Industries.

British inventors about one century ago took the lead in the improvement of mechanical devices calculated to reduce the cost of producing manufactured goods but the high rate of wages in the United States stimulated invention, till now nearly every new thing of a labor-saving character originates in this country. The cause of this is that American workmen have fallen into the inventing habit, which has been fostered by the great rewards workmen of other days have received from valuable devices they patented.

Some lines of industry have been revolutionized by inventions originated and perfected by workmen. In this country nearly all employers of skilled labor encourage their help to devise labor-saving appliances and successful inventors of such devices generally profit from their introduction, even if the invention is not considered worthy of patent-office protection. This is entirely different from the policy pursued in most foreign workshops and factories, the practice there being to snub workmen who presume to propose improved devices or methods. Most foreign workmen recognize the snub framed in the jibe, "You are not here to think; your duty is to obey orders."

The system of manufacture by subdivision of labor is generally credited to Eli Whitney in the manufacture of firearms, which he carried on with wonderful success in Whitneyville, Conn. Whitney certainly was the first to introduce the interchangeable system of producing metallic parts; but one humble industry predated him in the subdivision of labor system.

In the last decade of the eighteenth century certain enterprising shoemakers in Massachusetts evolved a system of shoe manufacture where the various processes were done by separate workmen. One workman cut the leather, others sewed the uppers, others fastened uppers to soles, and so on. This division of labor was successful from the start, and soon the practice was adopted of sending out the uppers to be sewed by women in their homes. This gave the manufacture of shoes great impetus in New England, and the method continued until it was superseded by machinery.

Master Boiler Makers' Association.

At a meeting of the executive committee of the Master Boiler Makers' Association, held at the Fort Pitt Hotel, in Pittsburgh, last month, it was unanimously decided to hold the sixth annual convention of this association in Pittsburgh May 14 to 17, 1912, inclusive, headquarters being at the Fort Pitt Hotel.

George N. Riley, of the National Tube Company, was made chairman of the general committee of arrangements, and Roger T. Flannery, of the Flannery Bolt Company, secretary of such committee.

Cost of the Santa Fe Strike.

In our October issue we commented on the paper read by Mr. Wilson E. Symons before the Franklin Institute on "The Practical Application of Scientific Management to Railway Operation," and referred to a discussion in the paper on the effects of scientific management on the Santa Fe system. Scientific management of the repair shops has been reported to have effected material reduction of expenses, and Mr. Symons analyzed the reports in a manner that proves that the economies claimed were a delusion.

"We reproduce the salient points of the conditions as described by Mr. Symons as follows: During the year 1901-1902 there was constant evidence of discontent on the part of the shop men generally throughout the West, and a few local strikes occurred at different points on the western portion of the Santa Fe lines. All were of short duration, except one on the company's lines in Texas, which included all shopmen except carmen, and continued for many weeks, the men being finally defeated.

"This proved to be the forerunner of a general strike on the entire Santa Fe system, which took place in May, 1904. It was a bitterly fought contest, etc.

"It is unnecessary to dwell on the cost of the strike to the Santa Fe at any *great* length; that it was extraordinary, however, is evidenced by the fact that, as a result, the cost of locomotive maintenance advanced, as follows:

Years.	No. of engines.	Cost per engine per yr.	Increase over 1900.
1900...	1,136	$2,096	
1901...	1,174	2,858	
1902...	1,312	3,156	
1903...	1,309	3,041	
1904...	1,433	3,772	
1905...	1,454	4,165	98.7%

"It should be noted that the cost of locomotive maintenance in 1905 above 1903, the year prior to the general strike, was 37 per cent., or $1,634,296, this item being one of the essential factors in determining the economic effect of 'scientific management' on the cost of maintenance, but on which the advocates of this plan have so far remained painfully silent, even when quoting figures affected thereby, thus conveying the impression that conditions were normal in 1905, and thereby taking credit for the reduction in cost per engine, to $3,101 in 1906 and $3,036 in 1907, that was bound to follow the termination of this struggle, thus changing the basis of company's financial budget from a *war* to a *peace* basis.

"Having reviewed the conditions up to 1905 with a view of making clear any comparisons with that of other years, a tabulated display of mechanical department expenses for the years 1900 to 1910, inclusive, is next presented, from which many interesting comparisons may be made and deductions drawn.

"Referring to Table E, attention is invited to the following facts:

"This table shows that the average cost of maintenance of locomotives was 47 per cent. during the years 1904, 1905, 1906, and 1907 than during the four years prior.

"That the average total cost for maintenance of equipment was 50 per cent. greater in 1904, 1905, 1906, 1907 than during the four previous years.

"That general office clerks expense increased 50 per cent.

That maintenance of equipment superintendance expense increased 153 per cent.

"That shop machinery and tools increased 67 per cent.

"That cost of new engines and cars increased 80 per cent.

"And the item 'other expenses' increased 258 per cent. during the four-years period of 1904-1905-1906-1907 as compared with four years prior.

"The comparisons given were intended to show that with the abnormal high cost caused by the shopmen's strike as a favorable starting point, together with the lavish expenditure of millions for new locomotives, cars, shop tools, supervision and other expenses, the showing for the four years mentioned, or even for the three following, 1908, 1909 and 1910, or a total of seven years, has not at any time been as good as prior to the introduction of scientific management on the road in 1904."

The Old-Time Apprenticeships.

The question of apprenticeships, which is exercising the minds of practical men, is one of great moment in the history of the country. It is many years since the practice of binding by indenture to a trade—or apprenticing, *i. e.* to learn—was rendered obligatory by statute. In the reign of Elizabeth it was enacted that no person should exercise any "trade or mystery" without having served a seven years' apprenticeship. In consequence of the anomalies to which this legislation gave rise, the section relating to apprenticeships was repealed in 1814, and apprenticeship has since been a voluntary act. In the days when handicrafts were at their zenith youths were indentured for seven years. The master was a highly-skilled workman. In many cases he could command a substantial premium. The term of years was considered no more than sufficient to instruct the learner in his "profession, craft or mystery under a qualified man, teacher or doctor"—these terms being synonymous—and to reimburse the latter by service for the training received. This was always considered to be the only effectual means of acquiring such a knowledge of the mechanical arts as should enable a man to exercise them to advantage.

When Man No Longer May Work.

A profound sensation was created some years ago when Professor Osler enunciated the theory that man's usefulness generally ended when he had reached the age of fifty; and the statement led to fierce discussion that is not yet ended. A statement was made last month before the Employers' Liability and Workman's Commission, at Washington, by Arthur E. Holder, of the American Federation of Labor, that is likely to create as much controversy as the theory of Professor Osler. While discussing the operation of the British compensation act of 1906, Mr. Holder said that regardless of this law there was a marked discrimination against men past forty years old, not alone in Great Britain, but throughout the industrial world.

"The man who is more than forty and has a few gray hairs cannot get back when he once loses his job, but he can hold on if he has a place," he said. "It is the same here as in England, and it is the same in Germany and throughout the continent."

This is a savage condition of affairs, but it is no doubt substantially correct, for we all know that employers of labor in taking on new men prefer to have those who can be depended upon to give many years of useful service before old age is likely to impair their productiveness, or efficiency. The human being is not merciful towards the fellow creature who has outlived his usefulness. Man is little more humane towards the weaklings than are the wild animals which chase wounded creatures out of the herd.

Superficial means must be employed to care for those left behind in the race of life through age or infirmity. The ordeal of industrial life does not provide for people more than two score years of age. The governments of Europe will not permit new men to enter their service when they are more than twenty-five years of age. Nearly all railway companies have rules that prohibit the hiring of men older than twenty-five years; and it is not to be supposed that other employers of labor will follow more humane practices. We bewail this cruel condition of industrial inevitableness, but all we can do is to sympathize with the unfortunate man who needs to beg a brother of the earth to give him leave to toil when age has marked him with gray hairs.

In the days when modern methods of steel making were getting worked out, Robert F. Mushet, a Scotsman, perfected a new process. He solved a problem that had baffled the leading metallurgists of the time—how to leave just enough carbon in the molten metal to harden it with the required quality of steel. Instead of trying to stop decarbonizing the metal at the right moment he made the Bessemer process possible.

General Correspondence

Boring Bar for Rocker Boxes.

Editor:

Enclosed is an isometric drawing of a boring bar for boring out high legged rocker boxes, which cannot be bored in lathe, but which, by the use of this bar (made in the shop here) may be bored out in their places on the locomotive. We have just finished the first job with this bar, and it occurred to me that it might be worth the time of writing a description of it for publication in your popular magazine, so that others may, if they think proper, take advantage of the device.

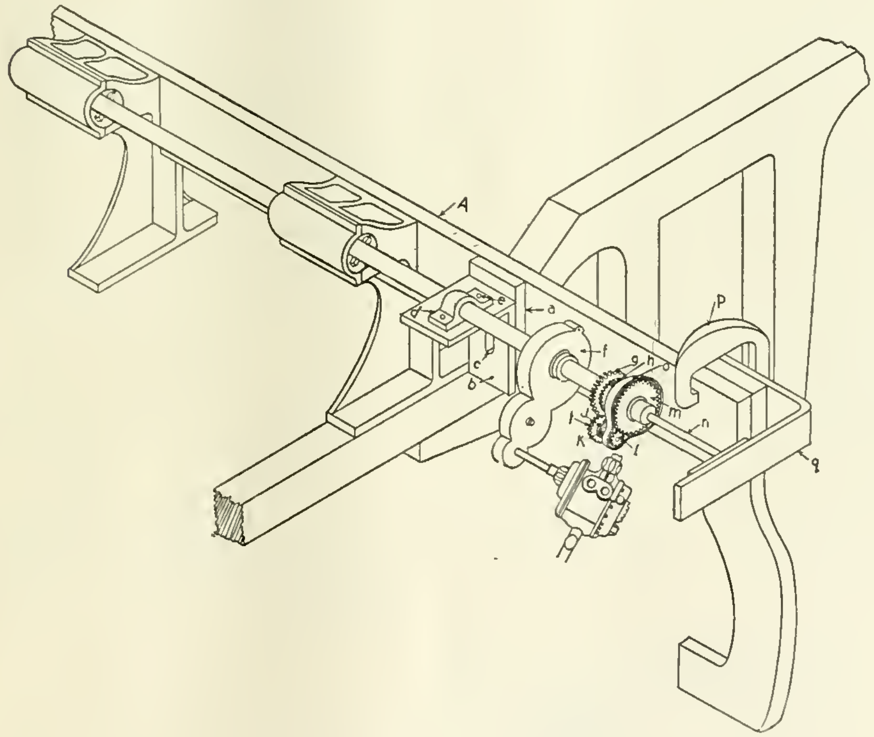
It will be observed that *a* is an L-shaped bracket with a turned-up lip, so as to fit over the lower edge of the locomotive yoke *A*, and is held in place by three set screws attached to the turned-up lip, and bearing against the yoke *A* on the other side, not seen in the drawing. *b* is another bracket fastened to bracket *a*, with a stud and nut, the bracket *b* has a slot *c*, which slides freely over the stud when the nut is loosened, so as to adjust the boring bar to the required height vertically. Box *d* is also adjustable laterally by the bracket *b*, having slots working freely over studs that go into holes *c*, and is held in place by tightening the nuts attached to the studs that fit in holes *c*. *f* is a gear case containing a series of gears that reduce the speed of the motor to the bar five times. The sides of the case are made of 5/16-in. boiler steel, which also serves as a framework for the gears. Brass bushings are provided in the casing for the gear journals, the whole being covered with a neat sheathing of Russia iron.

The feed mechanism consists of gears *G* and *N*, which receive their motion from the boring bar; feathers are provided for them to slide in the key-way of the bar, and also set screws, so as to keep them from moving laterally. The gears *G* and *h* are for two different rates of feed by shifting them laterally, so as either one or the other comes over gear *I*. Gear *I*, and a like gear not seen in the drawing, are mounted on a small frame *i*, which frame is held in place by thumbscrews to the case *O*. The frame serves to throw the gear mounted on it with the gear *I*, and which gear is not seen, in and out of engagement with gears *g* and *h*, *I* being in contact with the unseen gear, receives its motion from it, and imparts it to gear *i* through shaft *k*, and gear *i*, in turn, imparts motion to gear *m*, and gear *m* drives the feed screw *n*.

The boring bar is drilled about two feet in from the feed end, and a brass bushing about half the length is also drilled and thread cut—square thread—and pressed in the end of the bar, part of the bushing extending out for the casing *a*, which casing is pressed into the end of the bushing and set screwed. The gear revolves in a gudgeon in the case *O*, and is kept from slipping off by the gudgeon being grooved on the circumference, and three pins being driven through the hub of gear *m*. The hub of this gear is threaded with a square thread to match the feed screw *n*. *q* is a brace, held in place by a clamp *p*, to take the thrust of the feed screws. At the farther end of the boring bar is a duplicate arrangement of *a*, *b* and *d*.

V. T. Kropidlowski.

C. & N. W. Ry. Shops, Winona, Minn.



BORING BAR FOR ROCKER BOXES.

Superheated Steam.

Editor:

There seems to be considerable diversity of opinions as to how an engine gets more power in using superheated steam than in saturated steam.

I have had eight years' experience on superheated locomotives, both as engineer and road foreman, and I have always observed that when the superheater damper was closed, the exhaust was weaker, and engine not so strong with full steam pressure on boiler. The only conclusion I can come to is that the steam, being at a higher temperature when it enters the cylinders; has more expansive power; therefore, when valves cut off steam, it holds at a higher pressure to the point where it is relieved by the exhaust. In other words, say steam leaves boiler at 200 lbs., cuts off in cylinders at 180 lbs., and at point of exhaust 100 lbs. in a saturated engine. In a superheater engine it would enter cylinders at about 190 lbs., and at point of exhaust at about 130 lbs., so you can see that the most of the increased power is received in expansion after valve has cut off.

W. L. Blennerhassett.

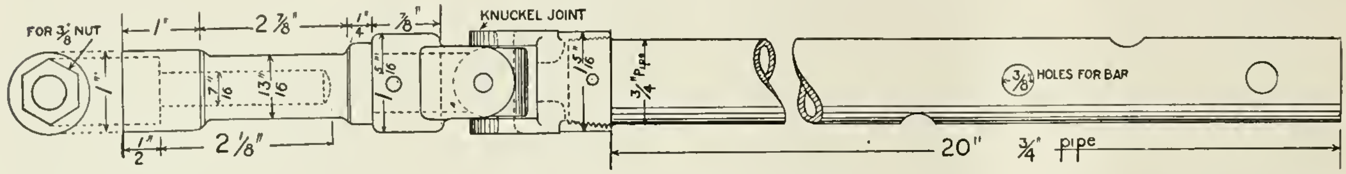
Fort William Ont.

Knuckle-jointed Socket Wrench.

Editor:

Attached is a sketch showing a knuckle-jointed socket wrench that is used to remove and apply jacket and boiler head lagging nuts. This wrench is very handy, as it can be used for the purpose of tightening or loosening nuts behind pipes, or under running boards, or in any narrow or obstructed place. Machinist Harry Killean is the inventor of this handy tool, and as he is young and studious, there are others coming.

CHAS. MARKEL,
Shop Foreman.
C. N. & W. Ry., Clinton, Iowa.

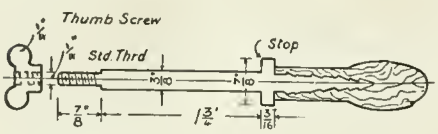


KNUCKLE-JOINTED SOCKET WRENCH.

Device for Grinding in the Air Cylinder Packing Ring of 1-Inch Pump Governor.

Editor:

Perhaps the most difficult operation encountered in the overhauling of a pump governor is the grinding in of the air cylinder packing ring. The valve must be inserted in order to secure a means of holding the piston in line with the sides of the cylinder. There is nothing in this method that affords a good control of the piston so that it can be worked swiftly back and forth. The job, because of these conditions, takes a great deal more time than is necessary to grind in a brass ring



DEVICE FOR GRINDING PACKING RING.

of that size. The sketch explains the details of a tool that makes quick work of this part of governor repair. The turned end of the jig is of the same dimensions as that of the upper part of the steam valve. The handle arrangement makes it possible to work the piston rapidly within the cylinder and quickly grind in the ring.

The piston is held in line with the cylinder, and the stop shoulder allows it to be worked only the distance it goes in actual operation. The thumb-screw is easily twirled off and allows the tool to be quickly withdrawn for examination of the ring.

F. W. BENTLEY, JR.
Huron, S. Dak.

Test for Defective Slide Valve Strips in Locomotives.

Editor:

In response to your invitation for the views of some of your readers on this subject. A very simple but effective means of ascertaining the defective valve strip was followed by the writer while running a locomotive fitted with balanced slide valve on the South African Railways, and, I believe, is still followed by a large number of enginemen here. First close the steam valve supplying steam to the slide valve lubricator. Then place both the crossheads as near the back cylinder cover as possible, open cylinder drain cocks. Take a flare lamp and get down beside the right cylinder; get the fireman to put the lever in fore gear and open the regulator slightly, just sufficient to show steam at the cylinder front drain cock. Then the fireman should pull the lever back towards the centre until the steam is cut off from the front port. The valve is now shut, close the regulator, then lift the air valve on the steam chest with a tommy bar, and as soon as the steam has escaped, hold the flame of the flare lamp close to the air valve and tell the fireman to put the steam blower on hard. If the flame is drawn in, it is owing to one of the strips being down and the vacuum created in the exhaust pipe by the blower is drawing air through the air valve past the strip and pressure plate, then through the hole in the back of the valve to the exhaust pipe. If strips are sound, the flame of the lamp will not be affected in the least, owing to no connection between the steam chest and exhaust pipe. The left valve can be tested without moving the engine, by going through the same procedure as with the right.

E. S. LIDSTONE.
Johannesburg, Transvaal, South Africa.

Old Locomotive in Cuba.

Editor:

I enclose a photograph of an old-timer that I saw in Cuba. It was in active service in Santiago. It was over sixty years old, being built by M. W. Baldwin in 1847, and looked as if it might run sixty years more. The valve gear is managed by a hook motion. There are six eccentrics, two on each side, for ordinary steam admission, and one for exhaust, making six in all. There are two reverse links, one for steam admission and one for exhaust. The cylinders are 16 ins. by 26 ins. There are two scales for safety valves. A peculiarity is that the left engine is the leading engine. The smokestack is 7 ft. 4 ins. in height and 4 ft. 6 ins. in diameter at the largest end. As will be observed, there is no truck attached to the locomotive, the wheels all being of the same size. There are four pairs of connecting rods necessary to couple up the wheels. It is claimed that nearly all of the original parts of the engine are still in service, and I certainly never saw better workmanship, and it certainly reflects great credit on the Baldwin Locomotive Works that their machinery is still in operation after so many years.

W. W. SNODGRASS.
Highland Park, Ill.

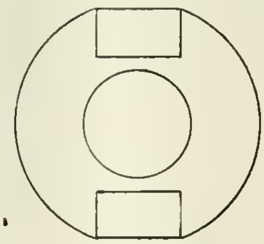


FIG. 1.

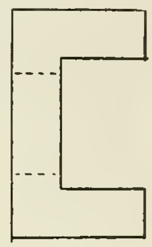


FIG. 2.

Drilling Push Rod Holder.

Editor:

The enclosed sketches show the details of angle plate, clamp and casting to be drilled on drill press table. The piece to be drilled is a push rod holder for air brake cylinder. This arrangement for drilling overcomes the difficulty of adjusting such a piece of work in the lathe or otherwise. The attachments are simple and easily constructed and readily adjusted to an ordinary drill press table. It is the work of one of the machinists in the Northern Pacific shops here.

Fig. 1 represents front view of push rod holder; 2, side view of the same; 3, front view of angle plate; 4, side view of angle plate; 5, top view of clamp used in holding push rod holder in place of angle plate; 6, end view of clamp; 7, shows push rod holder clamped in place ready for drilling.

John W. Percy.

N. P. R. R. Shops, South Tacoma, Wash.

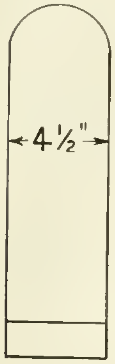


FIG. 3.

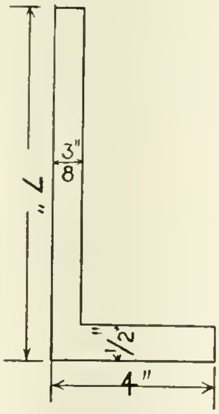


FIG. 4.

Joys and Tribulations of the Fireman.

Most of us who have gone through the grim ordeal of firing a locomotive for the first time, and are never likely to forget the experience. In Sinclair's "Locomotive Engine Running" a paragraph reads:

"A youth entirely unacquainted with all the operations which a fireman is called upon to perform finds the first trip a terribly arduous ordeal, even with some previous experience of railroad work. When his first trip introduces him to the locomotive and to railroad life at the same time, the day is certain to be a record of personal tribulation. To ride for ten or twelve hours on an engine for the first time, standing on one's feet, and subject to the shaking motion, is intensely tiresome, even if a man has no work to do. But when he has to ride during that period, and in addition has to shovel eight or ten tons of coal, most of which has to be handled twice, the job proves a terrible ordeal.

"Then, the posture of the body while work is new; he is expected and required to pitch coal upon certain exact spots, through a small door, while the engine is surging about so that he can scarcely keep his feet; his hands get blistered with the shoveling, and his eyes grow dazzled from the resplendent light of the fire. That does not sum up all his work. He must attend to taking water, to shaking the grates, cleaning the ash pan, and even the fire when inferior coal is used, besides filling oil cans, trimming lamps, to say nothing of polishing, dusting and keeping things clean and tidy. By the time the young fireman has attended to all those duties he does not draw much enjoyment from watching the passing scenery."

The actual experience of a fireman on his first run, as described by a correspondent of the *Locomotive Engineers' Journal*, gives a graphic description of first-run tribulations that will come home vividly to many of our readers.

The aspirant for the glory of firing a locomotive was working in the shop, and one day was delighted with the news that he had been marked up as an "extra fireman." Days of disappointment followed because he was not called to go out. Reflecting on delayed hope, he begins to tell the story thus:

"There was nothing for me to do but to go to my room, to bed and to sleep, only to be awakened soon after by something standing over my head shaking me and saying: 'Come, come, come; I've been half an hour trying to wake you. You will have to hurry or I shall call someone else. Here, sign this book.' Then he placed an open book before me and put a pencil in my hand, and told me I was called for an 'extra'

"The word 'extra' had the desired effect to cause me to realize the true situation that I was a fireman and had been called for an extra. Instantly I jumped out of bed, dressed myself, and went down stairs three steps at a time, jerked open the door and rushed out into the darkness.

"It was bitterly cold. The wind whistled around the corners of the house and through the limbs of the great skeleton trees in a frightful manner and whipping the snow into great drifts. This cold, raw wind chilled me through, and caused me to pull my coat close around me, and I wished they had called someone else this cold night and left me another day in the shop. I had not yet learned that it took just such nights and undesirable runs to make it possible for an extra man to have a change of shirts.

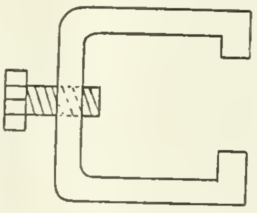


FIG. 5.

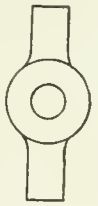


FIG. 6.

"There was an engine standing at the water tank which I was just passing when someone called out from the cab:

"'Dixey, is that you?'

"'Yep,' I replied, and hurried on.

"'Where are you going?' he said.

"'To the roundhouse to get warm,' I replied.

"'Warm!' he said. 'If you are going out on this engine you haven't got time to get warm. Come,' he continued, 'get on here; I want to back up for orders and get out.'

"I went back and got on the engine, but with some difficulty, however. My feet were so cold there seemed to be no sense of feeling in them, and my boots cracked on the deck like brickbats. I was about to remark that I was about frozen, when he said:

"'Ring that bell!' then started for the yard.

"I reached for the bell cord, wishing I had not asked for a job of firing until spring. My hand was so numb I could not hold, so I tried the other, and had just got a good grip on it when he almost yelled:

"'*Ring that bell! ring that bell!*'

"It's surprising how it warms a fellow up when he is spoken to in that manner, but it does; and I soon had the bell swinging in good shape, and kept it ringing until we stopped at the office, when he told me I needn't wear it out. I had just let go the cord and the bell was carrying out the slack, when I grabbed it, intending to stop it, but instead, the weight of the bell so suddenly stopped broke the cord.

"'That's right,' he said, 'I suppose you will have her all broken to pieces before we get back. Now, go out and tie that,' he continued, 'then fill the oil cans, and have a good fire in when I come back.' Then he jumped off and disappeared into the office.

"I had just repaired the bell cord and entered the cab when he appeared in the gangway, and inquired if I had filled the oil cans.

"'No; I haven't had time,' I said, as I reached for a can intending to do so.

"'Oh! *you haven't got time to do that now,*' he said, so I put it back in its place just as we started off, and then he inquired if I had in a good fire.

"'No,' I said, as I reached for a shovelful of coal, and had just opened the firebox door to receive it when again he sang out:

"'*Ring that bell!*' I dropped the scoop, shut the door, and took hold of the bell cord just in time to have him jerk it out of my hand and suggest, in a much milder tone, that I put in some coal. So again I ducked under the buck board and

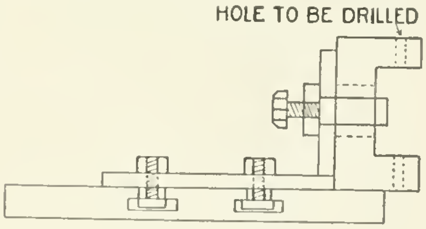


FIG. 7.

got right down to business, and I would have emptied the tank of coal no doubt if the firebox had been large enough to have held it, and the engineer had not stopped me by advising me to save some for farther up the road, and that I might sweep off the deck while I was resting. In fact, I had dropped about one-third of the coal on the deck.

"I was about half warm by this time; that is, my left half. My half on the right side was being frozen by the cold wind and snow coming up between the tank and engine. Once I stepped up to the boiler head and turned my right side to it, intending to stew it just a little; but it was no use, for the engineer told me I had better go out and break up some coal so the engine would steam better.

"This request, or order I should say, froze all those beautiful dreams into great square blocks; and as I ducked down under the buck boards to my duty I was thinking how impossible it was to enjoy anything, let alone those beautiful scenes, through frost-covered glass and blinded eyes from staring into a flaring firebox to see where all the coal was going to.

"By and by I had learned the greater part of my business. All I had to do was to shovel coal, break up the lumps, sweep off the deck, and ring the bell at road crossings. Of course, I knew nothing about where the road crossings were, but when the engineer whistled for them I must ring the bell. All I knew about the crossings was a rumbling noise and an extra gust of wind and snow up my pants legs.

"My experience up to this time put me in mind of a monkey in an iron cage as I would swing from the bell rope to the coal pick, from pick to shovel, from shovel to broom, then back to the bell cord, a regular merry-go-round; but, oh, Lord, I was cold.

"Those parts of my body that were not too cold to feel pain of any other nature ached. Great lumps of coal rolled down in the darkness on my toes, I nearly broke my back against the buck boards, my head was bruised from being bumped against the tank, the back of one hand was all peeled off from coming in contact with the coal gates, and the other was burned from taking hold of a heated pipe to balance myself, and both were so cramped I could hardly take hold of the shovel, and when I did it was difficult to let go again.

"When half way over the road my estimation of the beauties and comforts of a locomotive fireman had gone down considerably below zero; for to all the pain from bumps, burns, and bruises, hunger was being added. Yes, I was hungry, so hungry that I felt as though if I did not get something to eat soon I would collapse like a mud-bound flue; therefore, when we came to a restaurant and the engineer told me to take water, oil up and fill the cans while he was getting something to eat, my very thoughts would have frozen quicksilver.

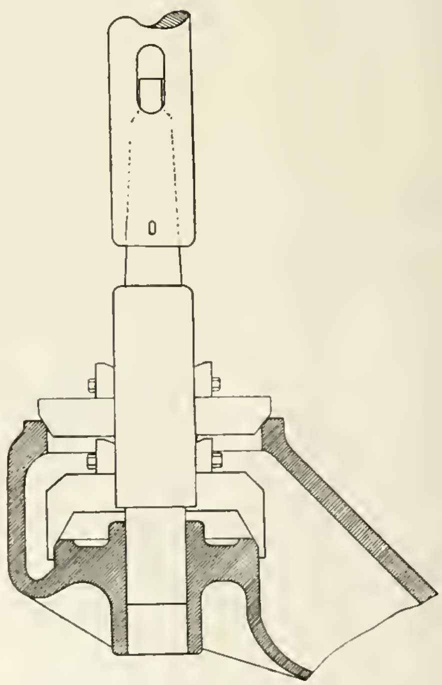
"Can it be possible that this is Thomas Bixby? I thought. The gayest, kindest and most generous man on the road, as I had so often heard. No matter, I thought, I must do my duty; and I did.

"I had just finished wiping off the oil cans when he came upon the engine and threw a bundle on my seat box, at the same time saying there was something to eat, then pulled out.

"I swung from the bell cord to the coal pick, then to the shovel, then back to the bell cord with one hand in the lunch box. I filled my mouth every time I came to the bell cord, and when I had finished he offered me a cigar, then slapped me on the back so hard he nearly knocked me down, at the same time saying:

"'You're all right, Dixy, you've got the grit, and I am going to speak for you for the next regular engine.

"And so he did. But I never could understand how that blow knocked all the cold out of me, but it did; and my heart was filled with gratitude for his kind and encouraging words. And from that hour on through all the years of my experience as locomotive fireman and engineer I enjoyed it, though there was much bitter to be taken with the sweet."



Throttle Box Reamer.

Editor:

Attached print shows method of reseating throttle boxes on drill press by simply bolting the throttle box to platen on drill press. It only takes a few revolution of tool to make a first-class job on both seats. This tool, you will note, maintains the correct bevel and distance between both seats. There are also two tools which are placed in this holder which faces down the tops of both seats which keep the bevel of seats the same width. The tools are held in position by the keys or wedges drawn together by nuts in end of studs. This will be found a fine tool by those wishing to make one. It is easy of construction and does work that cannot be done by any amount of ordinary grinding.

CHARLES MARKEL,
Shop Foreman, C. & N. W. Ry.
Clinton, Ia.

Testing Dry Pipes, Throttle Boxes and Stand Pipes.

Editor:

There have been several articles from different sources from time to time in your columns on the subject of leaky dry pipes, and locating the leak in round houses, none of which have been to my idea as quick and absolutely certain to locate trouble of this kind as the method generally used by us.

My method is to remove the dome cap, fill boiler with water over the throttle box joint, then plug nozzle stand and connect up air pressure to one of the relief valves, close throttle and turn in air; if bubbles come back from forward of dome, your leak is in dry pipe or collar; if it is in standpipe or throttle box joint, it will also be shown by the bubbles. There is absolutely no guesswork or speculation about this test; it is always reliable.

X. Y. Z.
K. C. M. & O. Ry. of Texas.

Hoodoo Engines.

Editor:

The hoodoo engine is a fallacy that is hard to overcome, but how many cases of this kind have there been that sooner or later a cause for the hoodoo has been discovered, and the engine has been as good as any of her class?

Poor performances always have a cause. It may be material or possibly workmanship that has caused it; the trouble may be found in the most unlooked for and unusual place. Every man of experience as an engineman or shop man, can cite you to some instance and nearly always tell how and by whom the trouble was located. A certain engine or class of engines may be persistent in the breaking of frames, rods, pins or axles, but they would not do it if there was not a reason for it.

Another engine has never been able to handle tonnage compared to other engines of the same class, never did steam, was always a hard rider, or could not be kept together, but a little thought will bring it home that something mechanical is at the bottom of it.

X. Y. Z.
K. C. M. & O. Ry. of Texas.

Type of Locomotive for the Duluth, Winnipeg and Pacific Ry.

TEN-WHEEL LOCOMOTIVE FOR THE DULUTH, WINNIPEG AND PACIFIC RAILWAY.

M. H. MacLeod, Gen. Mgr. Baldwin Locomotive Works, Builders.

The Duluth, Winnipeg and Pacific Railway has recently received from the Baldwin Locomotive Works, five passenger locomotives, which are equipped with fire-tube superheaters. These engines are of the ten-wheel type, and exert a tractive force of 28,800 pounds. The ratio of adhesion is 4.57.

The boiler used in this design is of the wagon-top type, with a long fire-box placed above the frames. The mud ring is of forged iron, and is sloped toward the front. This arrangement provides a deep throat, the distance from the top of the grates to the bottom row of tubes being 26¾ inches. The flexible staybolts number 218; they are applied in the sides, throat and back, and are placed principally in the outside rows. The crown staying is radial, and the four center rows of bolts are provided, under the crown sheet, with pressed steel nuts and copper gaskets. The fire-door opening is formed by flanging both sheets outward, and uniting them with a sleeve.

The superheater is of the top-header type, with 1½ inch pipes; and the elements are placed in 24 tubes, each 5⅜ inches in diameter. Considering each square foot of superheating surface as equivalent in value to 1½ square feet of evaporating surface, the total equivalent heating surface of the boiler is 2,613 square feet, or 229 square feet per cubic foot of cylinder volume.

The superheated steam is conveyed from the header to the steam chests through pipes which pass through the side walls of the smoke-box. The steam thus reaches the cylinders in the most direct manner possible. The distribution is controlled by 12-inch piston valves, arranged for inside admission and set with a constant lead of ¼ in. The cylinders are bushed, and the piston and valve rods have front extensions. A five-feed lubricator is placed in the cab, and separate leads are run to each cylinder and steam chest, while the fifth lead is run to the two air pumps. The valve gear is of the Walschaerts type. Castellated nuts are used on the motion work, crank pins and crosshead pins.

The frames are of steel, with single front rails. They are braced transversely by the guide yoke, the valve motion bearer, a broad steel tie immediately ahead of the main pedestals, and a tie under the front end of the firebox. The front bumper and back foot plate are of cast steel. Because of the location of the firebox, the equalization is arranged with yokes over the main and rear driving boxes, and half elliptic springs between adjacent axles. At the rear, the frames are supported on full elliptic springs.

The tender is carried on two four-wheeled trucks, which have cast steel bolsters and steel-tired wheels. The frame is composed of 13-inch channels. The tank has a water bottom, and is fitted with steel coal gates. It has a capacity for 6,000 gallons of water and 10 tons of fuel.

The following are the principal dimensions of these engines:

Guage, 4 ft. 8½ ins.; cylinders, 22 ins. x 26 ins.; valves, balanced piston.

Boiler—Type, wagon top; material, steel; diameter, 66 ins.; thickness of sheets, ⅝ in., 11/16 in., ¾ in.; working pressure, 170 lbs.; fuel, soft coal; staying, radial.

Fire box—Material, steel; length, 113⅛ ins.; width, 40¼ ins.; depth, front, 79 ins.; depth, back, 70 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water space—Front, 4 ins.; sides, 4 ins.; back, 3½ ins.

Tubes—Material, steel; thickness, 5⅜ ins.; No. 9 W. G.; 2 ins., No. 11 W. G.; number, 5⅜ ins., 24; 2 ins., 189; diameter, 5⅜ ins., and 2 ins.; length 13 ft. 2¼ ins.

Heating surface—Fire box, 183 sq. ft.; tubes, 1,737 sq. ft.; total, 1,920 sq. ft.; grate area, 31.6 sq. ft.

Driving wheels—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, main, 9 ins. x 11 ins.; journals, others, 9 ins. x 11 ins.

Engine truck wheels—Diameter, front, 30 ins.; journals, 5½ ins. x 12 ins.

Wheel base—Driving, 14 ft. 6 ins.; rigid, 14 ft. 6 ins.; total engine, 24 ft. 10 ins.; total engine and tender, 57 ft. 7½ ins.

Weight—On driving wheels, 131,850 lbs.; on truck, front, 44,450 lbs.; total engine, 176,300 lbs.; total engine and tender, 295,000 lbs.

Tender—Wheels, number, 8; wheels, diameter; 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 6,000 gals.; fuel capacity, 10 tons; service, passenger; engine equipped with superheating surface, 462 sq. ft.; fire-tube, superheater.

Scientific Management.

So much has been said and written in the last ten years about the so-called scientific management, that we supposed every person connected with practical work understood the meaning of the expression; but we recently have had reason to suspect that we were mistaken. We have, within the last fortnight, received several letters asking for information concerning the scientific management discussed in Mr. Symons paper on page 490 of our November number, so we feel called upon to give an explanation. The most powerful advocate and exponent of scientific management has been Mr. Fred W. Taylor, of Philadelphia. He is author of several papers describing scientific management, so we believe our best plan is to quote from Mr. Taylor as follows:

Under scientific management the initiative of the men is in all cases obtained with absolute regularity, and therefore, that alone is quite a thing. It is not, however, the largest part of the gain. The larger part of the gain comes from the very extraordinary and new burdens and new duties which are taken over by those on the management side. Those on the management side take on new burdens and new duties that are almost unthinkable, unbelievable under the old system; and it is due to the new duties and the new burdens taken on by the management, more than to anything else that this great increase in output always comes under scientific management. Now these new duties that were not before taken over by the management are divided into four groups of duties or new performances, and it is those four sets of duties in this new state of things, on the management side, that are called rightly or roughly the principles of scientific management.

The first of the new great burdens, which are undertaken under scientific management, is to gather in on the management side every bit of the knowledge possessed by each one of the thousand workmen in the establishment; gather it in, record it, tabulate it, classify it, and finally reduce it to the rules and to mathematical formulae. This knowledge is of immense help when the management proceeds to cooperate with the workman instead of driving them. Under the old order of things the problem was put up to the workman. "You do this or I will drive you or beat you." But when the management and workmen get busy side by side doing the job, when they use this amount of classified knowledge for the benefit of the workman, to help him do his work faster, it is of immense benefit to the workman increasing the output. That is one of the principles of scientific management; the development of a science of classified knowledge, of organized knowledge, which is the definition of the word science, the development of organized or classified knowledge to replace to old rule-of-thumb knowledge possessed by the workman in the past. That is the first of the four great duties undertaken by the management.

The second is the scientific selection and the progressive development of the workman. The workman is studied. It may strike you, gentlemen, as extraordinary that it should be so. He is studied under scientific management quite as thoroughly as horses are studied by those who deal with horses. Every one of you know that it is quite customary if you have horses in your stable to study them; not to let the horse do what he is going to do, what his job is, but to study that horse and see what that horse is fit for. That is a daily occupation that every one is familiar with. But it is far from a daily occupation to get next to every man and know what he is fitted for, and to make that of the duty of the establishment. This is the second duty that devolves on the management of scientific management, the deliberate, careful and accurate study of every man in the company, and then afterward the progressive development of that man to rise him up and teach him to do the best class of work for which he is fitted. That may sound to you, gentlemen, very much like philanthropy, but it is nothing of the kind. It is good horse sense, because it pays.

The third of the new duties under scientific management is to bring the science and the scientifically selection man together, to make—I say "make," and I don't mean it in any disagreeable sense, I don't mean to hit them with a club, but, nevertheless, make, through putting proper pressure, proper teaching, proper care— in a tactful way make the men work in accordance with the laws of the science. You can develop this science all you want to and then show it to the workman, but he won't use it unless someone makes him use it. So the third duty, and a great big one, is to bring the science and the scientifically selected and trained man together and see that the one practices the other instead of doing his own old way.

Now, gentlemen, I want to soften down the word "make." It sounds pretty hard. A great many men don't like to hear about making other men do anything. But let me tell you that in our work of systematizing manufacturing establishments nine-tenths of our trouble comes in trying to make the managers and those on the managers side—make I say—do their share of the work, and do it right. That is the fact. So I want to soften it down and temper it a little. When it comes to this word "make" it has a disagreeable sound. Applied to ourselves it cannot be so disagreeable, but applied to men it sounds pretty driving, as if it was a rather mean, hard system.

Then the fourth of the principles and scientific management, something which at first is exceedingly blind, which I daresay you gentlemen won't see at all at first, is this: That under scientific management actual work of the shop is divided into two not equal sections, but fairly equal sections. A very large slice of the actual work of the shop is handed over to the management. The work which in the past has been done by the workman is deliberately handed over to the management, and done by those on the management side. When I tell you that in a well organized machine shop that turns out a miscellaneous output, it takes one man on the management side for about every three workmen, you will see that I am earnest when I say that the work of that shop is divided into two sections and a very large slice of it is handed over to the management. In a well organized machine shop, for instance, doing miscellaneous work, there will be about one man on the management side to every three workmen, and those men on the management side are busy, not holding down chairs and drawing salaries, they are just as busy as any workman in the shop doing productive work.

Wages in Different Countries.

British government investigations are generally fair and impartial, but they sometimes make a trend towards favoring some particular policy. This is strikingly apparent in British Board of Trade investigations extending over four years which show that, where the British workman earns a dollar, the German workman earns eighty-three cents, the French workman seventy-five cents, the Belgian workman sixty-three cents, and the American workman two dollars and thirty-two cents; also, that the food for which the British workman pays a dollar at home would cost him a dollar and seventeen cents in Germany, ninety-nine cents in France or Belgium, and a dollar and forty-three cents in the United States—where, by the way, the hours of labor are four per cent. shorter than in England.

Such is the gist of a rather celebrated report; but in this report the only American workmen considered were those employed in the building, engineering and printing trades in the larger cities. It makes out the pay of American workmen to be much larger than it really is. Thus the American schedule starts off with city bricklayers and stonemasons, working eight hours a day and earning four to five dollars a day, and winds up with city printers getting three dollars a day for eight hours' work. It is limited to our highest-priced labor, but it seems to prove that our labor is the highest paid.

Persecution of Railways Suspended.

For years it seemed that every state in the union vied with each other in passing laws opposed to railway interests. Abuse of railway interests was regarded by certain frothy politicians as a cheap and easy means of attaining popularity and of winning votes; but by degrees the voters have come to realize that antagonizing railroads did not pay, that it was a new case of killing the goose that laid the golden egg. There is scarcely a state in the United States that has all the railroad mileage necessary for the possible business, and some of the states have a very small proportion of the railway mileage required to develop potential resources; yet most of them fall into the habit of putting embarrassing restrictions upon railroads calculated to reduce their revenues or to increase operating expenses. The result was that capital looking for investment kept clear of railroad enterprises so that railroad construction has practically stopped.

The Railway Business Association have compiled a pamphlet entitled "Constructive Railway Policy in Many States in 1911," from which we learn that a new policy has been adopted in many of the states hitherto noted for active opposition to railroads, and that "the era of conciliation, conference and co-operation which this association was formed to promote is manifestly dawning." President Post says the association deems it "of high value that the experience of states long given to much regulation and now turning to a period of legislative rest should be made known in the language of the representatives of those states to their fellow-citizens throughout the nation."

The pamphlet, which reflects much credit upon the compiler, Mr. Frank W. Noxon, concludes:

To the Railway Business Association it is evident that at the present moment political leaders who advocate a far-sighted policy toward railroads do receive the support of the voters. We point out further that the railways and cognate industries have assiduously conciliated the public, and that toward the railways the growth of public friendliness is now shown: We submit:

"First, that to convince the public of a desire to be frank and fair has been demonstrated to be an effective method for bringing about a better understanding.

"Second, that continued efforts toward conciliation promise for the railways a wider recognition by the public and by regulators that it is wise in the public interest to permit sufficient earnings.

Great Coal Discovery by a Scots Engineer.

We are beginning to hear a good deal about the development of coal mines on the line of the Grand Trunk Pacific out in Alberta; but the story of how the coal measures were discovered is known to few persons, and it constitutes another romance of industrial enterprise.

During the summer of 1908 Alexander C. Dunn, a young Scots mining engineer, was rambling about Western Canada. He was first drawn to Manitoba, but did not find it congenial territory for a mining engineer, so he proceeded westward over the mountains and began prospecting for coal which he considered would be more profitable than gold in that part of the world.

After long, weary search Dunn found near Edmonton indications that meant coal, so he sent to Scotland for his brother James C. Dunn, a coal agent, and together they proceeded to make sure by boring into the most promising places, and their quest was rewarded by finding thick seams of good coal. The brothers next took an option on 1,800 acres five miles from Edmonton, on the main line of the Grand Trunk Pacific, and the elder brother hurried home and interviewed several business people he know. As a result the Great West Coal Company has been formed with the modest preliminary capital of £30,000 to develop the mine—one of the shareholders being Mr. Donaldson, of the Donaldson Line. The Messrs. Dunn have taken machinery from Scotland sufficient to start the mine on a basis of 1,000 tons a day output. The coal discovered lies in three seams, and is estimated to total 240,000,000 tons—enough to put out a million tons a year for 240 years.

May Use Old Style Engines.

It is said to be a strong possibility that the Pennsylvania will go back to the old style of passenger locomotive if experiments that are under way continue to give as satisfactory results as they have so far.

For some time the company has been compiling statistics relative to fuel consumption and passenger engines. It is stated that a certain class show a saving in the operation of certain trains while others do better with heavier hauls. The new engines in use for several years have made good in the matter of speed, but as there are only certain trains which require that extra speed be made, the officials believe that those making more stops and operated on a slower schedule can get along very well with the old style of engine.

After all, the average passenger is in no such great hurry to get from place to place. Sometimes the greater the haste, the less is the amount of real accomplishment.

Traveling Engineers' Committees.

If the next convention of the Traveling Engineers' Association fails to be as successful as usual, it will not be the fault of Secretary Thompson or of the chairmen of the various committees, for a programme of next year's work was issued on October 9. The subjects for next year with the chairmen of the committees, are:

No. 1.—"The increased efficiency of locomotives and benefits derived from chemically treated water."—Fred McArdle, chairman.

No. 2.—"Fuel Economy; What relation do mechanical appliances, such as locomotive superheaters, mechanical stokers, brick arches and the handling of trains, have on this subject?"—F. P. Roesch, chairman.

No. 3.—"Handling of long passenger and freight trains with modern air-brake equipment."—W. F. Walsh, chairman.

No. 4.—"What sort of inspection of locomotives and work reports should be required of engineers upon arrival at terminals?"—H. F. Henson, chairman.

No. 5.—"How can the traveling engineer get engineers and firemen interested in economical use of fuel and lubricating material, maintain that interest and the influence upon fuel economy and lubricating methods?"—Robert Collett, chairman.

No. 6.—"What are the advantages vs. disadvantages of lead on the modern high-class locomotives?"—J. Fred Jennings, chairman.

Precious Steel.

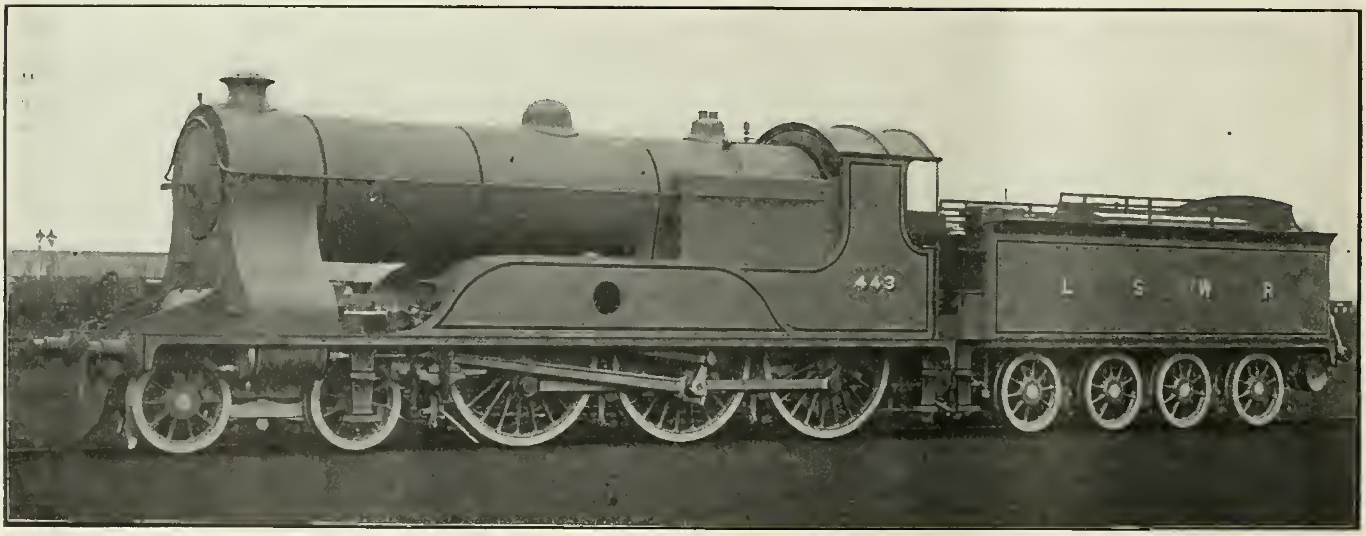
Steel is the most precious of costly metal used by man. The workmen engaged in the making of steel are not the high class artisans that worked in metal during the middle ages, but they will improve and even crude artisans become artists. Their product will be put to higher uses. Even in the present commercial conflict of commodities steel has found it's way above the precious metals. Watch screws, for instance, are worth $1,585 a pound, and hair springs almost twice as much. Fully twenty-five pounds of gold must be given for two pounds of these tiny nine-inch threads of steel.

A highly important decision has recently been made by the United States Supreme Court concerning safety appliances on cars. The Southern Railway in Alabama was prosecuted for using a defective coupling, and the defense was made that the car was not being used in interstate traffic; therefore was not subject to the United States law. The Supreme Court decided that the railway company was liable, since it was engaged in interstate commerce, no matter on what line of work the car might have been employed.

New 4-6-0 Four-Cylinder Locomotive.

An enlarged type of the 4-6-0 express locomotives has recently been built at the Eastleigh shops of the London and South Western Railway, from the designs of Mr. Dugald Drummond, the chief mechanical engineer. These engines differ from the preceding ones of the same general type in having all four cylinders in line between the bogie wheels. The valves are actuated by the Walschaert gear.

The leading dimensions are as follows: Cylinders, 15 in. diameter, 26 in. stroke; diameter of driving wheels, 6 ft. 7 in. The boiler barrel is 13 ft. 9 in. long and 4 ft. 9½ in. diameter, with center line 9 ft. 3½ in. above rail level. The working pressure is 200 lbs. per sq. in. The boiler tubes, of which there are 247, have an outside diameter of 1¾ in. and a length of 14 ft. 4½ in. The firebox is 9 ft. 6 in. long and contains 84 of Mr. Drummond's patent cross water tubes each 2¾ in. outside diameter. The heating surface totals 1,920 sq. ft., of which the boiler tubes contribute 1,580 sq. ft., the firebox tubes 200 sq. ft., and the firebox 140 sq. ft. The engine weighs, in working order, 74 tons 10 cwt., and the tender 44 tons—total 118 tons 10 cwt. The tractive force on rail equals 25,177 lbs. The tender carries 4,500 gallons of water. An exhaust steam feed water heater is provided in the tender well, consisting of 65 tubes 1½ in. diameter and 18 ft. long, giving 382 sq. ft. of heating surface. The total wheel base of engine and tender is 53 ft. 5 in. and length over buffers 63 ft. ¼ in.



4-6-0 FOUR-CYLINDER LOCOMOTIVE FOR THE LONDON AND SOUTHWESTERN RY.

The Fatal Small Defect.

We all know the old saying: "For want of a nail the shoe was lost, and for want of a shoe the horse was lost." That is one of the scraps of expensive wisdom that seeks to impress upon people the necessity for the close supervision that will detect the initial defect and prevent it from leading the way to disaster. The saying arose long before a machine tool or a steam engine was in use, yet it is more applicable to modern machinery than it was to the horse. "Keep the nuts tight and the bolts will give no trouble" would be a modern application of the old adage. One of the most valuable kinds of training that a young engineer can subject himself to is detecting small defects such as loose nuts.

Glass Houses.

The old saying, "Those who live in glass houses should not throw stones," left too much to the imagination, for there were no glass houses to be damaged by hurling of rocks. That deficiency will not exist much longer, for reports say that glass buildings will soon compete with those made of concrete.

In Berlin is constructed a small villa, the walls of which are built of glass bricks of several shades of dark green and blue. The glass bricks are especially adapted to construction where light, cleanliness and neatness are particularly in demand. In Hamburg they are utilized in place of windows. They admit light in walls which police regulations requie to be fireproof and windowless. In addition to admitting light to dark hallways, rooms, etc., they are said to possess the same strength as ordinary clay bricks. They are also utilized in walls in yards and partitions in the interior of houses, salesrooms, offices, workshops, etc., as well as for the construction of verandas, hothouses, kiosks, bathrooms, hospitals, ice factories, butchers' shops, railway stations, breweries, stables and in other places where cleanliness, light and uniform temperatures are especially desired. The bricks are also made with a wire coating for fireproof walls. In Milan, bricks made of glass have been adopted for ground and upper floors on account of the light obtained.

Distribution of Information.

The novel idea that it takes greater care and involves more elaborate arrangements to distribute information than for collecting it was brought out in a paper read by Mr. F. M. Whyte at the Central Railroad Club. The first impression is that Mr. Whyte is making the greater of the less, but a little reflection aided by a perusal of the paper convinces us that the point is well taken. Those who have gone through the ordeal of teaching their duties to new employees, to firemen, for instance, will readily admit that acquiring knowledge and skill is much easier than imparting the same to others.

An instance is given of a manufacturing company that had convinced a man at the head of the motive power department of a railroad that an addition which they had made to the device would be a convenience to the enginemen and justified a little additional first cost and quite a number of the new devices were placed upon the locomotives. But the enginemen were not told how to use it, and the new device, used ignorantly, was of considerable annoyance to the enginemen, whereas it would have been a convenience under proper explanation. The result was that the railroad lost the convenience and the manufacturer lost future business. However, it is being recognized very generally that specific information must go to the man who is supposed to use it.

We have repeatedly met with cases of that character, and the introduction of many useful improvements has been delayed and even defeated by want of information about their working having been neglected.

We commend Mr. Whyte's paper to the attention of our readers. It is one of the best papers recently made public through railway clubs, and is another proof, if proof were needed, that much good is being accomplished through the medium of the associations of railway men.

Growth of Business.

Complaints are heard almost everywhere that business is dull, but when statistics are examined they mark steady progress. The United States census shows that extraordinary increase of business marked the years 1904 and including 1909. In the latter year there were 268,491 manufacturing establishments, which produced to the value of over $500, as against 216,180 in 1904, when the previous census was taken, an increase of 24 per cent. The capital invested in 1909 was $18,428,000,000, as against $12,675,000,000, a rise of 45 per cent., while the average capital invested per establishment was about $69,000, as against $59,000; the figures are said to include the total amount owned, borrowed, and invested in the business, but not the value of rented property, plant, or equipment. The value of the products was $20,672,000,000 in 1909, against $14,793,000,000 in 1904, an increase of 40 per cent., while the cost of materials used was $12,141,000,000, against $8,500,000,000, a rise of 40 per cent. The average cost of materials for establishment was about $45,000 in 1909, and $39,000 in 1904. The value added by the processes of manufacture was therefore $8,530,000,000 in 1909 and $6,293,000,000 in 1904. Miscellaneous expenses, including rent of factory, taxes, and payments for contract work amounted to $1,945,000,000 in 1909, and $1,453,000,000 in 1904, an increase of 34 per cent. Salaries and wages reached $4,365,000,000 and $3,184,000,000, a rise of 37 per cent.; and the number of officials and clerks was 790,267, against 519,556, an increase of 52 per cent.

Utilizing Waste Coal.

An illustration of the feasibility of using waste coal for power purposes has just been given in Hull, one of the new patent water-tube boilers having been installed in an oil mill in that city. The success of a public exhibition given shows, it is claimed, that much coal which has heretofore been rejected as worthless, can be used, and that greater efficiency can be obtained from this waste coal by the new method than from the best coal by the old method.

The system employs the known principle that almost perfect combustion can be obtained by mixing air in proper quantities with pulverized coal before the latter is introduced into a furnace. This insures better combustion with less air than usual, and with a consequent increase of boiler efficiency by reducing the amount of heat carrried away by the escaping gases. The results obtained with the poorest kind of fuel are claimed to be as follows:

The almost total elimination of losses, as all the fuel is burned in suspension, the amount of unconsumed coal in the furnace at any given time being infinitesimal.

The rapidity with which steam is raised under ordinary conditions. The system differs from others in that with ordinary furnaces some time is taken before the fires are completely alight, but in this case as soon as the boiler is fired theoretically full effect is obtained.

The smallest and cheapest kinds of "slack" are burned with ease, and high efficiencies are obtained.

The arrangements which permit a close inspection of the straight vertical tubes.

The reduction of supervision necessary.

Coal dust costing $1.25 a ton, which could not be utilized in any other way, was burned under this boiler and gave equal efficiency as compared with coal costing $2.50 a ton and used with the old style of boiler. The boiler can be started and stopped, by holding the fire up, in one minute. In twenty-six minutes a steam pressure of 180 lbs. can be obtained, whereas it takes about four hours to fire a boiler of the old style. At mealtimes the fire can be cut off and a great saving of coal effected. An additional advantage is that the space occupied by the boiler is considerably less than that required for the ordinary boiler.

Very Strong Steel.

The automobile business is doing more than any other line of engineering work to develop the making of steel possessing great strength. We think that locomotive frames are subjected to more severe strains than motor car frames, and it might be economy to use the very strongest material, but railway companies do not think they can afford the high prices that are paid for chrome vanadium steel, nickel chrome steel, and other brands possessing extraordinary tensile strength. At a motor car show recently held in London specimens of steel were exhibited that had 120 long tons tensile strength.

The Foot.

One part of the human body receives no praise according to magnitude, that is the foot. It is well known that the Chinese use artificial means to keep the feet of women small, and there are many American women who suffer acutely because they habitually try to encase No. 8 feet in No. 5 shoes. The most acute sorrow that a male friend of ours has ever known, is the knowledge that he must for comfort wear a No. 11 shoe. It is a subject none of his friends dare joke about. Yet the time was when a big foot was a mark of distinction. In France, during the 15th Century, where fashions tended to extremes, the shoes of a prince were two and a half feet long.

High Prices and Low Wages.

Workers generally in the United States sympathize very little with the policy of the government in prosecuting the United States Steel Corporation and other great corporations, for all sensible people recognize that the prosecution of accumulated capital which has been the policy of our government for several years back, disturbs business without giving anything back to the people.

The history of the growth of wealth in the United States proves that corporations took the lead in raising the wages and shortening the hours of labor; but there have been grave exceptions to this rule, and the United States Steel Corporation has been one of the worst offenders in this respect. The Bureau of Labor recently reported upon an industry that is directly interested in the tariff—namely, the steel industry. It finds that one-quarter of all the employees embraced in its investigation work eighty-four hours a week, or twelve hours daily, including Sunday; and one-half of them earn less than 18 cents an hour, or $2.16 for a twelve-hour day. Highly skilled employees, comprising 4 per cent. of the total, receive 50 cents or upward an hour.

That is far short of being decent wages and justifies the reproach that corporations have no souls. The Standard Oil Company, which has been attacked so viciously by our government, is noted for paying its employees liberal wages, and wage-earners have no sympathy with the prosecutions, which they regard as persecutions, but it is different with the Steel Corporation. While charging exorbitant prices for steel (thanks to a high protection tariff), they pay their help the lowest market prices.

Long Hours and Small Pay.

Trainmen are a hard-worked class, but their condition is much less arduous than it was in what is often spoken of as the good old days. When railroad operating began wages were low and the hours of labor very long in all departments of industry. That beneficent improvements were effected all around was due in a great measure to the combinations formed by railroad men to promote higher pay and shorter hours of labor.

In reading notes of the experience of J. Conrad Englehard, an engineer who was retired from the Western Lines of the Pennsylvania years ago, we are informed that he began working on the Baltimore & Ohio in 1840 for $4 a month and board, his labor hours being from 4 a. m. to 8 p. m. Think of it. Sixteen hours' labor every day for sufficient remuneration to keep soul and body together. Years later, when he reached the position of wiper and extra fireman, about 1850, he received $1.15 a day.

General Foremen's Department

Next General Foremen's Convention.

When the members of technical organizations turn their minds to searching for subjects that will provide matter for further investigation and discussion, they sometimes select one that proves inexhaustible, as the Railway General Foremen's Association discovered, in the paper submitted by President Pickard on "The Best Method to Promote Shop Efficiency." That subject will be continued for discussion at the next convention, and other reports will occupy the attention of this industrious body of railway officials. The new subjects will be: "Shop Supervision and Local Conditions," "Shop Specialization Work and Tools," "Round House Efficiency," "The Relation of Tests to Shop Efficiency," "The Reclaiming of Scrap," and "Shop Arrangement." The officials of this association are making vigorous efforts to get all the reports ready for examination by the end of the year. It is hopeless to expect that men so busy as general foremen are will be able to prepare the reports in the short time proposed, but the request made for expedition will have a good effect.

Congratulations to a General Foreman.

In our November issue appeared a copy of a highly interesting practical paper submitted by Mr. Schlageter, general foreman of the Toledo Terminal Railroad Company, which would appeal to all our practical readers. Mr. Schlageter wrote a letter to Mr. C. L. Acker, his master mechanic, concerning his work, which was submitted to Mr. T. B. Fogg, the general manager, who replied as follows:

"It is certainly very gratifying to receive a letter such as was submitted to you by our roundhouse foreman, Mr. John Schlageter, who is our senior in service, stating that everything has gone well with him for the period of time he has so ably filled that position.

"There is no reason why all employees of every railroad should not feel toward the company they represent just as Mr. Schlageter feels toward this company, and if they do, nothing but pleasant working relations can exist.

"I congratulate Mr. Schlageter or anyone else who represents a company every day in the year, and throws his full heart's interest in the business. I trust that he will still be with this company when another seven years roll by, and feel just as content as he is today."

High Performance of a Pond Lathe.

Some months ago Angus Sinclair obtained from the Niles-Bennett-Pond people particulars about their machine-tool output to be used in the addresses he delivers to the apprentice schools of the Erie Railroad. His purpose was to compare modern machine-tool work with what could be done when the lathe was a one-man tool and no power-driven tools had been invented.

He found a good object lesson in the work done on the Pond centrally-driven car wheel lathe exhibited and used at Atlantic City last June. The performance was made by experts, but it shows what can be done by skill and industry. The performance was witnessed by a large number of master mechanics and car builders and was as follows:

June 14th..	3 pairs	turned in	52 minutes.
June 15th..	6 "	"	100 "
June 16th..	5 "	"	70 "
June 17th..	3 "	"	40 "
June 19th..	5 "	"	60 "
June 20th..	5 "	"	62 "
June 21st..	4 "	"	46 "
Total ...	31 "	"	430 "

This is an average of 13 87-100 minutes per pair.

They kept a record of the different operations on the three pairs of wheels turned in 40 minutes, on the 17th of June, and these operations averaged as follows:

	Mins.
Complete turning time	10 75-100
Putting wheels in machine	1 75-100
Taking wheels out of machine..	83-100

It is, of course, understood that these are record runs by skillful men, and it is not expected that these records will be equaled in railroad shops, or anything like it. It does show what the machine is capable of, and it is, therefore, up to each individual shop to handle it to the best advantage they can. The machine is there, and ready to do what it is called upon to do.

The company brought this machine out when *two or three pairs* of wheels was considered a ten-hour day's work. They have kept it constantly advancing with the improvements in electric motors and tool steel, until now it has a possible capacity of 40 pairs in ten hours, while the shop production should turn 20 to 30.

No such consistent progress is shown by any other machine tool that we know anything about. With the constantly-increasing number of steel tires used in freight equipment, this matter of re-turning becomes more and more vital to the railroads, and this fact is back of the persistent energy put into the development of this lathe.

Quick Repair Work.

At different times we have heard a great many stories about building locomotives in a few hours, but when particulars were called for it was found that the parts had been all furnished in advance, and what they called lightning building was merely assembling the parts as the parts of a sewing machine are put together in a factory. For real rapid locomotive repairing, we think a case reported by the Erie Railway Employees' Magazine is a little beyond anything we have ever heard. The operation was done in the Elmira roundhouse.

"Engine 401 arrived at Elmira on Tioga division train No. 252, at 9:15 a. m., September 19, with No. 2 driving box, left side, spring saddle and back spring, left side, broken. On arrival at shop engine had fire cleaned, coaled, tank cut loose and placed on drop pit at 10:15 a. m. Rods, pedestals, shoes and wedges removed, wheels dropped, new driving box bored and fitted, new spring saddle and spring applied, shoes and wedges planed to fit new box, pedestal braces and rods applied.

"Engine moved to another track to connect up with tank, and was ready to depart on regular run at 5 p. m. It will be conceded that this is a pretty quick piece of mechanical work."

Author of Scientific Management on Piece Work.

The principal apostle of scientific management, which is the best means of producing output of work quickly, is F. W. Taylor, of Philadelphia, yet Mr. Taylor seems to be particularly informed on causes which influence workmen to oppose the introduction of piece work and similar cost-reducing methods. In a paper which he read before the New England Railroad Club he said:

"You all know how shops are run. Every one of you know what the piece work game is. You know that you guess how many pieces of anything at all,—whatever it is, anything that is going to be made in the shop—ought to be done a day. You make a good bluff guess or you get some foreman and make a good bluff guess at about how many ought to be done a day, and then you fix a piece work price for doing that and say, 'I will give you five cents for making that,' or 'I will give you twenty-five cents for making that.' At the same time all of you have gorgeous boards of directors. You have got very enlightened and high-minded boards of directors in all your establishments. They look around their district of the country and say, 'Well, now our machinists ought not to earn more than $3.50 a day or $3 a day, whatever it is, in our section of the country. The board of directors look after that, because those are the very broad matters of policy that ought to be settled by the board. They settle that they must not earn more than $3 a day.

"The good, reasonable and sensible foreman, who has the interest of his men at heart, wants those fellows to turn out all they can, both for the interest of the men and for the interest of the company. He persuades the men, or if he is a stronger type of man he bulldozes them and drives them into turning out a larger and larger number of these pieces a day. We will say that a man starts at twenty-five cents and turns out twelve of them a day. He earns very good wages at that. With the combined pressure of the foreman and his own desire to get more wages he increases the output and gets out fifteen. His pay envelope comes out all right and he goes on. As far as the foremen are concerned that would probably go on for months or possibly years, but sooner or later someone who is on the board gets wind of the fact that this fellow, instead of earning $3 a day is earning $3.50. He gets busy. He says, 'My Lord, look here, all these other mechanics around here are only getting $3 a day, and why is it? We ordered you fellows not to pay one man more than $3 a day; why is it you are paying them such high wages? Are they worth more money than the rest of these fellows are around here? Get busy. You must have a very inefficient foreman.' The foreman is ordered to get busy and not let those fellows earn over $3 a day, and he cuts down the price, instead of paying twenty-five cents apiece he pays twenty cents, and Mr. Workman is notified. This starts him thinking, and he can think just as well as you or I can. His think is: 'Well, I was a d—d fool for ever doing more than twelve of those a day.' That is his think right off. And just two cuts, gentleman, about two is all that is necessary. All you have to do is to cut that man's wages twice, and if he has any 'think' in him he will never earn over $3 a day from that time forward. He will never turn out a bit more.

"That is not the man's fault, that is our fault, and it is true in ninety-nine out of every hundred establishments. And you wonder why the men are soldiering? Why, it is a great part of their life to see how slow they can go and yet make the man over them believe they are going fast, because they resent that treatment, just as you and I would resent it. It is human nature. They are not a bit different from you and I. We would do exactly the same thing.

"I dare say a good many of you have been through that fight. I have been through it, a bitter fight, too, and I want to tell you it is an awfully mean job. My sympathy is vastly more with the men in it than it is with the other side. Just put yourself on the man's side. If you have ever had that thing happen to you their justice of it, the meanness of the thing, comes home to you in a way that you never forget, and it is a strange man who does not begin to be a little bit hostile to the fellows who are over him. He may be a good-natured, kind-hearted sort of fellow, but he cannot keep from getting a little bit mad at the man who is treating him in that way."

Questions Answered

POSITION OF REVERSE LEVER.

113. W. K., Bristol, Tenn., writes: In running a locomotive down grade with steam shut off, is it a good practice to hook the reverse lever up near the centre or in the forward notch? A.—It is preferable at such times to place the lever in the forward notch for the reason that in a hooked-up position with a short stroke of the valve, a partial vacuum will be formed in the cylinder while the piston is moving from the point of cut-off to the point of release, and when the exhaust port opens the cinder laden gases, in the smoke-box, rush into the cylinder. The compression which is consequent upon the short travel of the valve has also the effect of raising the valve off the valve seat, and the lifting and dropping of the valve upon the valve seat may have the effect of cutting the face of the valve and valve seat, especially if any cinders find a lodgment between the two bearings. Opening the cylinder cocks relieves this trouble, but has the effect of rapidly cooling the cylinders.

TEMPERATURE OF STEAM.

114. R. B., Trinidad, Col., writes: What is the temperature of steam as it passes through the dry pipe at 180 lbs., boiler pressure, and how does it compare with the temperature of the exhaust steam when it has reached the smoke-stacks? A.—The temperature of steam at 180 lbs. pressure is about 380 deg. Fahr. This may be said to be the temperature of the steam passing through the throttle and dry pipe. Supposing that the steam is working expansively with a short stroke of the valve, and finally reaches the exhaust nozzle, the pressure may not exceed 5 lbs. per square inch. At that pressure the temperature of the steam would be reduced to 228 deg. Fahr. This calculation refers to saturated steam. In the case of superheated steam the temperature on leaving the exhaust pipe would be higher in a ratio to the increase of temperature induced by superheating.

BOILER HORSE POWER.

115. R. W., Saginaw, Mich., writes: Is there any exact rule in regard to calculating the horse power of a given size?—A. There are quite a number of rules relating to the subject, and it would not be prudent to venture an opinion as to the best rule. A simple and common rule is to divide the number of square feet of heating surface by 12, and the result will be the approximate rated horse power. Water consumption is also a guide as to the rating of a boiler, the calculation being based upon the amount of water evaporated. A boiler which evaporates 34½ lbs. of water into steam from and at 212 degs. per hour, is said to be equal to 1 h. p. of work. In James Watt's time the evaporation of 62½ lbs. of water per hour was calculated by him to be equal to 1 h. p. The steam engine has not changed much since it left his hands, but boilers have been greatly strengthened, with a consequent ratio of improvement.

BOILER EXPLOSION.

116. J. B., Trinidad, Colo., writes: A boiler exploded in this vicinity recently while the engine was standing. Some claim that there is extra danger in allowing engines to stand at a higher pressure of steam. Is this the case?—A. There is no extra danger if the safety valves are working and their openings large enough to admit of the egress of the superfluous steam. All boiler explosions come from over-pressure, and it is immaterial whether the engine is standing or running. Over-pressure does not mean that the pressure is higher than usual, but that the boiler in some part is weaker than usual. Boilers deteriorate at the rate of about 3 per cent. a year. Other causes, such as fractured staybolts, collection of scale, leaky flues and low water hasten the decay of the boiler, and the explosion is simply a proof that some portion of the boiler could not resist the pressure any longer.

The Long Distance Telephone.

It is very interesting to know that industrial long distance service has been put into operation between Denver and New York City, a distance of 2,100 miles, and with such success that probably before very long it will be possible to carry on a conversation from coast to coast, a total distance of 3,500 miles.

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Making and Treating Tool Steel.

The subject of "tool steel" has been receiving extraordinary attention lately from the New York Railroad Club, papers on the subject having occupied the attention of the members at two successive crowded meetings. The first paper by Dr. A. R. Roy, on "Swedish Steels," gave interesting particulars concerning the growth of the tool steel industry; while the second paper, by Mr. W. B. Sullivan, on "Tool Steel," dealt principally with modern methods of hardening and tempering steel.

The history of steel making is particularly interesting, and contains many romances that would hardly be expected from the material character of the subject. Most of those who have studied metallurgy, in connection with the development of civilization, are inclined to think that steel came into use as soon as people learned to separate iron from its ores. In Hindustan, and probably in ancient Egypt, a steel called "wootz" was produced directly from the ores. The first operation was carried on in a rough conical furnace of clay some two feet wide at the base and one at the top. Pure magnetites and other ores of India were used, smelted by charcoal. The ore and charcoal were dropped in from the top, and combustion was stimulated from below by a goatskin bellows. After the fire had been urged for several hours, the contents of the furnace were removed, and consisted of a rough porous ball or bloom partly melted. The ball was then cut up and put into crucibles, each containing about one pound of metal. Between twenty and thirty of these crucibles were then put into a furnace, where they were kept till the contents were melted. When the crucibles were removed and permitted to cool, an examination of the cakes was then made, and only those that were perfect hammered into bars.

When made of the best ore and properly worked, this wootz steel takes a magnificent temper, and has extraordinary strength and resistance. The famous Damascus blades were swords made of the finest wootz steel. Swords of this steel with an edge sharp enough to cut gossamer like a razor have been dashed with the full force of a man's arm against a bar or iron which it cut in two. The demand for perfect weapons, no doubt, led to the high development of wootz steel, but its finest triumph was paving the way for perfect tool steel.

The Eastern process of steel making did not suit the pioneer European metallurgists, because their iron ore was not sufficiently pure to be converted into steel direct. The process with them was to smelt ore in a furnace producing cast iron, which was a mixture of iron and carbon, loaded down with such substances as sulphur and phosphorus, both very objectionable impurities. To eliminate these, the cast iron was melted in another furnace and puddled, an operation that resembled on a large scale the stirring of the domestic porridge pot. When the puddling was done, the iron became a pasty mass, which was hammered and rolled into wrought iron.

To make wrought iron into steel, what was known as the cementation process was carried out. The cementation process consists of heating small pieces of wrought iron at a high temperature and surrounded on all sides by charcoal. In this way the iron absorbs a certain proportion of the carbon and is converted into "cemented" steel. The surface of the iron is covered with small blisters which gives it the common name of blister steel. As cemented steel was generally real steel only on the outside, it sometimes was doubled on itself and welded when the product became shear steel. This was again doubled on itself and welded, becoming double shear steel.

At its best cemented steel was an inferior material, unsuited to the making of fine tools. Before the making of cast steel was discovered, it was said that the British Government was in the habit of paying $25 a pound for wootz steel to be used in making coining dies.

The making of crucible steel was discovered by Benjamin Huntsman, a clockmaker, of Sheffield, England, about 1740. Huntsman had difficulty with the springs made from blister steel breaking, so he proceeded to discover a steel that would equal the high-priced wootz. After many years of painstaking experiment, he perfected the making of cast steel. The melting is done in crucibles made for the purpose capable of holding about thirty-four pounds each. Ten or twelve of these crucibles are placed in a melting furnace, and when the crucibles are at a white heat, to which they are raised by a coke fire, they are charged with bar steel broken into pieces of about a pound each. When the crucibles are all thus charged, lids are placed over them, the furnace is filled with coke and the cover put on. After about three hours' exposure to intense heat the metal is ready for pouring.

That was the method of crucible steel making invented by Huntsman, and it was followed with very little change until a few years ago, when the Siemens-Martin open hearth process was introduced. The method of making cast steel was kept a secret by Huntsman for years, and was made public by a rival steel maker who dressed up as a miserable looking vagrant, found shelter in Huntsman foundry on a wild, stormy night, and was able to spy on the steel making operations.

The secret of making good cast steel depends upon the mixture used, and nothing has been found equal to Swedish iron. Some grades of American iron can be refined until they are as free from phosphorus and sulphur as Swedish iron, but from some mysterious cause they do not produce the same quality of cast steel. Some cast steel makers have made idle pretensions about the high value of the mixture they use, and throw deep mysteries around their operations, which are mostly pure humbug. While their service is, or, rather, was, silly superstition, for the mystery of the "mix" has been exploded by real service. The mixers used to carry along the secrets of their craft from father to son, and these worthies had no more real knowledge to boast about than the old-time valve setter who made shop men believe that mysterious arts surrounded the plain operation of setting engine valves. The mixers' pretensions were particularly absurd. Most of them had great belief in the influence of a rabbit's foot kept in the left pocket of the man's trousers, while three hairs from a she ass's tail was reputed as a certain remedy against certain crucible defects. it is a fad that at one time in the city of Sheffield nearly all she asses had bald tails, the hair having gone to the steel crucibles.

In the manufacture of high speed steel several ingredients are used besides iron and carbon, tungsten having a conspicious place.

The paper which Mr. W. B. Sullivan read before the club was rather an ambitious effort to substitute scientific tests for the rule of thumb practices used by tool dressers from time immemorial in forging, treating, tempering and annealing steel tools. Tool dressers, as a rule, have been highly skilful workmen, possessing valuable knowledge concerning the working of steel, but circumstances are constantly occurring that produce errors, which are often expensive. In these days of strenuous shop operations workmen are urged to help in saving immense sums daily by following improved, up-to-date methods. These methods involve the use of the micrometer, the pyrometer, the scherescope and other instruments to give accurate information in place of the workman's judgment which defective light, a disordered stomach and many other sources ot disturbance will decrease.

The customary method of working tool steel has been forging at a high cherry red; annealing at a low cherry red; hardening at a full cherry red; and drawing to suit the nature of the work; that is to a high straw, a full straw, a pigeon blue, a peacock or some other equally indefinite color. The degree of temperature is approximated by the color and the best eye is guess work, the author of the paper having mentioned a case where five experienced workmen varied 500 deg. in their sight estimate of a heat.

Some of the ablest advocates of scientific management say that it takes many years to train a body of shopmen to the new methods that will bring much profit to employers and employed. We would judge that substituting the scientific instrument for the decision of the eye is not likely to be popular with, what lawyers call, the party of the second part. Young men ambitious to shine as tool dressers may rush to familiarize themselves with the working of pyrometers, sclerescopes, etc., but the experienced blacksmith, whose work may always be depended upon, will scorn to learn the new tricks, preferring the older methods learned in the school of experience, and which has stood the test of centuries, and in all probability will continue to be the methods in vogue for many more centuries to come.

Outside and Inside Valve Gearings.

We have taken the opportunity, during the summer months, to inquire of engineers on several of the leading railroads as to their opinions of the various types of outside valve gearings, the introduction of which has been, to a great extent, an outgrowth of the increased size of the modern locomotive, and we have everywhere been met with the statement that the outside gearings had passed beyond the experimental stage and had met the approval of all who had had the opportunity of taking their superior merits. That there should be no complaints in regard to the use of mechanism so involved in its construction, and so important in the sustained accuracy of its motion, is the highest kind of praise.

At the same time we have not heard any particular complaints in regard to the continued use of the older established inside, shifting-link, valve motions. It is a mere matter of utility and adaptability. On certain classes of locomotives the inside valve gearing has done, and is still doing, excellent service. The chief weakness in valve gearings of the shifting-link variety is their unavoidable liability to get slightly out of order. That is readily understood when it is observed that the moving force is so far removed from the valve itself, and, consequently, an increasing amount of lost motion is, under any condition, unavoidable. A multiplicity of points, each of them affected by strenuous and variable forces, it is a physical impossibility to make any kind of provision to retain the valve in its true position for any considerable length of time in actual service.

Out of this organic weakness, there grew, especially among engineers, a chronic feeling of dissatisfaction with the valve motion. A desire to rectify the growing defects often became a spirit of mere meddling, and readjustments that were no remedy were far too common. In fact with a large amount of lost motion, a perfect readjustment became impossible, and the lame exhausts, like false notes in music, were the rule instead of the exception.

With the outside valve gearings and their close attachments to the valve rod, not only has the element of lost motion been largely overcome, but the slipping motion incidental to a link oscillating in a long arc, has been entirely avoided, with the result that the valve gearing has passed outside of the pale of the consideration of the engineer, and this important part of the modern locomotive is now largely looked as having assumed a position of almost absolute reliability.

In the introduction of the outside gearings there was a tendency at first to construct the parts much lighter than the service actually required. There is always a wide discrepancy between them and practice, but a repetition of fractures are lessons that are generally needed by constructing engineers, and there is now a stronger system of bracing and a greater massiveness of bearings that meet the exigences of the service with a degree of rigidity that leave little to be desired.

In this important work it is gratifying to observe that the spirit of American enterprise and invention has kept pace with the requirements of the hour. The work of the Pilliods, now generally recognized as equally important, and, in many respects, more economical than that of Walschaert's masterly invention, has contributed largely to the advancement in the accuracy and reliability of locomotive valve gearing and we venture the observation that in the not far distant future the work of the American inventors will supersede both the British and Belgian inventors on the matter of simple and reliable methods of moving the valve gear of locomotives.

Facts Concerning Water.

The crystal head of dew glittering in the morning sunshine is a bit emblem of purity and represents water in its most attractively poetic form. Water is the most beneficient substance that the plan of creation has given to the earth, for without its germinating presence, this planet would be a huge mass of dry cinder, like what our moon is reputed to be, on which no form of life could exist.

In chemistry water has the symbol H_2O, meaning that it consists of two parts, by volume, of hydrogen to one part of oxygen, or by weight 16 parts of oxygen to 2 of hydrogen. These two gases can be separated from water in various ways, the best known process being that of the electric current. The process of separating the two gases of water by electricity is very simple, requires little apparatus, and can be carried out by any intelligent person if carefully conducted. Our studious readers can increase their knowledge with little labor by trying experiments with water.

When we consider the numerous comforts and benefits that the human race derive from water, it is not surprising that it has been the object of worship by various races. In Judahism water has been regarded as a representative of purity, in Hinduism it represents fertility, and in Taoism humility through its tendency to descend to the lowest level.

All the apparatus necessary to carry out the experiment is two electric calls of the kind used by automobilists for producing sparks, a glass funnel about three inches diameter at the widest part, two pieces of platinum wire and some copper wire, two glass test tubes about three inches long and a stand suitable for holding the apparatus together. Two platinum wires are forced through the cork that closes the end of the funnel and pushed upwards to the same level.

The funnel is then nearly filled with water and the test tubes full of water secured inverted above the ends of the wires. On connection with the battery being made, bubbles of gas begin to rise from the ends of the platinum wires and the gas gradually displaces the water in the test tubes. It will be noticed that the gas in one tube collects twice as fast as it does in the other, which gives an experimental proof that the volume of hydrogen composing water is twice that of the oxygen. Hydrogen is the gas present in the tube that fills fastest.

When the tubes are filled with gas, a simple fire test will indicate the character of the gas. If the experimenter takes the tube that filled most slowly, keeping a finger on the end to prevent the escape of gas, then turns the mouth upwards and applies a red hot match to the opening, the match bursts into flame, the peculiarity of oxygen gas being to burn at a low temperature. If the other test tube is treated in the same way, no flame will arise, but if the tube is held opening downwards and a flaming taper applied, the gas will burn slowly with a pale blue flame, that flame being peculiar to the combustion of hydrogen. The same kind of flame can sometimes be observed rising from the top of the coal of a banked firebox.

Other interesting experiments may be made to separate the water constituent gases. If a small pellet of the metal potassium be thrown on the surface of a basin of water, flame will arise around the pellet. The flame is due to the hydrogen in the water being set free and burning. The oxygen set free in this experiment combines with the metal and forms alkali potash.

A piece of the metal sodium thrown on the surface of water releases the hydrogen, but it does not produce sufficient heat to burn.

For boiler use, water is classed as hard or soft, a high degree of hardness limiting its use and calling for softening processes. The purest water found is rain water, but it does not continue to be pure long after it descends upon the parts of the earth where minerals lie that water dissolves.

Throughout a wide area of the American continent, limestones or various forms of calcareous rocks constitute the upper rock stratum immediately underlying the subsoil of plains and valleys. During the stupendous operations of nature in building up this continent, the rocks have been subjected to vast disintigrating agencies; they have been fractured by eruptive forces; they have been torn and eroded by huge masses of ice; they have been burned by the rays of the unshadowed sun; disintrigrated by the conjecting power resulting from deep-searching frost; melted by water, that most universal solvent in nature; then scattered far and wide by avalanche and flood. This process has been as complete, that in the whole limestone territory, all the earth seems to be charged with lime.

Limestones are very sparingly soluble in pure water; but the rain that falls from the clouds is not pure, but it always contains a charge of carbonic acid gas that acts chemically upon lime, forming salts which the water readily dissolves. Owing to this circumstance, there are few streams and fewer wells in the calcareous regions that are not contaminated with lime. The water that passes into streams, generally runs over surfaces that have been washed partly free from lime; and in consequence of this, brooks and rivers are not so badly tainted with lime-salts as the water in wells that stands saturating the rocks. The appearance or taste of water gives us indication of the quantity of lime it may hold in solution. The ice cold deep well, may be charged with deadly sewerage, and saturated with lime while the sparkling spring, whose water is so pleasant to drink, may hold so much lime-salts in solution that its use as boiler feed water would be ruinous to heating surfaces.

The Commerce Court Acts.

The Interstate Commerce Commission has been given so much power over railways that it has repeatedly acted as if there was no limit to its actions and orders. One of its latest moves was to divide the United States into freight zones and to apply percentage principles when fixing rates on traffic between those zones. The Commerce Court has now interfered with that action of the Interstate Commerce Commission, saying that it finds nothing in the Federal railway law to authorize the forming of zones for the control of freight rates. This seems to be a victory for the railway companies which objected to the zone arrangement, but it will be an expensive victory if it again throws the question of railway rates into the hands of Congress.

The decision of the Commerce Court will go to the Supreme Court for final settlement. No matter what that decision may be there is danger that it will bring on another agitation against railways. The country is committed to the principle of control over railway rates, subject to the conditional prohibition against confiscation by the Commerce Commission. Every agitation instituted between the people and the railways ends in the railways getting the worst of the deal.

Since the above was written the Commerce Court has again decided in favor of giving railroad companies fair rates. In making sacrifices to encourage the business of orange growing on the Pacific Coast the railroads made a rate of $1.15 per hundred pounds from coast to coast, a rate which is very close to cost. Lemon growers on the Pacific Coast wanted still lower rates and the Interstate Commerce Commission made out that one dollar per hundred pounds was reasonable for carrying lemons over the continent. On appeal being taken to the Commerce Court that body decided that $1.15 per hundred pounds was just as reasonable for lemons as it is for oranges.

According to a dispatch from Washington a new movement has been inaugurated in connection with the fair decisions made by the Commerce Court. It is said that certain senators, who are chronically against the railroads, have combined to abolish the Commerce Court. We wonder if a charge for combining in an unlawful conspiracy would hold against a group of unworthy senators?

Oil-Burning Locomotives.

Perfect combustion can be created in oil-burning locomotives when an accurate combination of oil and steam is made, with the requisite quantity of air. Heating the oil in the tank is desirable, and this is done by admitting steam into the tanks to warm the oil sufficiently. It is good practice to heat the oil while the engine is standing. When properly adjusted, the mechanism is easily managed, and the labor is much less than on coal-burning locomotives.

The same care must be exercised as in coal-burning to raise the pressure slowly. The firing should never be forced, the filling and choking of the tubes with soot being one of the attendant evils, while the burning of the shell and rivet heads cause leaking of the joints and flue ends. With a falling steam pressure care should be taken to raise the pressure slowly to the desired point. Sanding should be continued lightly as long as the smoke lasts, and it is not now considered good practice to put the fire entirely out until the engine has finished its trip.

In waiting at the stations it is as well to keep the fire burning fairly strong if the injectors are working. In case of it becoming necessary to shut off the fuel supply altogether, the dampers should be shut to prevent an excess of cool air from rushing into the firebox and flues. Sudden changes of temperature have a pernicious effect upon boilers, and the tendency to changes in the case of oil-burning engines is very great, and should be carefully guarded against.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series Continued.

50.—If you discovered that a fixed signal was missing or was improperly displayed, what should you do?

A.—Stop, ascertain the cause and report to the proper official from the first telegraph station. The absence of switch lights would be taken as a danger signal.

51.—If you happened to see anything on the track or beside it that looked like a dangerous obstruction or defect of track, what would you do?

A.—Stop at once, notify the conductor in order that he might investigate and take proper action.

52.—When fixed signals are obscured by fog or storms, what special precautions do you consider necessary?

A.—Would reduce speed to be able to stop within the distance at which their indication could be distinguished, and should I be unable to see the indication of the signal without encroaching upon the danger point protected by it, would stop clear of such point and send fireman ahead to ascertain the indication and be advised thereof before proceeding.

53.—What signals are you required to carry in your cab?

A.—At night engineers are required to have in their cabs, where they cannot be seen from outside or passing trains, red lamps lighted, and during the day red flags, mounted both in good order, with three torpedoes attached to each, to be used by the fireman in protecting the train and to signal approaching trains in case of danger.

54.—How much power has the piston, on one side, to move an engine when the center of the wrist pin, the crank pin and the main driving axle on that side are all in a straight line, that side being on the center?

A.— None whatever.

55.—How then is the engine kept moving?

A.—Since a locomotive consists of two separate engines, with each cylinder a medium of power, transmitting force to the same driving wheel as the other to a crank pin secured at right angles to the other crank pin, it follows that when the main pin on one side is on the dead center, the other is on the top or bottom quarter, which is the point of greatest leverage, so the one cylinder in that position transmits sufficient power to carry the other crank pin past the dead center when the steam immediately becomes effective to carry on the work on that side. Bicycle riders are having constant experience with the powerless dead center, which in their case happens when the crank is on top or bottom.

56.—What would you do in case you found the throttle valve disconnected and closed?

A.—On lines where trains are numerous would treat this as a disabling accident. Would at once protect myself from approaching trains, then send to the nearest telegraph station to call for assistance, and would prepare to be towed in by taking off the main rods. If the distance to be towed was short would disconnect the valve stems and saturate the cylinders with oil, which would be practicable by taking out the lubricator chokes. If the weather was so cold that there would be danger from the pipes freezing, would empty the boiler, also the tank, and break pipe joints. In case there was no danger of delaying trains, would blow off steam, remove the dome cap and connect the throttle valve.

57.—What would you do in case the throttle valve was disconnected, open?

A.—Reduce the boiler pressure sufficiently to enable me to handle the reverse lever safely. Would notify the train crew and proceed with whatever train the engine could handle. What is sometimes mistaken for a disconnected throttle valve, is merely a stuck valve, due to excessive lost motion of parts. This will happen when the throttle is pulled full open. The remedy is tapping the throttle rod, which often releases the valve.

58.—What valve gears are used on locomotives you are acquainted with?

A.—The shifting link motion, usually known as the Stephenson valve gear; the Walschaert valve gear, the Joy valve gear, the Pilliod, and the Baker-Pilliod.

59.—What description can you give of these different valve gears?

A.—The Stephenson valve gear is actuated by two eccentrics secured, generally, to the main driving axle. These eccentrics or sheaves are provided with straps to which rods are attached that connect with a radial movable link. By means of a sliding block the link connects with the lower end of a rocking shaft. The upper end of this rocking shaft is attached to a valve rod which transmits the motion of the eccentrics to the slide valve. The movement of the valve is regulated by the position of the sliding block in the link. when that block is near the top of the link, it gives full movement to the valve in forward gear. When the block is near the bottom of the link it produces full motion to the valve in back gear. The Walschaert is of the type known as a radial valve gear, has a single crank arm attached to the main crank which performs the functions of the two eccentrics in a link motion. The crank arm has a rod connecting it to an oscillating link traversed by a movable block. A radius bar conveys the motion of the block to the valve rod. There is a combination lever attached to the crosshead at its lower end and to the valve rod at its upper end. This combination lever moves the valve a sufficient distance from the central position to provide for the lap or lead.

60.—How can the valves of a shifting link motion have lead increased or diminished?

A.—By moving the eccentrics.

61.—How is lead changed in a Walschaert motion engine?

A. By lengthening or shortening the combination lever.

62.—How can one know whether the valve is of the outside or the inside admission type on a Walschaert gear engine?

A.—When an outside admission valve is used the eccentric crank will be set a quarter of a revolution ahead of the main crank when the engine is running forward. When an inside admission valve is employed the eccentric crank will be set a quarter of a revolution behind the main crank pin.

63.—Are there any other peculiarities of construction that would indicate the particular kind of valves in use?

A.—The manner in which the radius bar is coupled to the combination lever indicates the type of valve in use. When coupled below the valve rod the arrangement is suitable for outside admission valves. When connected above the valve rod, the valves are of the inside admission kind.

64.—Where is the link block when a locomotive having shifting valve gear is running forward?

A.—With all link motion engines, the link block is near the top when running forward?

65.—In Walschaert valve gear where is the link block when the engine is running forward?

A.—Near the bottom.

66.—What is the cause of this difference?

A.—In moving the reverse lever ahead, the lifting shaft arm attached to the link hanger is lowered, thereby lowering the link, the block being attached to the lower arm of the rocker in shifting link motion. On the other hand, the link used in the Walschaert gear is attached to a central pivot or stud upon which it oscillates, the block being attached to the radius bar is lowered when the reverse lever is moved forward and consequently is at the bottom of the link when the gearing is in the forward motion.

67.—In case of breakage on the locotive and it becomes necessary to block the valve, how should the Walschaert motion be disconnected?

A.—The radius rod should be disconnected from the combination lever, and suspended by any convenient means clear of the valve stem.

68.—Is it necessary to remove the combination lever when the Walschaert valve gear is disconnected?

A.—No.

69.—In disconnecting the Walschaert valve gear in what part of the link should the block be secured?

A.—In the middle. Pieces of wood should be packed on top and bottom.

70.—What are the principal features of the Joy Valve gear?

A.—In this form of valve gear the eccentrics and their equivalents, such as the eccentric crank are dispensed with. The motion for the valve is taken directly from the connecting rod. By utilizing the backward and forward motion of the main rod and combining this with the vibrating action of the rod up and down, a movement results which is employed to actuate the valves of engines using any combination of lap and lead desired.

71.—What are the chief features of the Baker-Pilliod valve gear?

A.—It resembles the Walschaerts valve gearing in having a signal crank attached to the main crank, which by a connecting or eccentric rod transmits the motion to the valve, and also by the addition of a combination lever which modifies the motion, but it does not transfer the motion from the main crank through a movable or oscillating link, but through a system of bell cranks the motion of which is modified by a suspended radius bar attached to the reach rod. The lower arm of the bell crank is attached to the valve rod by suitable connections.

72.—How can the amount of lead or opening of the valve be increased or diminished in the Baker Pilliod valve gear?

A.—By lengthening or shortening the lower arm of the bell crank to which the valve rod is connected. The amount of lead and the stroke of the valve may also be changed by lengthening or shortening the combination lever.

73.—What important variation distinguishes the Pilliod valve gear from that of the Baker-Pilliod gearing?

A.—The chief variation consists in transferring the motion obtained from the crank and crosshead on the right side of the locomotive to move the valve on the left side of the engine and vice versa.

74.—What advantage, if any, may be claimed for this variation?

A.—The variable motion of the speed of the crosshead is taken advantage of to insure a more rapid opening and closing of the valve.

75.—What are the chief advantages, if any, that may be claimed for the Walschaerts, Baker-Pilliod, and Pilliod valve gearings?

A.—The parts of the gearing may be much more readily reached than is the case with the Stephenson shifting link motion, and as the moving power is nearer to the valve, the joints being fewer in number, the retention of the exact position of the valve is more enduring, and hence more reliable.

Efficiency of American Railway Men.

The railway companies in Europe charge their patrons about twice as much for service of transportation as the rates charged by American railroad companies, and they pay their employees a little less than half the wages paid in the United States and Canada. Yet the dividends paid to the stockholders in Europe represent low interest on the capital. When the matter is closely investigated it seems to indicate that the high-paid railroad men of America do their work so efficiently that they really constitute the cheapest railway labor to be found anywhere.

Brains Wanted.

There is a railway problem, of course, and no one dissents from the proposition that the roads should be compelled to deal justly with the public and that rates should be as low as consistent with the rights of the owners and the interest of the public. But entirely too many shallow minds are fooling with this problem. Perhaps most of them are inspired by good intent.

For Slipping Belts.

When a ready remedy is demanded for a slipping belt, the powder known as whiting, sprinkled sparingly on the inside of the belt, is least harmful of any similar application.

Bronzing Cast Iron.

A German paper gives the following process of bronzing cast iron without covering it with a metal. Thoroughly cleanse the metal and rub it smooth. Apply evenly a coat of sweet or olive oil and heat the iron, being careful that the temperature does not rise high enough to burn the oil. Just as the oil is about to decompose, the cast iron will absorb oxygen, and this forms upon the surface a brown oxide skin which holds securely, and is so hard that it will admit of a high polish, thus giving it the appearance of bronze.

Coloring Brass Blue-Black.

To color brass blue-black make a solution of ammonia and copper carbonate in the approximate proportions of ten parts of ammonia and one part of carbonate by weight. Shake the mixture until the copper carbonate is dissolved, adding the copper carbonate to the ammonia little by little until the ammonia will not dissolve any more. Then add water equal to about one-fourth of the mixture. The pieces of brass to be colored should be polished bright either with fine, dry emery cloth or by dipping in a strong solution of caustic soda. Agitate the compound thoroughly, and on immersing the pieces of brass keep them in motion two or three minutes. Rinse off in clean water and dry in sawdust.

Hydrostatic Level.

A simple method of determining the accuracy of work on the walls of a new building which is usually done by the regular leveling instrument, is occasionally resorted to. It consists of placing four pails attached to each other with suitable piping, and pouring water into the system, and upon the water having assumed its level it is readily found by inspection whether the four corners are of equal height. Instruments may vary or get out of order, but Nature is infallible.

Quick Casehardening.

A quick method for casehardening consists in heating the material to be hardened to a red-heat and submerging in a bath of molten cyanide of potash or potassium, leaving it in from one to four hours, according to the bulk of material to be hardened. Cyanide of potassium gives off poisonous fumes, so that the vessel containing it should be placed in a furnace with a draught. This method is dangerous to the operators and should, if used at all, be used in a very careful manner, and the security of a strong draught of air to carry off the fumes is the only safeguard.

Air Brake Department

"P. C. Brake" Efficiency.

In the October and November issues of this journal an effort was made to explain the operation of the control valve without designating every port opening in each position, and the reader will readily see that the operation is almost as simple as that of a distributing valve, save that some added features have necessitated the use of some additional valves, but any slight annoyance due to the use of a somewhat more complicated apparatus can offer no serious objection when the remarkable accomplishment of the equipment in question is considered.

The practical value of this type of brake is very forcibly illustrated by the results of the Lake Shore emergency tests, in which the shortest possible stop of modern train from sixty miles per hour speeds, with the high-speed brake, was 1,675 feet. With the P. C. brake these trains were stopped in 1,100 feet. In comparison, the train when stopped with the high-speed brake passed the point at which the P. C. brake stopped the train, with a speed of thirty-eight miles per hour. The results are readily foreseen, had an 1,100 or 1,200 feet stop been imperative.

It is, of course, impossible to enumerate every special feature of this brake in these columns, but there are two features worthy of especial mention.

In applying this brake, should there be a heavy over-reduction of brake pipe pressure, that is a dangerous waste of brake pipe air, the control valve will go into emergency position, and the P. C. equipment will stop the train and hold it until the brake pipe is replenished. The other feature in releasing the brake is that as the reservoirs and brake cylinders equalize at a pressure of 86 lbs. from a 110-lb. brake pipe pressure, it is evident that the brake pipe pressure must reach approximately 90 lbs. before the train can again be moved, whereas, if the train was stopped by the high-speed brake with a depleted brake-pipe pressure, it could again be started about the time that 60 lbs. pressure has accumulated in the brake pipe.

It will be noted that when the direct release of the control valve is being used it operates in harmony with the high-speed brake equipment, and when the graduated release feature is employed the control valves operate in harmony with the L. N. equipment.

The graduated release means that a reduction of brake cylinder pressure can be made from each car in the train without entirely releasing the brake; in fact, several reductions can be made and the brake still held lightly applied by alternating the brake valve handle between lap and running positions after a heavy reduction in brake-pipe pressure.

Finally, we trust that the P. C. brake will not be regarded in the light of a great invention, or as a result of some particularly bright idea, because it represents the solution of a difficult problem, and was attained through incessant toil, perseverance and apparent failures.

Air Pump Test.

The most frequent query on air brake subjects that comes to us relates to an efficiency test for air pumps. The writers usually wish to know what sized orifice or opening to the atmosphere the various sized air pumps should maintain air pressure against when in good condition, and at what stage of deterioration the pump should be condemned.

Now it is obvious that the time of pump removal must be governed to a certain extent by local conditions, as a pump on a yard engine or in local passenger service will not necessarily be compelled to pass as rigid an efficiency test as the air pump on a locomotive in heavy freight service, and the methods of repair work and the attention the pump is given when in the roundhouse are also factors bearing upon the necessity for roundhouse air pump tests. When an air pump is turned out of the repair shop, where intelligent and economical repair work is in vogue, it should of course be given, and made to pass, a standard test, and we have already referred to this matter a number of times in a general way and will now print a table showing just what various sized air pumps can be expected to do when they are in good condition, and their performances in the following series of tests were under conditions of piping that tend to approximate the average encountered on locomotives.

These results of a very elaborate series of tests are the averages of great number of single tests, and can be relied upon as an accurate record, and with the steam pressure indicated the pump was driven at the speed shown and was enabled to maintain the air pressure given against the size of orifice given; thus the test includes the efficiency of the steam cylinder and steam valve mechanism as well as the air cylinder.

Size of Pump.	Steam Pressure.	Size of Orifice.	Air Pressure.	Strokes per Min.
9½ ins.	125	11/64	77	135
9½ "	125	5/32	87	124
9½ "	175	⅛	127	136
11 "	125	11/64	94	109
11 "	125	7/32	76	136
11 "	175	⅛	150	107
11 "	175	5/32	130	130
No. 5A	125	11/32	41	104
No. 5A	175	7/32	109	108
No. 5A	175	19/64	67	125
8½ C. C.	125	11/32	52	104
8½ C. C.	175	9/32	98	129
8½ C. C.	175	7/32	127	100
10½ C. C.	125	15/64	130	113
10½ C. C.	100	21/64	74	131

It will be understood that in expanding a volume of compressed air through a circular opening, the volume expanded is governed by the length as well as the diameter of the opening, and the orifices expanding the proper or most constant volume when the length of orifice is 2.6 times the diameter and the ends of the drilled opening are to be maintained perfectly sharp. In a shop test the piping arrangement and the steam pressure obtainable affects very materially the results of tests and no less than 125 lbs. steam pressure should be employed, as the speed will be too low to maintain sufficient air pressure to constitute a severe test.

In this connection it may be observed that with steam pressures of 100 lbs. or less the capacity of the 9½ and 11-in. pumps is practically the same in the matter of cubic feet of free air per minute; that is, the speed of the 9½-in. pump is in excess of that of the 11-in. pump, so that both pumps working at a low pressure compress approximately the same number of cubic feet of free air per minute, or, in other words, the steam pressure at this time is capable of doing just so much work per minute whether through the medium of a 9½ or an 11-in. piston.

Now we know that an air pump properly overhauled will approximate the tabulated results and should then give at least six months' service under the most exacting conditions and having remained in service a specified length of time it should be removed for a thorough inspection of all the movable parts and renewal of parts if necessary.

If this is followed up there can be no occasion for a roundhouse test of air pumps, as the roundhouse repairs will have been abolished, and should a pump be reported, the average repair man can tell by the amount of air drawn in at the strainer, by the temperature of the cylinder and by the sound of the pump, whether the pump is in first-class condition or whether it is not. If in good condition repairs or efficiency tests are unnecessary, and if not in good condition, the pump should be removed and replaced by one that is in good condition. It must be admitted, however, that up-to-date methods of air brake maintenance are not pursued in all engine houses, and where engine house repair work is done on air pumps an inefficient air pump is very often found in service, and the engineer may protest against the pumps remaining in service while the repairman, in order to defend his own work, may claim that the pump is still in good condition.

Again, when pumps are not removed periodically and kept in good condition it is obvious that the time must come when the pump is no longer fit for service, and many air brake men who are up against propositions of this kind have asked for results of tests that will indicate when the efficiency of the pump is impaired to an extent that would warrant its removal.

We can sympathize with the engineer who is told by the yardmaster and train crew that his air pump is worn out, and told by the engine house foreman and repairman that the hose between the cars must have been disconnected, but the test of working a pump against an opening of known size will eliminate any guesswork as to the condition of air pumps, but, as stated before, there must be some stage of impairment, taken arbitrarily, at which time repairs are to be made.

As a result of some investigations along this line we believe that the pump should be removed from an engine when its efficiency has reduced about 25 per cent., assuming this to be under average conditions of service, and to indicate when the pump's efficiency has reduced this amount we have this table which shows that the 9½-in. pump working against a ⅛-in. opening with 175 lbs. steam pressure, should attain a speed of 136 single strokes and maintain air pressure at 127 lbs. Suppose then that the pump would maintain air pressure at but 95 lbs. under the same conditions, we find that the pump in good condition was compressing air at the rate of about 31.5 cu. ft. of free air per minute, but in maintaining pressure at but 95 lbs. the pump is compressing only about 24.5 cu. ft. of free air per minute, or, its efficiency is reduced about 25 per cent.

The table also shows, that the 11-in. pump in good condition compressed air at 94 lbs. pressure against an 11/64-in. opening, when the steam pressure was 125 lbs. and the speed 109 single strokes, which was approximately 40 cu. ft. of free air per minute, whereas if the pump could not maintain air pressure above 65 lbs. under the same conditions it would not be compressing more than 30 cu. ft. per minute, or not over 75 per cent. of the volume it should compress.

In this it will be noted that there is a difference in main reservoir pressure during the tests, and the higher the pressure being operated against, the lower the compressors per cent. of efficiency; but with the piston speed the same in either case there must be a difference in main reservoir pressure or a difference in the size of the orifice if there is to be a comparison in the work of pumps in good condition with pumps that are not so. A change in the size of orifice is essential if accurate results are desired, but as we have only the results of the pump's performance when in good condition, and do not know at what stage of inefficiency the pump is to be removed, it is easier to use the same size of orifice for one type of pump and note the difference in pressure maintained until such time as those who supervise the work specify the speed, the pressure and the size of orifice the pump must maintain pressure against or be removed.

As previously stated, we believe that a pump should be removed from service when the method of testing given indicates that its efficiency is reduced about 25 per cent., and at this time it will be found that the air cylinder of the pump is usually in one of the following conditions: With air valves having the proper amount of "lift" and being free from leakage, no leakage at the gaskets or stuffing boxes and the air cylinder worn but a trifle, if any, a pump indicating but about 75 per cent. of the efficiency shown in the table, the piston rings in the air cylinder will be found from ⅛ to 3/16 open at the ends, with the air piston about 1/16 smaller than the bore of the cylinder; or, if the piston is a pretty neat fit in the cylinder, say 1/64 or less smaller than the bore of the cylinder, the packing rings will be found practically worn out; that is, they will no longer fit the cylinder.

This opinion as to time of removal is based upon examinations and tests of pumps in the state of inefficiency mentioned, and it is evident that such a pump should be removed for repairs, as its tendency to overheat renders it unsafe for severe service.

We understand that leaky air valves may reduce the pump's efficiency 25 per cent. while the air piston and rings are still in fairly good condition, therefore it is suggested that air valves be known to be free from leakage before tests are conducted.

We would recommend that, previous to a roundhouse test, the brake valve handle should be placed in lap position and the main reservoir and pipe connections should be looked over for leakage; and bell ringer and sander valves should be known to be closed. Then, with no leakage at the stuffing boxes or at the air cylinder gaskets, the orifice to be used in the test should be connected with the main reservoir drain cock and the test conducted.

Advancement Encouraged.

In dealing with the transportation problems of our country, the progress made during the past five or six years is nothing short of marvelous, not only in the way of improvements in equipment and facilities, but in the reduction in the number of serious accidents during a constant increase in traffic.

Some railroads can claim the transportation of millions of passengers without a single loss of life or injury to a passenger as a result of a train accident, and our readers are well aware that the safety device of railroad transportation is the air brake.

Now the manufacturers of the air brake apparatus have kept pace with the increased speed and weights of trains in providing suitable and efficient brakes for heavy modern locomotives and the "P. C." (passenger control) and the "electro pneumatic" systems are all that can be desired for the present-day service, but the demands of the future, incident to the degree of perfection that will be attained in the transportation of passengers and freight, are at this time a mere matter of conjecture.

It is, however, an assured fact that there will be a constant advancement in methods of transportation, and in devices pertaining thereto, and every individual connected with the operation of the system and the maintenance of the equipment must also keep the pace set by the builders and managers, as the only alternatives will be to drop out or be left behind.

Those whom we are particularly interested in and who we wish to keep in touch with the improvements in the air brake art, are our subscribers, and we will consider it our duty to publish a character of air brake information that will benefit everyone who is concerned with the operation and maintenance of the air brake.

May we remind our readers that it is each and every individual's duty to fit himself to give his employers the most efficient service he is capable of.

Railroad companies in particular, assume that they are paying for intelligent service and in some instances go so far as to insist upon getting it, for it is obvious that if the company gains by intelligent service and competent workmanship the individual gains the education and experience derived from the ability to deliver the satisfactory results.

"As a man is known by the company he keeps, so is a company known by the men it keeps."

Combined Test Rack.

The photographic view is of the combined triple valve and distributing valve test rack, manufactured by the Westinghouse Air Brake Company.

Its purpose is to provide an equally exacting test for the cleaned or repaired distributing valve and the cleaned or repaired triple valve, and it will be noted that the distributing valve section is an attachment to the present standard triple valve test rack.

As all brakes in a train must be cut in and operated by the brake valve on the leading locomotive, it sometimes happens that in helping service a distributing valve may be on the rear brake of a train, and for this and many other reasons the distributing valve must now receive the same accurate test as regards leakage of parts, frictional resistance, packing ring leakage and service port capacity, that is accorded a quick-action triple valve.

This rack furnishes every detailed test for the distributing valve that the triple valve is submitted to and insures that these valves will work in harmony when placed in any portion of the train.

The code of tests and explanations as to the manner in which they are conducted, as well as a description of the general operation, accompanies the rack, or will be furnished upon application.

Questions Answered

On Air Brake Subjects.

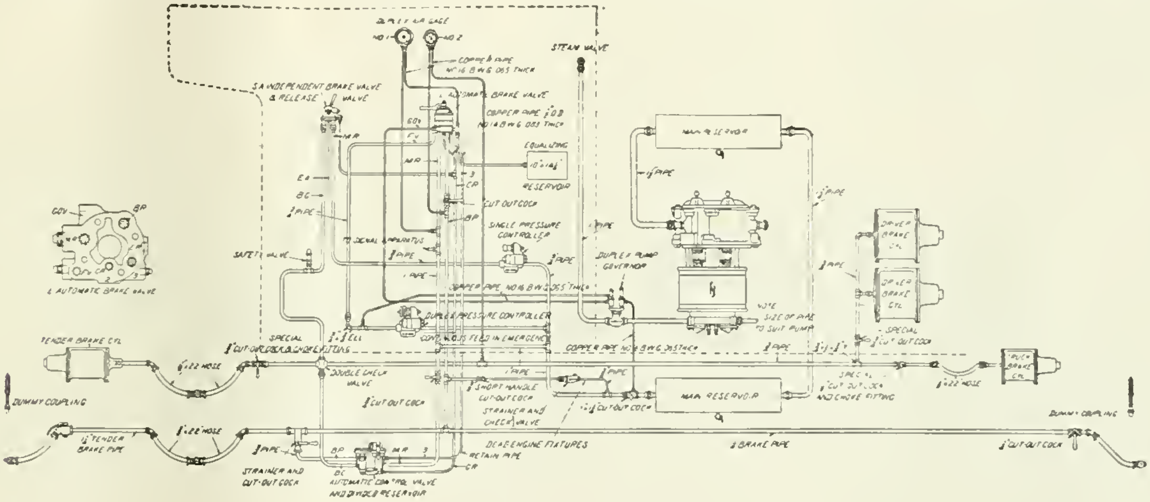
Triple Valve Repairing.

H. W., Christchurch, New Zealand, writes: (1) In the absence of a test rack, what practice is recommended in renewing triple valve piston packing rings; is it it best to be guided by the openings at the ends of the ring or by leakage past the ring? (2) What is the maximum opening at the end of the ring or the maximum leakage that may be permitted, and what amount of wear should condemn the bushing?

Answer—(1) In this country, the hauling of 130 to 150-car trains makes the use of test racks an absolute necessity, and inferior repair work cannot be checked up anywhere without the use of the rack; but if you cannot obtain one, you might be able to devise an arrangement whereby the triple valve piston can be blocked in lap position, and with 80 lbs. air pressure on the brake pipe side of the piston leakage past the packing ring into a standard auxiliary reservoir of the 8-in. freight equipment should not exceed 15 lbs. in one minute. (2) We cannot consider any opening whatever at the end of the ring, as the ends must come together neatly without binding, and in reference to the bushing, a gauge .008 of an inch larger than the original diameter of the bushing should be used, and when the service end is enlarged this amount the bushing should be renewed, and if worn less than this it can be reground, but it is very poor practice to attempt to roll or scrape the bushings. In the absence of proper facilities for doing this kind of work it is much cheaper and more satisfactory, to return the valves to the manufacturers for repairs.

"BRAKE CREEPING ON."

H. J. M., Wellington, Kans., writes: (1) What causes the No. 6 E. T. brake to apply and release during the time the pressures are being pumped up to 70 and 90 lbs? (2) How is the piston travel adjusted with inside hung and with outside hung brakes? A.—(1) Brake pipe leakage applies the brake while a "sluggish" or defective feed valve permits the leakage to create the defferential necessary to operate the brake. Both disorders should be corrected. If this occurs only while pumping up the pressure, it may be due to moving the brake valve handle to release position as the supply valve piston spring of the feed valve maintains a difference of from 7 to 12 lbs. pressure. (2) Foundation brake gear being properly designed and installed, either inside or outside hung beams have the brake piston travel taken up by means of moving the dead truck lever through the lever guide, it being held in place with pins. To take up the piston travel with outside hung beams the lever is moved toward the center of the truck and with inside beams in the opposite direction.



COMBINED TEST RACK.

BRAKE PIPE VOLUME.

M. A. W., Barstow, Cal., writes: Could you give me an estimate of how many cubic feet of free air it would take to charge a train of 50 freight cars to 70 lbs. pressure? A.—Disregarding the inside diameter of the pipe, the number of cubic inches space in 1 foot of 1¼-inch pipe may be taken at 15, then the brake pipe on the average freight car would contain about 700 cu. ins. of space from hose couplings to the triple valve piston and emergency valve. If the cars have 8-in. equipments, the auxiliary reservoir contains 1,620 cu. ins.; if 10-in. equipments are used, 2,800 cu. ins. Assuming that they are 8-in. equipments, 50 cars with a volume of 1,620 + 700 cu. ins. or equals 2,320 × 50, of 116,000 cu. ins. of space to be filled. At 70 lbs. gauge pressure we find 5.76 atmospheres (70 + 14.7 = 84.7 ÷ 14.7 = 5.76), but as the brake pipe contains at least 1 atmosphere at all times it will require but 4.76 atmospheres to reach 70 lbs. gauge pressure, then 116,000 × 4.76 = 552,160 cu. ins., or 313 cu. ft., with no allowance for leakage.

DEFECTIVE PRESSURE CONTROLLER.

H. M. C., Saratoga, writes: One of our yard engines is equipped with a New York combined automatic and straight air brake and the pressure controller will not operate properly, and there is a constant blow of air from relief port at all times: where could this blow be coming from? A.—There should be a constant blow as long as brake pipe pressure is equal to or in excess of the tension of the regulating spring. In the event of leakage from the relief port when brake pipe pressure is considerably lower than the adjustment of the controller, it indicates leakage from the diaphragm seat of the regulating position. There is also a possibility of leakage from the supply valve and guide or from the threads between the valve guide and controller body, which would find its way out of the relief port if the waste port was stopped up. Before attempting any repairs, be sure the hand wheel is in its normal position.

BRAKE CREEPING ON.

W. C. H., Hampton, N. J., writes: Will you kindly explain what causes the engine and tender brake to apply with the D-5 brake valve in running position and, after holding on awhile, release of its own accord? A.—The only way that the triple valves can be moved to application position is by a decrease of air pressure on the brake pipe or train line side of the triple valve pistons, which means brake pipe leakage that is not being constantly supplied by the feed valve. During the time the feed valve fails to supply the leakage, the leakage applies the brake and as the feed valve then opens to supply the leakage, the triple valve pistons will again be forced to release position. Tightening up the leakage and putting the feed valve in condition to open and close promptly will overcome the trouble.

ADJUSTING BRAKE SLACK.

H. J. M., Wellington, Kan., writes: (1) How should the slack be taken up or let out on a car fitted with an automatic slack adjuster? (2) Please explain what is meant by the expression, "Percentage of braking power"? A.—(1) Assuming that the car is properly cylindered and that the design of foundation brake gear is correct, with all new shoes the slack should be taken up to 6 ins. travel by means of the dead truck levers before the slack adjuster has made any movement, and thereafter no further movement of the truck levers will be required, as the adjuster range of movement is sufficient to wear out a set of shoes. When the renewal of brake shoes becomes necessary, the truck levers, if moved, should be replaced in their original position and the adjuster screw slacked off to give 6 ins. piston travel, which will ensure about 8 ins. when running. (2) The percentage of braking power is the total maximum brake shoe pressure in pounds as compared with the weight of the car. If a car weighs 40,000 lbs. and a maximum shoe pressure of 28,000 lbs. is developed, the percentage of braking power is 70 per cent., or 28,000 lbs. is 70 per cent. of 40,000 lbs.

TRIPLE VALVE OR TEST RACK DISORDER.

C. C. R., Colorado City, Colo., writes: I would like to find out through the columns of your magazine if any other triple valve test rack operators are having the same trouble that I am with K-1 triple valves. The test rack is not the latest style, but outside of finding an occasional kicker have no difficulty in testing the H triple valve, but nearly all of the K-1 triple valves show up as kickers. The valves appear to be in perfect condition, lubricated with graphite, and there are no leaks in the test rack, and in testing six new valves direct from the factory, three of the six would go into quick action with a 7-lb. reduction in brake pipe pressure, which makes it appear that there is some mechanical defect in the valves when they are sent out. I would like to find the actual cause of this. A.—If your test rack is in good condition, and the triple valves are apparently so, it would indicate a restricted service port in the triple valves that kick or work in quick action, and you should have a test rack that will show up the restricted service port, or rather have a rack by the use of which the capacity of the service port can be tested, but as you have found this trouble to exist when new triple valves were being tested, we would suggest that you disconnect and blow out the pipe on your test rack that leads from the triple valve stand to the brake cylinder, be sure that the auxiliary air has a free passage to the brake cylinder, and if the trouble does not cease it indicates that the triple valves are at fault, but before returning them to the manufacturers they should be tested on an up-to-date rack.

VARIATION IN BRAKE PIPE PRESSURE.

D. W. G., Fornfelt, Mo., writes: On an engine equipped with the No. 6 E. T. brake in freight service, the pressures on the lone engine are 70, 90 and 110 lbs., and when coupled to a train the pump stops when the pressures reach 50 and 70 lbs. If the feed valve is then adjusted to 70 lbs., the pressures will be about 90 and 110 lbs. when uncoupled from the train. Piping is correct, new governor and feed valve has been applied, gauges tested and brake valves cleaned; what could cause this trouble? A.—An action of this kind would indicate a very loose supply valve piston in the feed valve, but as you have replaced the governor and feed valve with new ones without improving the situation, we will assume that those parts are not at fault. When coupled to the train the feed valve must have been set at 50 lbs., and as you were able to get 70 lbs. brake pipe pressure by screwing up the adjusting mechanism of the feed valve it proves that the trouble is not due to any restriction in the pipes leading from the main reservoir through the feed valve, brake valve and into the brake pipe, but as the gauge hand rises to 90 and 110 lbs. as the engine cuts off from the train, it is evident that there is some leakage from the main reservoir into the brake pipe that can raise the pressure above the adjustment of the feed valve when the engine is alone, but the volume of leakage is not sufficient to raise the pressure when coupled to the train, which would account for the variation in brake pipe pressure.

The leakage may be through the feed valve gasket, the pipe bracket, the dead engine fixture, through the brake valve or the excess pressure head of the pump governor, but in giving this answer it is assumed that the governor and feed valve are known, by test, to be working correctly and that the pipes leading to the governor are not partly obstructed.

Effect of Snow on Electric Railroads.

Now that winter is nearly here the question naturally arises as to whether the electric locomotive is better able to handle the traffic during cold and stormy weather than the steam locomotive.

An interesting example is that of the Spokane and Inland Railroad operating in the State of Washington by means of the Westinghouse Single Phase System, where severe snow storms are encounted. The winter of 1909 and 1910 was one of the most severe ever experienced in that vicinity, and this road was the only local one that maintained its regular scheduled service, although for a short time all of the steam roads were completely tied up. At no time were the trains more than twenty minutes behind the schedule, and the only plows used were those of the usual shield type mounted on the pilot.

The ability of the steam locomotive to haul loads is actually reduced in cold weather because of greater losses of heat, while the capacity of the electric locomotive increases as the heat caused by the passage of current through the motors radiates more quickly.

Additional electric power can be most economically secured by the low pressure steam turbines, using the exhaust from reciprocating engines. They will operate on full load at 15 lbs. pressure and under a vacuum of 28 ins.

Testing a Mallet on the New York Central

An increase of 40 per cent in the operating capacity of a single track division without the construction of a single mile of new track is one of the savings resulting from the installation of 26 Mallets in place of heavy consolidation locomotives in slow freight road service on the Pennsylvania division of the New York Central & Hudson River Railroad. Where formerly 1,000 cars daily was the maximum, 1,400 cars can now he handled in 24 hours.

Formerly the traffic was handled by consolidation locomotives, having a total weight of 236,000 pounds and a tractive power of 45,700 pounds.

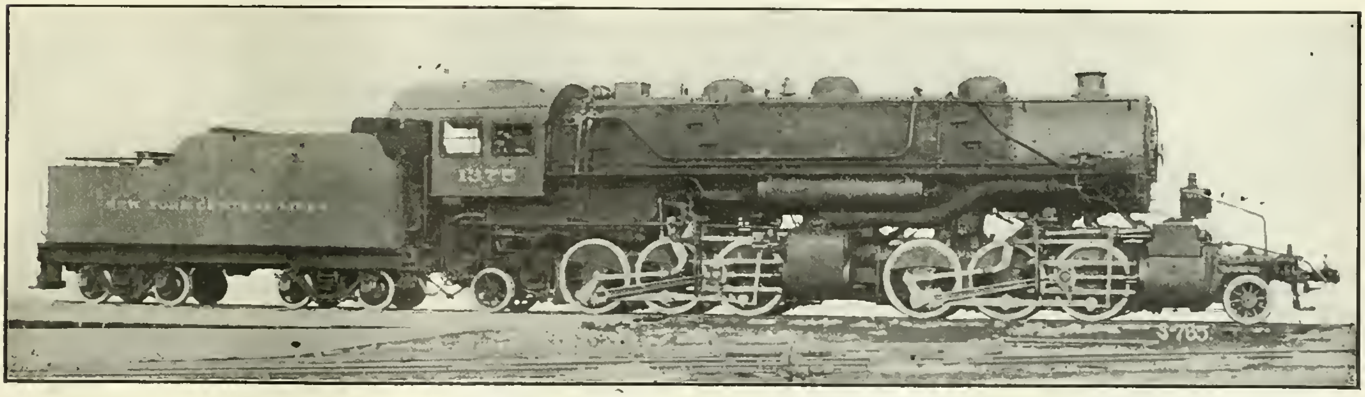
With the assistance of another engine of the same class on the ruling grades, a consolidation could take a maximum train of 3,500 tons over the road at an average speed of 15 to 18 miles per hour.

Sixty locomotives of this class were required to handle the traffic. Of these 31 were used in road service and the remainder in pusher service. With this arrangement had been constructed by the American Locomotive Company for trial purposes.

In order to secure reliable data by which to accurately determine whether further investment of money in the Mallet type of locomotive would be justified and upon which to develop a design best adapted to the service conditions on the Pennsylvania division, a thorough and exhaustive test of the trial locomotive (though not designed for this division) was made in competition with two of the consolidation type operated under identical conditions.

Two separate series of tests were made, the first being so conducted as to determine the comparative economic performance of the Mallet as designed, at various speeds. In this series, the Mallet gave considerable economy in fuel per unit of work as compared with the consolidation, when operated under the conditions for which it was originally designed; namely, low speed termine the best practice by a thorough comparative test, participated in jointly by the New York Central and Pennsylvania railroads, and the American Locomotive Company. The Mallet was returned to the Schenectady plant and was equipped with a superheater and otherwise prepared for the tests and for the operating conditions of the road at large expense. The changes included the application of a "Security" brick arch.

A second test of the Mallet as modified was then made. In comparison with the results of the first test, the second test proved conclusively that highly superheated steam used in conjunction with compound cylinders gave greater economy in operation as a result of the improved cylinder performance thereby secured. Acting on the basis of the data secured, the American Locomotive Company has strongly recommended the application of fire tube superheaters to Mallet engines subsequently built by them.



MALLET 2-6-6-2 FOR THE NEW YORK CENTRAL AND HUDSON RIVER R. R.
John Howard, Supt. of Motive Power. American Locomotive Company, Builders.

motive power, the maximum operating capacity of the single track was so nearly reached that over time—always expensive—was excessive.

To secure greater operating capacity meant either double tracking the line or increasing the weight of the train by the adoption of heavier power. The management desired to procure a locomotive capable, without assistance, of handling a train of 70 cars—the maximum capacity of the existing sidings—over the division at an average speed of 10 to 14 miles per hour. Because of the enormous tractive power available in the Mallet, this type seemed to offer the best means of accomplishing the end in view, and steps were taken to thoroughly investigate its merits for this division.

The adoption of the Mallet type on another division of the New York Central had previously been considered, and a design of the 2-6-6-2 type of wheel heavy freight service in which its maximum draw bar pull at slow speeds was obtained over a considerable percentage of the division. But in order to adapt this design to a wider range of operating conditions such as obtained in the service on the Pennsylvania division, and to secure greater economy and increased capacity at higher speeds, the testing committee recommended the application of a superheater.

Although the possible advantages of the application of the superheater to the Mallet were thoroughly appreciated, the American Locomotive Company had not hitherto felt fully justified in recommending such practice except as an experiment. In spite of long and thorough investigation, sufficiently accurate and complete data as to the economic performance of the Mallet with and without superheater were not available. The company therefore welcomed an opportunity to definitely de-

These tests thus mark an important step in the development of this type of locomotive to a still higher degree of efficiency, and as a result of the successful performance of the Mallet in the final tests, the additional twenty-five Mallets now in service were purchased.

These were built to practically the same specification as the original Mallet as modified except that both the high and low pressure cylinders were increased 1 in. in diameter to 21½ and 34 ins., respectively, and the boiler pressure was reduced from 210 to 200 lbs. The net result of these changes was an increase of 900 lbs. in the normal maximum tractive power over that of the engine which was tested, or from 66,600 to 67,500 lbs. The total weight of the engine was also increased 2,000 lbs. or from 352,000 to 354,000 lbs.

A single Mallet hauls a 4,000-ton train without assistance. As a result, pusher service has been eliminated, and in place of the 60 engines previously required, 26 Mallets alone now handle the entire traffic.

Because of their higher efficiency, the Mallets save on the average 35 per cent. in fuel burned per ton mile. This means that they make 54 per cent. more ton miles per ton of coal than the consolidations which they replaced. The test of the original trial engine, from the results of which the adoption of the Mallet locomotive for road service on the Pennsylvania division directly followed, was the first thorough and complete test of this type of locomotive. The management of the New York Central invited both the American Locomotive Company and the Pennsylvania Railroad to assist in making the test, the aid of the latter being of a special value because of their well known wide experience in work of this character.

A committee composed of one expert from each of these three companies was appointed and the test conducted under their personal direction. The three primary objects of the test were to determine the capacity and economic performance of the Mallet locomotive; to discover what modifications in design, if any, were needed to develop it to the highest efficiency for the service for which it was intended and to determine whether the Mallet locomotive could be operated at maximum speeds of 30 miles per hour for protracted periods without injury to track or locomotive.

Following the completion of the final tests, the committee reported the following conclusions as to the advantages of the Mallet.

"Economy in train operation due to larger output in ton-miles per locomotive."

"Greater economy in coal per unit of power due to the larger boiler available, and especially to the use of compound cylinders and superheated steam."

"Judging from the construction of the parts of this locomotive and its riding qualities with the ability to take curvatures as represented on the division over which the tests were made, there would seem to be no reason to expect any undue injury to the locomotive itself when running at a speed of 30 miles per hour."

"A number of the runs were made at speeds which would indicate that 30 miles per hour would not be at all detrimental to the locomotive itself."

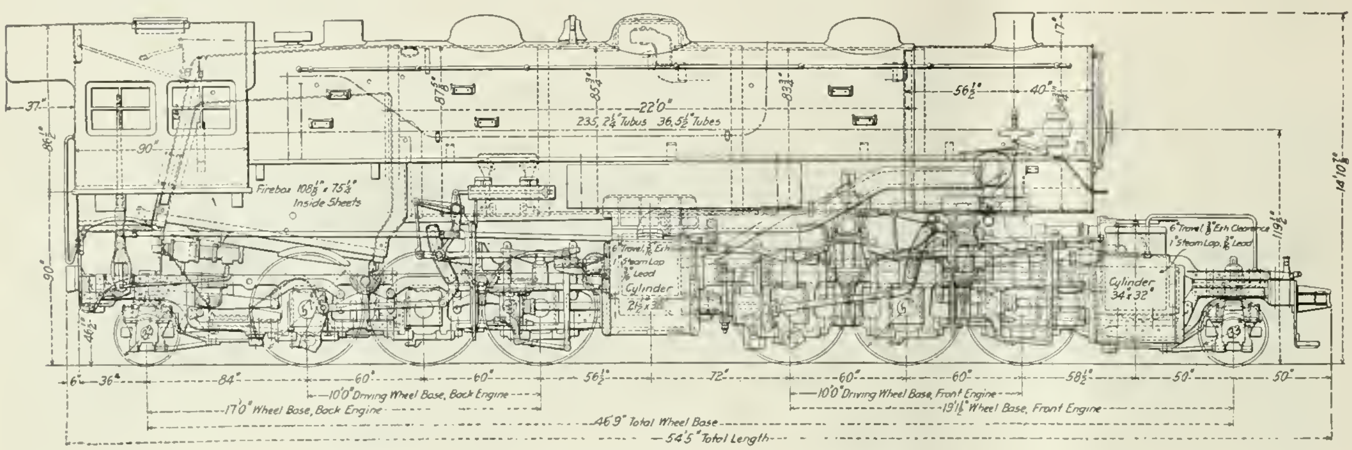
"As to injury to the track at speeds of 30 miles per hour, the weight per axle for the Mallet locomotive is very much below that which is common practice with passenger locomotives, where as high as 60,000 lbs. per axle is often employed and from this standpoint, it is considered that no undue injury would be occasioned to the track suitable for consolidation locomotives."

As a comparison between the modern up-to-date powerful freight locomotive and the most approved design of, say five years ago, for the same class of service, it is an important contribution to locomotive data, and shows the remarkable improvement toward economy in operation that has been successfully accomplished in locomotive design during the past few years.

The two consolidation locomotives were so similar in design that the average of the results obtained with both, in comparison with the records of the Mallet serve as an accurate measure of the rotative efficiency of the three

The most important comparison is the saving of 39.6 per cent. in coal burned per ton-mile in favor of the Mallet.

The following comparison of the Mallet and consolidation locomotives is especially valuable from the fact that it is the first axact and reliable test as to the amount of fuel consumed, and the relative performances of the two distinct classes of locomotives, and as such cannot fail to be of interest to railroad men.



DETAILS OF MALLET FOR THE NEW YORK CENTRAL LINES.

COMPARISON OF PERFORMANCE OF MALLET AND CONSOLIDATION LOCOMOTIVES.

	Approximate average speeds.	Type of Locomotive. 2-8-0 Type. Mean between the performance of the two consolidations.	Type of Locomotive. 2-6-6-2 Type. Mallet.	Per cent. in favor of Mallet as compared with mean for the two consolidations.
Average speed running time, miles per hour	12.5	12.75	12.9	....
	15.0	15.7	15.2	....
	17.5	....	17.5	....
	21.0	21.4	....	....
Average drawbar pull, pounds	12.5	22,726	34,071	49.9
	15.0	19,883	31,360	56.9
	17.5	......	23,424	....
	21.0	15,930	......	....
Maximum starting drawbar pull, pounds	....	46,280	66,000 working compound.	42.6
			80,000 working simple.	72.8
Machine efficiency, per cent.	12.5	88.85	89.21	....
	15.0	86.17	89.16	....
	17.5	.....	86.60	....
	21.0	85.35	.....	....
Machine friction in pounds of drawbar pull	12.5	3,066.5	4,468	....
	15.0	3,517.	4.083	....
	17.5	....	4,044	....
	21.0	3,288.5	.....	....
Dry coal per dynamometer horsepower per hour, pounds	12.5	5.235	3.15	....
	15.0	5,295	3.47	....
	17.5	.....	3.65	....
	21.0	5.465	....	....

Electrical Department

The Development of the Electric Motor.

(Continued from page 484.)

We have outlined the history of the electric motor to 1893, which was the year of the World's Fair at Chicago, describing in our last number the development from the high speed motor, requiring an intermediate shaft to reduce the speed to a suitable value, to the slow speed single reduction geared motor and the gearless motor. The Intramural Railroad was referred to, which was built at the World's Fair, using cars on which were mounted four motors, for hauling trailers.

These cars might be called locomotive cars, and were used instead of electric locomotives, which were popular with most electrical engineers. This idea of using locomotive cars grew in favor, and was recommended for the elevated railroads in New York. A modification was proposed but was never adopted, to place at each end of the train a locomotive car which would both be controlled from either end. The disadvantages of this are obvious, for the wires would have to run the whole length of the train, through which would be flowing large value of currents, and the danger to passengers due to fire would be great.

In May, 1895, the Metropolitan West Side Elevated Railroad, Chicago, which was the first commercial elevated road electrified, commenced operation, using the locomotive car, on which was mounted two motors, to haul trailers. One year later the Nantasket Beach Railroad, a branch of the N. Y., N. H. & H. R. R., commenced operations with the locomotive car.

During 1897 proposals were made by the various engineers and manufacturing companies to the elevated railroads in New York and Chicago, and the plans submitted were to use the locomotive car with one exception. The exception was to use the multiple-unit system, and was proposed by Frank J. Sprague, who had built the Richmond road in 1887, described on page 399, which was the beginning of the modern electric street railway. The multiple-unit system, a name coined by Sprague, considered the mounting of motors on each car in the train, all of which could be controlled simultaneously from either end of either car. Sprague had suggested this system as far back as 1885, when in an address on "The Application of Electricity to Propulsion of Elevated Railroads," he said: "By a system of electrical propulsion, the power can be distributed underneath the cars, every car, or two cars if need be, being a unit, and at the same time arrangements can be made for propelling five or six cars under simultaneous control." Again in 1888 he referred to the same thing, and in 1896 he offered to make a demonstration of a multiple-unit train of eight cars, at his own expense, before a special committee of the Manhattan Elevated Railroad, New York. Sprague's ideas were not given much consideration by electrical engineers, and it was not until 1897 that he had a chance to demonstrate what he could do.

The South Side Elevated Railroad, Chicago, decided to electrify and proposals were received from manufacturers in favor of the locomotive car plan, and from Sprague on the multiple-unit system. The president and engineers on this road were extremely keen and active, and they decided in favor of Sprague's plan. A contract was signed in May, 1897, to equip 120 cars, the conditions of which were extremely severe for it required that six cars should be completely equipped and tested by July 15. This contract shows plainly what courage and ability was required, for the multiple-unit system at this time had not been tried out or even developed. Work was commenced immediately, the first two cars were equipped and tested by the contract date and operation commenced on the South Side Elevated in April, 1898.

This was the beginning of the multiple-unit system which plays such an important part in the railroad electrifications of today. At first the large manufacturing companies opposed this system strongly, but shortly recognized the immense advantages and adopted a similar system. The advantages are, that no matter what the length of the train the same amount of weight of each car can be used for adhesion and the same additional motor capacity added so that the same ratio of weight and horse power is maintained with one or a dozen cars. By having each car a power unit, operation can be most economical and the length of train suitable for the travel at any time. This system does not only apply to cars for elevated railroads or subways, but is used with electric locomotives, so that two or more locomotives can be coupled together and operated by one man in the front cab.

The locomotive built by the General Electric Company in 1893, and which was the largest locomotive in the world at that time (described on page 484) did not long hold its supremacy. In 1895 the General Electric Company built three ninety-five-ton electric locomotives for the Baltimore & Ohio Railroad to haul freight and passenger trains through the tunnel at Baltimore. The large size of these locomotives attracted the attention of the whole world, as nothing of such high power had ever been attempted before. They were of the 0-4-4-0 type, with a six-pole gearless motor mounted on each axle. This motor was similar to except larger than those on the locomotive built in 1893. Fig. 13 shows one of these motors assembled and also the parts. The hollow shaft with the five quills at either end for engaging with the spokes of the drivers, on which is built up the armature, is clearly shown. The inside diameter of this shaft is larger than the axle which passes through it so that vibration can occur without the weight being carried directly on the axle. To

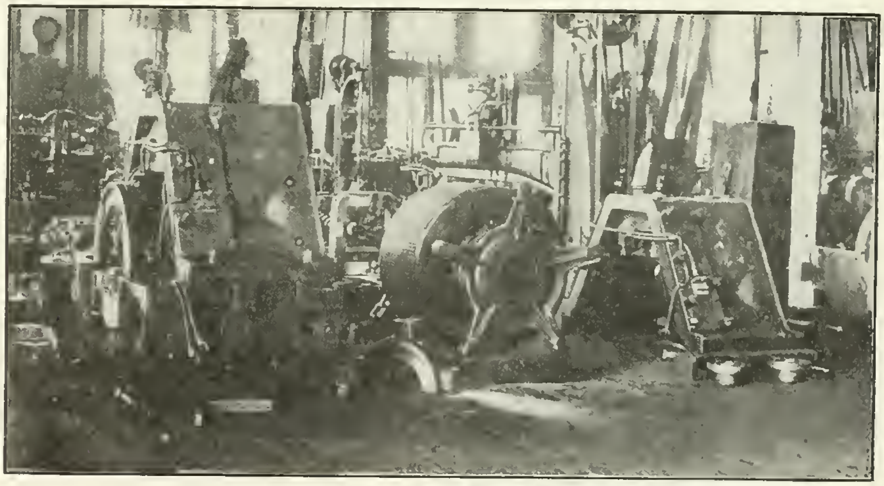


FIG. 13. MOTORS FOR THE BALTIMORE AND OHIO. 1895.

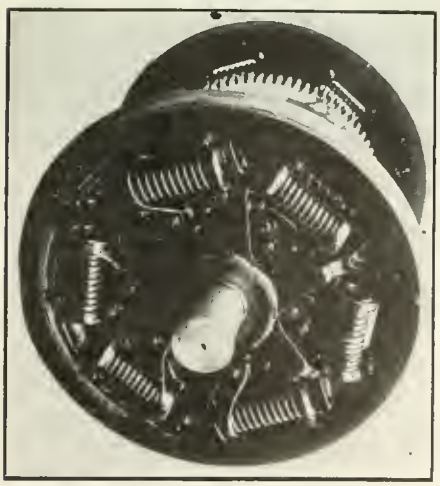
the right of the armature is the top half of the motor housing and to the left is a motor completely assembled. The locomotives are operating today at Baltimore which shows how successful they have been.

Since these locomotives were put in operation many other electric locomotives have been built for other railroads. The number of railroads electrified have increased rapidly and many improvements have been made in the mechanical design of the electric locomotive so that today they are duplicating and in some instances doing more than, the work done with steam locomotives.

The Boston & Maine (Hoosac Tunnel) Electric Locomotives.

Electrical operation on the Boston & Maine R. R., which was commenced the latter part of May, has been most gratifying to all concerned. Previous to electrification, the tunnel, which is double tracked and 4.75 miles long, limited the traffic on the division because of the steam and smoke. The conditions in the tunnel previous to electrification can be appreciated by knowing that it cost about two dollars for each tie replaced. Block signals were not feasible because they could not be seen.

Since this section of the road has been operated by electric locomotives the air in the tunnel is always pure and clean. Block signals are being installed, and the capacity of the tunnel will be increased 100 per cent. All of the electrical apparatus, including the power house, 11,000 volt single phase overhead line, and six locomotives, were furnished by the Westinghouse Electric and Manufacturing Co.



PAIR OF DRIVING WHEELS.
Boston and Maine Elec. Locos.

The locomotives are each of approximately 1,500 horsepower. Half of these are geared for a speed of 30 miles per hour for hauling heavy freight trains, and the others are geared for 50 miles per hour for passenger service. Our illustration shows the method of drive between the motors and wheels. The motor, one for each of the four driving axles, is mounted on the side frames directly over the driving axle. Around the driving axle but with 1½-in. radial clearance is a hollow axle or quill, on which is mounted at each end a gear. The gear center is equipped with six arms, arranged alternately with the wheel spokes, each arm bearing against a heavy helical spring, the other end of which is fastened to one of the spokes. On each end of the motor armature shaft is a solid pinion meshing with its gear mounted on quill. The gear has a rim that is flexibly connected to its center, so that each of the two pinions on the one armature shaft will be doing its share in transmitting the armature pull or torque to the gears, and to the drivers through the six helical springs.

This method of mounting the motors has proven advantageous, for the motor itself is high above the track and easy of inspection, while the method of drive allows each wheel complete individual freedom in negotiating track inequalities.

Automatic Train Stop.

Every possible precaution has been taken by the Pennsylvania Railroad for the safe handling of passengers in and out of its station, New York City, through the tunnels under the Hudson river. One of these safeguards is an automatic train stop which will cause the air brakes to set on a train if same runs by a danger signal. Connected to the mechanism of the signal is a tripper located a few inches above and less than two feet away from one of the track rails, which, when the signal is at danger, will be in a position to strike a projecting casting mounted on the third rail shoe beam of the electric locomotive and cause a plunger to open a valve to which is piped the train line pressure, thus setting the brakes.

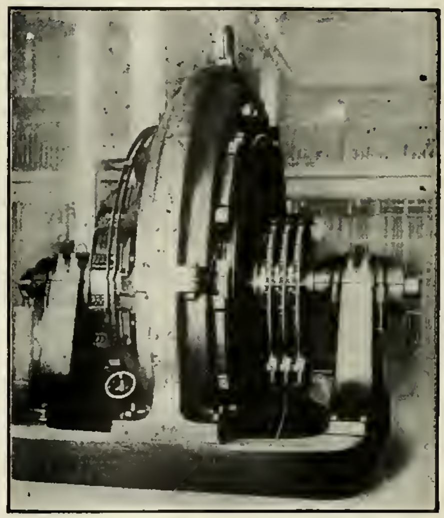
Battery Truck Crane.

A very useful and interesting piece of apparatus has just been placed on the market by the General Electric Company. It is called the Battery Truck Crane, and consists of a truck driven by an electric motor receiving power from a storage battery. On one end is mounted a swinging crane of one ton capacity, operated by another motor. It is especially suitable for handling freight and materials which have to be lifted and moved through moderate distances, such as at great railway terminals.

The Largest Rotary Converters.

On present electric railway direct current systems where large amounts of power are required, it is necessary for economical operation to generate alternating current at high voltage at the central power house, transmitting same to the various sub-stations and there changing it over to direct current for the third rail or trolley supply. The current is changed or converted from alternating current to direct current by a rotating piece of apparatus known as a rotary converter.

The largest rotary converter ever built is shown in our illustration. It is of



3,000 K.W. ROTARY CONVERTER.
Interborough R. R., New York City.

3,000 kw. capacity, equal to approximately 4,000 h. p., and has proven so satisfactory that the Interborough Rapid Transit Co. has ordered seven more from the Westinghouse Electric & Mfg. Co.

A New Instruction Car.

The P. R. R. have just placed in service a train lighting instruction car containing one of each of the different kinds of axle lighting devices of which there are as many as eight exclusive of the straight battery system. This car will be sent to different divisions where lectures will be given to those interested.

An Apt Answer.

An attorney for a Western railroad was arguing before the Interstate Commerce Commission for postponement of the enforcement of the safety-device regulations, so far as they applied to his road.

He said the road was in the hands of receivers and the court that appointed the receivers would not sanction the issue of certificates for the purpose of buying automatic couplers.

"So you see, your Honor," he declaimed, "we are between—between"—he hesitated and concluded lamely, —"the upper and the nether millstone."

"Why didn't you say what you started to say?" asked Chairman Knapp.

"Very well, your Honor," replied the attorney blandly, "we shall, in that case, consider your august body the—deep blue sea."

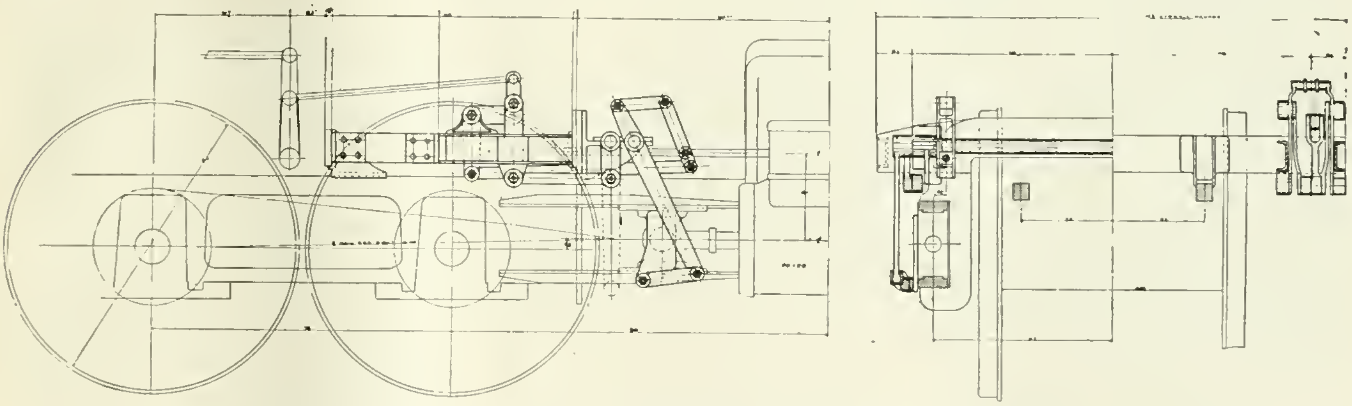
Pilliod Locomotive Valve Gear—Style "B."

In the crank and crosshead connected gears in practical use today, the valve gear frame is attached to the engine frame and the moving of the engine up and down on its springs changes the position of the valve gear in relation to the eccentric crank connection. To illustrate: If the locomotive was stationary and the engine was moved up on its springs, it would raise the gear and change the angle of the eccentric rod, since the eccentric crank, which is attached to the main driver, would remain stationery, thereby causing the link to be drawn toward the eccentric crank, but if the engine was moved down on its springs the link would be moved away from the eccentric crank, thus distorting the valve movement. This would happen when the engine is taking curves or running over irregularities in the track. Referring to the diagrammatic sketch, it will be easily seen that when the line of motion is changed by the engine settling 2½ ins. the eccentric rod on the bottom quarter will be long, and short on the top quarter. If made short on long side will be doubly short on short side and vice versa, and hence in attempting to square the gear, it must be done by changing the crank circle. To overcome these objectionable features and at the same time give as good results as are now obtainable with any outside connected gear, and that with no more wearing surfaces, the Pilliod valve gear, style "B," has been designed.

The style "B" should have the consideration of those who are satisfied with the economy and efficiency results obtained with the Stephenson and Walschaerts gears, but who desire a gear that eliminates the objectionable features of these gears, and one that can be applied to old power at a less cost than any other gear. It should be of special interest to those who contemplate changing old engines from the Stephenson link to an outside connected gear, because it can be applied without any modification of the engine, in much less time, and at a considerably lower cost than any other gear. It is an outside gear, of few parts, perfectly accessible, without links or blocks. The movement is obtained from the crosshead only, and it is not subject to the strains and distortional effects of the crank connected gears. All parts, including frames, are standard for any type or class of engine, either inside or outside admission, with exception of the combination lever, which has an oil cellar of special design, automatic in its feed and so arranged that any sediment which might pass with the oil from the outside can in no way get into the bearings. Roundhouse men cannot make any changes in this gear, as there are no rods to lengthen or shorten. It can be applied in 48 hours, without any modification of the engine, requiring ordinary roundhouse equipment to install. New main crank pins are not required.

The question has been raised at various times, as to whether or not there is more distortion from a crosshead piston within the cylinder. It makes no difference what position the wheel or main crank is in, the piston must keep within its limits of travel. The angularity of the main rod always remains the same, and whether the wheel base is up or down the piston will travel to the exact point, or the same point, from the front end of the 90 deg. position of the crank, and cannot possibly be modified. The crank centers of the engine are constantly changing as the relation of the wheel base to the cylinder base changes to the travel of the piston and cannot be modified except in extreme conditions. That is, the main crank could move from the center line of cylinder 3 ins. below or 3 ins. above and it would not effect the complete stroke of the piston. The piston will travel the same identical distance from the end of the stroke to the 90 deg. travel of the crank, regardless of the position of the wheel base and cylinder base. Therefore, if that is true there can be no distortional effect in a crosshead connected gear, because while the piston is in mid-position the other is in neutral position or at the completion of the stroke, and as the steam distribution is determined by the piston, the piston must travel the same distance at all times, and the valve gear maintains its same relative position regardless of the crank travel. It is well established that the combination lever of the Walschaerts valve gear requires no modification within or during its operating period, but it is necessary to constantly change the eccentric rod and eccentric crank connection of the main pin to maintain uniform steam distribution.

Referring to the accompanying drawing, a brief description showing how results are obtained is as follows: Point 10 of the combination lever is connected to the crosshead with a union link. The combination lever transmits the motion through the auxilary combination arm to point 6 which is connected to point 7 of auxiliary combination lever by means of the connecting link. This gives the lap and lead travel of the valve through point 6 which is connected to the valve stem. Point C is a cross shaft extending across engine and opposite crosshead through cross shaft D, the motion is transmitted to point 5 which is connected to point 3 by the motion rod. The oscillation of the radius yoke around point 1 raises and lowers the radius bar. This is connected at point 2 to the bell crank which in moving around point A transmits the motion of the radius rod through point 4. The radius rod in turn acts upon the auxiliary combination lever and gives the accelerated movement to the valve through point 8 which is connected to the valve stem. Point 11 is connected to reverse lever by the reach rod. The movement of the reverse yoke, at the various points of cut-off, around point "B," will cause point 3 to move in various places.



SIDE ELEVATION AND CROSS SECTION. PILLIOD VALVE GEAR. STYLE "B."

Courtesies Are Cheap.

Even in these matter of fact days it is well to cherish the belief that angels still go about in disguise, and that he may even pose in the form of a railway supply man or even as a journalist. We have heard of a gentleman who was bearer of an important message from the Supreme Court Judge to the president of a railway, calling on the general manager where he received a rude reception and afterwards told that he was mistaken for a damned supply man. That G. M. who had the intuition of slighting the supply man filled a position he was not entitled to. That class of railroad official was very numerous at one time, but his type is becoming extinct.

The sensible, up-to-date railway official welcomes every supply man, and recognizes him as a specialist in his line, draws from him valuable information worth much more than the time and trouble used up in securing it.

We find that some railway supply men when closed in their own offices display as much arrogance toward business callers as even the most intolerant railway official ever displayed toward the despised drummer.

An excellent example is shown by Mr. C. W. Clapp, publicity manager of the Brown Hoisting Machinery Company, of Cleveland, toward callers. Mr. Clapp receives people in the afternoon, and he receives people from a distance first, so that they can catch trains to get away if necessary. The local agents are received last, as they have no solicitude to catch a train.

Scarcity of Freight Cars.

The gratifying news has reached us that the Canadian railways are suffering from shortage of cars. They have been blessed with shortage of capitalist persecution, which would promote the conditions that make freight cars scarce. The New York *Evening Sun* commenting upon the demand for more cars says:

It is undoubtedly a pretty hard job to kill a railroad, and when it comes to laying the axe to the root of such a complex network of railroads as the people have been used to regard as great and useful institutions, it is very hard indeed. It must be confessed that they have had to stand some pretty severe attacks during the past decade from more or less influential persons whose intelligence scarcely matched their zeal; but, after all, there appears to be a little sap left in the old tree; maybe some persons who regard the railroads as reserving some consideration at the hands of the public, and at least as still possessing the right to existence, will be glad to hear that some of them still expect to carry a little freight.

The New York Central announces that orders have been placed for a total of 120 locomotives and 17,400 freight cars, for all the lines, about four-fifths of them box cars. The Southern Railway announces that the company has contracted for 2,200 steel cars of the newest pattern and 250 steel flat cars. The Baltimore & Ohio Railroad is now said to be in the market for 8,000 freight cars of various types.

At the same moment, freight car shortages are reported from the Canadian Northwest. Canadian elevators are obliged to close because they cannot ship their wheat. It is said that seventy-five shipping points have no cars in sight and that if the railroads could furnish the cars receipts at Winnipeg would be 2,000 cars a day.

It looks as if there was going to be a little business, first and last, for the railroads, and that they have some idea of preparing for it, within their existing limits. But nobody has announced that any new lines would be built, opening up new districts to better service. Yet there is the territory, waiting for service. Doubtless the Mahdi of Madison (Senator La Follette) would say that the railroads must be pretty prosperous if they have to buy so many new cars. It is amazing what an insight into the railroad business is possessed by gifted statesmen who follow law and politics, in a circle, around and around and around.

Sir Walter Scott on Mechanical Education.

Sir Walter Scott had no sympathy with the sentiment that was creeping into life in his day that children ought to be taught useful arts. Writing to Joanna Baili he said: "I have not the pen of our friend Maria Edgeworth, who writes all the while she talks, laughs, eats and drinks, and I believe all the time she sleeps, too. She has good luck in having a pen which walks so unweariedly and so well. I do not, however, quite like her last book on 'Education,' considered as a general work. She should have limited the title to 'Education in Natural Philosophy,' or some such term; for there is no great use in teaching children in general to roof houses, or build bridges, which, after all, a carpenter or mason does a great deal better for two shillings and sixpence per day. In a waste country, like some parts of America, it may do very well, or perhaps for a sailor or traveler, certainly for a civil engineer. But in the ordinary profession of the better-informed orders, I have always observed that a small taste for mechanics tends to encouraging a sort of trifling self-conceit, bounded on knowing that which is not worth knowing by one who has other matters to employ his mind on, and in short, forms a trumpery gimcrack kind of character, who is a mechanic among gentlemen and most probably a gentleman among mechanics.

"You must understand I mean only to challenge the system as making mechanics too much and too general a subject of education, and converting scholars into makers of toys. Men like Watt do not come within ordinary rules; but your ordinary Harry should be kept to his grammar, and your Lucy will be best employed on her sampler instead of wasting wood and cutting her fingers."

Thugs Attack a Smart Towerman.

The lonely railway signal tower operator has so little to attract robbers that it is surprising how frequently the towerman is the victim of heartless ruffians. One of the latest hold-ups of this character was on the Baltimore & Ohio near Uniontown, Pa. Thanks to the coolness of the victim and the energy of a train crew the would-be robbers are likely to spend a good many years in durance vile.

When two scoundreds broke into the tower managed by A. L. Carroll, the cool headed operator signalled an approaching train before he was beaten unconscious. The train crew acted promptly and in spite of revolvers used by the robbers overpowered them, and made them prisoners. We hope they began punishment of the robbers by a sound beating. A vigorously used club appeals to cattle of the robber type better than anything else.

Power of Sincerity.

Take from a man every gift but sincerity; let him be blind and deaf and lame, let him stammer in his speech, lack education and good manners; handicap him as you please, so you leave him sincerity and he will command respect and attention. His work will endure. The world, which is always looking for the real thing, will gladly overlook all his infirmities. In every relation of life sincerity is the secret of power. The salesman who does not himself sincerely believe in the merits of his goods will generally be a failure. The business man who sets about to fool other people must end, as he has, in fact, begun, by making a fool of himself. The clergyman who preaches anything that his soul does not approve need look no further to explain empty pews. There is no virtue that more men believe in and fewer men practice.

Items of Personal Interest

Mr. R. D. Malloy has been appointed general foreman of the Pere Marquette, at Frankfort, Mich.

Mr. George Stone has been appointed shop foreman of the Chicago, Rock Island & Pacific at Shawnee, Okla.

Mr. Henry Martin has been appointed general manager of the International & Great Northern, with office at Houston, Tex.

Mr. W. T. Kuhn has been appointed master mechanic of the Toronto, Hamilton and Buffalo, with office at Hamilton, Ont.

Mr. W. H. Stoll has been appointed roundhouse foreman at Dunmore, Pa., Erie Railroad, in place of Mr. E. L. Briggs, deceased.

Mr. W. D. Campbell has been appointed general superintendent of the Northern and Central districts of the Southern Pacific.

Mr. H. A. Uhler has been appointed road foreman of engines on the National Railways of Mexico, with office at Monterey, Mexico.

Mr. G. W. Cuyler has been appointed general foreman of Rock Island Lines at Cedar Rapids, Iowa. He succeeds Mr. T. Kilpatrick, resigned.

Mr. A. B. Todd has been appointed master mechanic of the Butte County Railroad, succeeding Mr. James Chambers, with office at Chico, Cal.

Mr. L. C. White has been appointed superintendent of the St. Louis, Rocky Mountain & Pacific, with office at Raton, N. M., succeeding Mr. E. J. Dedman.

Mr. F. B. Sanford has been appointed chief despatcher of the Missouri, Kansas and Texas at McAlester, Okla., in place of Mr. J. D. McCaffrey, transferred.

Mr. H. C. Bixler has been appointed assistant superintendent of the Philadelphia terminal division of the Pennsylvania, with office at Philadelphia.

Mr. T. W. Younger has been appointed superintendent of motive power of the Southern Pacific, with jurisdiction of the Northern and Central districts.

Mr. T. F. Dreyfus has been appointed master mechanic of the Baltimore & Ohio, with office at Benwood, W. Va. He succeeds Mr. D. H. Speakman.

Mr. W. T. Hall, assistant superintendent of the Houston & Texas Central at Houston, Tex., has been appointed division superintendent with office at Ennis, Tex.

Mr. A. S. Howe has been appointed superintendent of motive power of the Nevada-California, Oregon Railway, with office at Reno, Nev. He succeeds Mr. W. D. Gardner.

Mr. J. W. Keppel, formerly employed as machinist on the Canadian Pacific, has been promoted to the position of night foreman of the Canadian Pacific shops at Sutherland, Sask.

Mr. H. H. Hale has been appointed superintendent of motive power of the Cincinnati, Hamilton and Dayton, with offices at Cincinnati, Ohio. He is a western railway man of wide experience.

Mr. James Sheal has been appointed assistant master mechanic of the Lehigh & Susquehanna division of the Central Railroad of New Jersey, with office at Mauch Chunk, Pa.

Mr. John Clare of New Albany, a locomotive passenger engineer on the Southern, has been appointed inspector of locomotives for the Indiana railroad commission at a salary of $2,500 a year.

Mr. R. P. Edsen has been appointed assistant superintendent of the Iowa & Dakota division of the St. Paul system west of Sanborn, Ia., and of the Black Hills division, with office at Mitchell, S. D.

Mr. James Shea has been appointed night roundhouse foreman at Bergen, N. J., Erie Railroad, in place of Mr. John Fuller, who has been transferred to night roundhouse foreman at Jersey City.

Mr. H. Rhoads has been appointed master mechanic of the New Orleans, Texas & Mexico, and the Orange & Northwestern, with office at De Quincy, La. He succeeds Mr. G. H. Matthews.

Mr. V. M. Robinson, formerly foreman in the car department of the Missouri Pacific at De Soto, Mo., has been appointed general car foreman of the Trinity and Brazos Valley, with office at Teague, Texas.

Mr. Harold B. Hayes has been appointed master mechanic of the Alabama Great Southern, with office at Birmingham, Ala. Mr. Hayes is a native of Alabama, and has filled various positions on Southern railroads.

Mr. S. H. Barnes has been appointed superintendent in charge of the transportation and mechanical departments of the Midland Valley, with offices at Muskogee, Okla., reporting to Mr. J. W. McCloud, assistant to the president.

Mr. T. M. Younger, master mechanic of the Southern Pacific lines in Oregon at Portland, Ore., has been appointed superintendent of motive power of the Northern district of the Southern Pacific, with office at Portland, Ore.

Mr. John Burns has been appointed master mechanic, Eastern division of the Canadian Pacific, with office at Montreal Que., Mr. J. B. Elliott, formerly master mechanic, being retired under the pension rules of the company.

Mr. S. H. Ryan, formerly chief dispatcher on the Texas & New Orleans, has been appointed trainmaster, and Mr. J. J. Campbell, formerly second train dispatcher, has been appointed chief train dispatcher in place of Mr. Ryan.

Mr. John G. Sullivan has been appointed chief engineer of the Western lines of the Canadian Pacific, with office at Winnipeg, Man. Mr. Sullivan has had many years' experience as an engineer on the leading railways in Canada.

Mr. Bruce W. Benedict, for several years in the motive power department of the Atchison, Topeka & Santa Fe Railway, has been appointed director of the shop laboratories in the department of mechanical engineering at the University of Illinois.

Mr. J. Fahy, general foreman of the New York, New Haven & Hartford at New Haven, Conn., has been transferred to the Readville, Mass., shops, and Mr. John Reid, foreman at Readville, has taken charge of the New Haven shops.

Mr. C. J. Burkholder has been appointed superintendent of the northern division, Kansas City Southern, with headquarters at Pittsburg, Kan. Mr. O. Cornelson, who has been acting superintendent, resigned to accept service with the Virginia Railway.

Mr. J. W. Walton has been appointed assistant general manager of the Katy in Texas, in place of Mr. C. M. Bryant, resigned, and Mr. W. E. Williams has been appointed general superintendent of lines north of Texas, in place of Mr. Walton.

Mr. H. C. Manchester, superintendent of transportation of the Maine Central at Portland, Me., has been appointed superintendent of motive power and equipment of the Delaware & Lackawanna with office at Scranton, Pa., in place of Mr. T. S. Lloyd, resigned.

Mr. J. F. Prendergast, for many years master mechanic at the Baltimore & Ohio shops at Pittsburgh, Pa., has been appointed master mechanic of the East Broad Top Railroad & Coal Co., and also of the Rockhill Iron & Coal Company, with office at Orbisonia, Pa.

Mr. W. E. Williams has been appointed a superintendent of the Missouri, Kansas & Texas, with office at Sedalia, Mo., succeeding Mr. A. E. Boughner, assigned to other duties. K. A. Easley has been appointed superintendent at McAlester, Okla., succeeding Mr. W. E. Williams, transferred.

Mr. W. C. Stears, master mechanic at Lima, Ohio, has been appointed master mechanic of the Cincinnati, Hamilton and Dayton at Indianapolis, and Mr. J. R. Griener, roundhouse foreman at Toledo, is promoted to succeed Mr. Stears, who takes the place formerly occupied by F. E. Pickard.

Mr. George W. Ruhl, for nearly fifty years a locomotive engineer on the Baltimore division of the Northern Central, and just retired under age limit, has a record of never being reprimanded for negligence, and never having an accident that injured a passenger or a member of a crew.

Mr. C. L. Mayne has been appointed superintendent of the Southern Kansas division of the Missouri Pacific, with office at Coffeyville, Kan. Mr. Mayne entered railroad service on the Lake Shore when he was telegraph, station agent and train despatcher. He afterwards held positions on several railroads, and lately has been on the Grand Trunk.

Mr. E. A. Watson has been appointed as assistant locomotive engineer of the Great Western Railway of England. Mr. Watson's early training was with the American Locomotive Company at Schenectady and the Pensylvania Railroad at their Juniata (Altoona) Works, from which latter he came direct to the Great Western Railway. Mr. Watson is an Englishman of Scots parentage.

Mr. H. A. Ivatt retired from the position of locomotive engineer to the Great Northern Railway of England recently. His successor is Mr. H. N. Gresley. Mr. Ivatt was a remarkably able locomotive superintendent, and effected several important improvements on railway rolling stock. He was an occasional correspondent of RAILWAY AND LOCOMOTIVE ENGINEERING.

Mr. F. C. Pickard, master mechanic of the Cincinnati, Hamilton & Dayton, has been appointed master mechanic of the Pere Marquette, with office at Saginaw, Mich. Mr. Pickard was elected president of the Railway General Foremen's Association at the last convention, and has proved a highly energetic and useful member of that organization. A report which he prepared for the last meeting on "The Best Method to Promote Shop Efficiency" occupied the convention for several days, and had to be carried over to next year.

Mr. Bruce W. Benedict, formerly employed in the motive power department of the Santa Fe, has been appointed director of the shop laboratories in the department of mechanical engineering at the University of Illinois. Mr. Benedict is a graduate of the University of Nebraska, and was occupied as mechanical inspector on the Chicago, Burlington and Quincy, and latterly as an engineering writer on a Chicago publication. Mr. Benedict will be a valuable acquisition to the engineering instructors of the Illinois University.

Mr. F. S. Lloyd, superintendent of motive power of the Delaware and Lackawanna, has resigned. It is generally reported that Mr. Lloyd purposes engaging in private business. It will be remembered that Mr. Lloyd left the company's service before to accept a position with Chicago, Rock Island and Pacific, returning to Scranton as superintendent of motive power of the Delaware and Lackawanna four years ago. The construction and equipment of the new shops at Scranton, said to be the largest in the world, were completed under Mr. Lloyd's supervision.

Mr. E. H. Fitzhugh, formerly vice-president of the Grand Trunk system, has been elected president of the Central Vermont, Central Vermont Transportation Company, Southern New England, and the Montreal & Southern Counties Railway. Mr. William Wainwright, second vice-president of the Grand Trunk and the Grand Trunk Pacific, has been made senior vice-president of the former road, and will remain second vice-president of the Grand Trunk Pacific. Mr. Howard G. Kelly, chief engineer of the Grand Trunk system, has been made vice-president in charge of the construction, transportation and maintenance departments.

Mr. J. F. Deems, general superintendent of motive power of the New York Central lines, has resigned to become president of the Ward Equipment Company. Mr. Deems has filled the office of general superintendent in the mechanical department for nine years, and takes with him the good wishes of all who had the honor of his acquaintance. Mr. Deems began railway work as a machinist apprentice on the Baltimore & Ohio, which he left to join the C. B. & Q., where he rose through various grades to be superintendent of motive power. He left railroad life to be superintendent of the Schenectady Locomotive Works, but was there only a short time when he was appointed general superintendent of motive power of the New York Central Lines. Mr. Deems was unusually popular among his mechanical department friends, and was elected president of many of the technical organizations.

Mr. James Alexander McCrea, for the last six years general superintendent of the Long Island Railroad, has been made general manager of the same line. The appointment has been made at the request of President Ralph Peters, who believes in putting young men under heavy burdens so that they may develop their powers while overflowing with energy. Mr. McCrea, who was born in 1875, began railroad work as rodman in 1895, when he was twenty years old, and he has been in active work ever since as engineer, superintendent and general superintendent. Mr. McCrea, who is a son of President McCrea, of the Pennsylvania Railroad, comes of stock that go to the front without pushing. The race has had a long apprenticeship of hustling. As long ago as 1610, when enterprising Scotsmen were receiving encouragement to go and help in regenerating Ireland, Mr. McCrea's forebear left Kintail in the northwest of Scotland and settled on a large farm in the north of Ireland, where the same family are still prosperous farmers. In 1776 the great-great-grandfather of Mr. McCrea came to Philadelphia, and most of his descendants have remained in Pennsylvania.

Mr. Frank S. Gannon, the most genial of railroad officials, who was till within a few months ago president of the Norfolk Southern, has now determined to devote himself to special work connected with railway property. The mature experience enjoyed by Mr. Gannon in the varied spheres of railroad life through the positions of telegraph operator, train dispatcher, superintendent, general manager and president, has provided the practical capital that makes his services exceptionally valuable as an advisor and as a judge of values. His future work will be investigating the value and management of transportation properties, the examination of and prospects of proposed new lines, and to throw oil upon labor troubles. Mr. Gannon's reputation for high sense of justice will make his service a powerful factor for peace and harmony. When labor and capital stand glaring at each other ready to fight. Mr. Gannon, like many other eminent railroad men, is a graduate of the Erie, having begun work as an operator at Port Jervis. He was always open for a better job, and in his progress upwards worked for several of our leading railroads, among them the Baltimore & Ohio and the Southern Railway, on which he was general manager for five years.

John F. McIntosh.

We are privileged to place before our readers a very faithful likeness of Mr. John F. McIntosh, locomotive su-

JOHN F. McINTOSH,
Locomotive Superintendent, Caledonian Railway, Scotland.

perintendent of the Caledonian Railway, who, as noted in our November issue, had the honor of being decorated by King George with the member Victoria Order, in recognition of his eminence in the railway world and his long and intimate service in connection with the running of the Royal Railway Train, extending over three reigns. Mr. McIntosh began firing locomotives on the Scottish North Eastern Railway, now part of the Caledonian system, fifty years ago, and has steadily risen to his present position through sheer force of merit. A few years after having reached the position of engine driver, Mr. McIntosh lost his right arm in an accident, which he feared would end his active career in the mechanical department, but it had the opposite effect. When able to resume work he was appointed an engine house foreman, where he displayed so much energy and hustle in effecting running repairs that he was soon promoted to a higher grade. He then advanced steadily until sixteen years ago he reached the top, being made locomotive superintendent. He has displayed remarkable ability in the designing of rolling stock, particularly locomotives, the flattery of imitation of his engines having been accorded to him by several important railway companies. When Mr. McIntosh was a fireman, he and Angus Sinclair lodged in the same house, and John has always given Angus credit for having influenced him towards the study of engineering problems that proved so helpful in pushing him upward.

Andrew Carnegie.

Andrew Carnegie believes in spending his wealth while he remains in active life, able to supervise the management of his benefactions, as following this policy he has just turned over twenty-five million dollars to the Carnegie Corporation of New York, a body which was incorporated by the New York legislature on June 9 for taking over Mr. Carnegie's work in connection with educational institutions, libraries and hero funds. In short, the Carnegie corporation will be entrusted with carrying on the benevolent schemes that have been for years the pride and glory of their originator. This is the most magnificent act of benevolence that we have ever heard of being performed by any man. The yearly income of the gift will amount to $1,125,000.

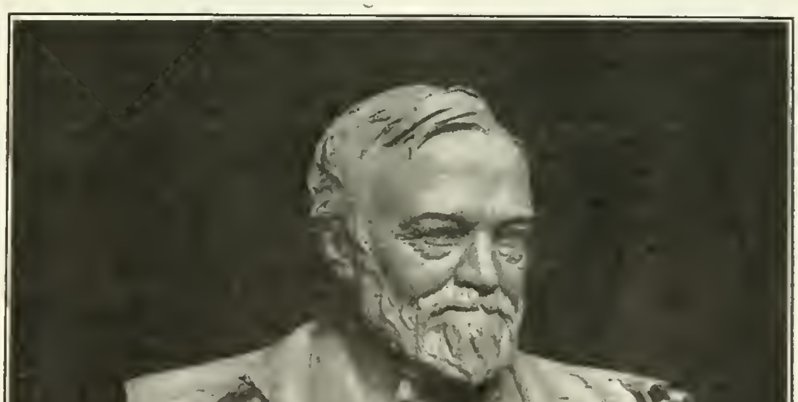
At one time Mr. Carnegie gave promise of becoming a great railroad manager, but a few years' experience convinced him that the sphere was too limited for his ambition. When little more than a boy he became a telegraph operator and assistant to Col. Scott, president of the Pennsylvania Railroad. Soon after entering upon this position, during the absence of Col. Scott, an accident was reported on one of the lines which tied up the road. All was confusion for want of a head, but young Carnegie rose to the occasion. With a dozen telegrams each signed Thomas A. Scott, he started trains moving and prevented an expensive blockade. For this initiative he was made Col. Scott's private secretary.

Mr. Carnegie was blessed with a thrifty, clear-headed mother, who helped him to save money and advised him on sensible investments. He saw the possibilities of profit in iron and steel making long before others. By short steps he became an iron master, which was soon extended to steel. The success achieved then was largely due to the stupendous vigor of the man who cleared the way to money making when others in the same line were faling into bankruptcy.

Some of his mottos were "Labor is the universal law of our being. Man must eat his bread in the sweat of his brow, or not at all." Mr. Carnegie was not only willing to work, but his pace and energy were of the lightning express order.

He was greatly given to encouraging young men, and had a keen sense for detecting ability in those he employed. He once offered to open for the writer the gate that led to millions. He has done as much good to his fellow being as any one who has graced our nation's history.

The illustration which accompanies this brief sketch is from the bronze monument erected in the Institute in Pittsburgh and, which at his expense, furnishes education in the higher branches of technical education, especially in engineering, and is already one of the best equipped institutions of the kind in America. The monument is the work of Mr. J. Massey Rhind, the well-known New York sculptor.



ANDREW CARNEGIE.
Courtesy of J. Massey Rhind, Sculptor.

Annual Dinner of Railway Business Association.

As near as we can figure it out about 600 railway men, supply and other men, sat down together in the big dining room of the Waldorf-Astoria, New York, on November 22, to enjoy the third annual dinner of the Railway Business Association. The guests came from all parts of the Union and comprised 40 presidents and vice-presidents of railroads, 23 presidents of chambers of commerce and many other gentlemen no less important in the business world.

The entrance to the ballroom had been built up to represent a railway terminal gate with the transparency above announcing "R. B. A. No. 5, Prosperity Special." Then Albert Ackerman, the official announcer of trains of all sorts at the Grand Central Station, roared out that special was ready on track No. 1. "All aboard!"

"Bigger business" was the slogan sounded by George A. Post, president of the Railway Business Association, as the members and guests of the association took their seats. The Hon. Emmit O'Neal, governor of Alabama, one of the chief speakers of the evening, was specially honored by a quotation from a resolution passed by the Legislature of his state blazoned on a banner in the place of honor over the speaker's table, which read as follows:

"Investors of capital, whether money, mind or muscle, shall have thrown around them the protection of wise and just laws."

President Post, in his opening remarks, said, "All evils should be suppressed." These he interpreted as "Cut it short, keep down to business." This was a gentle hint to the speakers who were to follow. The speakers were asked to discuss:

"What is the value and efficiency of existing statutes?"

"What is there in them which should be discarded?"

"What is yet needed to make regulation comprehensive?"

"Wherever statesmen were needed in this land, it is now," declared Mr. Post in his most emphatic manner.

The speakers were Governor O'Neal, of Georgia, who talked about one hour, Walker D. Hines, of the Atchison, Topeka & Santa Fe, who told the meeting that, "the railroads are in the hands of the government more than ever before and are steadily getting more completely into that position." For many years Texas legislators were notorious for putting burdens upon railroads, but a change of heart appears to come about through the need of more railroads, for Mr. H. J. Pettingill, of Dallas, Tex., said:

"The slogan of the Texas Commercial Secretaries and Business Men's Association is fewer laws and better laws. Equal rights to all and special privileges to none. The present chief magistrate of Texas, the Hon. O. B. Colquitt, not only adopted this motto as his own, but added the words legislative rest and political peace."

The report goes on to say that it is vital to determine quickly the value of existing satutes and which ones in the light of experience should be discarded. Continuing the report says:

"Federal and State commissioners are evidently anxious to be regarded as solicitous for the financial stability of the transportation companies. In the atmosphere thus created our work now is to encourage the development of co-operation, frank and above board, between the rate regulating tribunals and men of affairs in the establishment of principles and policies affecting revenues."

The executive committee finds in its report that while at present "the depression from which many industries are suffering" has been somewhat relieved, the relief is small for those lines of business dependent upon the carriers. Since the United States is "a government by parties," it is suggested that the way for the association to gain its end is to "urge upon the political parties in nation and in State that they pledge themselves to administer the regulations of railways with the motive of discovering the most enlightened methods, not only of preventing discriminations and excesive charges but of making railways grow and thrive."

Meeting of Railway Business Association.

At the Annual Business Meeting of the Railway Business Association held in New York November 22 the following officers were elected: President, George A. Post; vice-presidents, H. H. Westinghouse, C. H. Cutler, W. H. Marshall, A. H. Mulliken; A. M. Kittredge, W. E. Clow, George W. Simmons; treasurer, Charles A. Moore; assistant treasurer, M. S. Clayton.

The annual report of the executive committee took for its text the recommendation that the association get to work to secure planks in party platforms favoring liberal railway rates. "A clear track for better business was the slogan that found favor with the members. The present situation, as the executive committee sees it, was set forth in part on the first page of the evening's programme:

"Legislation has now reached a point in conferring and exercising power over railways when business men, to use a business phrase, may well 'take account of stock.'"

Adversity is sometimes hard upon a man, but for one man who can stand prosperity one hundred can stand adversity. That is an expression from Carlyle's philosophy. It is not so true in this nineteenth century as it was fifty years ago when those to whom prosperity came were rare.

Dr. Angus Sinclair has been elected a member of the American Railway Guild, which consists of persons who have served as officials of the American Railway Association, or who have served on any of its committees. All who have been delegates to the International Railway Congress are eligible for membership, the courtesy which made Dr. Sinclair eligible, since he was a delegate for the Erie Railroad at the last International Railway Congress.

Edward C. Brown, manager foreign department, Dearborn Drug and Chemical Works, after spending the last two years in the Orient, has just returned to Chicago. Mr. Brown has been very successful in "pioneering" for the "Dearborn," in the far East. A branch office in the Philippines, and agencies covering Japan, Formosa, Korea, and China, have been established. Many of the principal railways in China and the Philippines are using Dearborn Water Treatment, while tests are being run on the Japanese lines.

The main offices of A. Eugene Michel and staff, advertising engineers, have been moved into the Park Row Building, 21 Park Row, New York City, where larger space has been secured, as necessitated by constantly increasing business. Temporarily the photo retouching and illustrating department will remain in the Hudson Terminal Buildings, but all business will be managed from the new offices.

Obedience Not Slavery.

To obey another man, to labor for him, yield reverence to him or to his place, is not slavery. It is often the best kind of liberty—liberty from care. The man who says to one Go, and he goeth, and to another Come, and he cometh, has in most cases more sense of restraint and difficulty than the man who obeys him. The movements of the one are hindered by the burden on his shoulder, of the other by the bridle on his lips: there is no way by which the burden may be lightened, but we need not suffer from the bridle if we do not champ at it. To yield reverence to another, to hold ourselves and our likes at his disposal, is not slavery: often it is the noblest state in which a man can live in this world. *John Ruskin.*

Human companionship counts for so much in this life—but, after all, the sharpest corners are to be turned alone.—*E. S. Phelps.*

A man's generosity must be gauged not by what he gives away, but by the amount he has left after giving away.—*New York Sun.*

Commercialized Science.

Upon invitation, a member of the editorial staff of Railway and Locomotive Engineering recently visited the International Correspondence Schools of Scranton, Pa., and was highly edified with the interesting and thorough workings of their system as well as impressed with the magitude of this work.

Truly, the impression of thoroughness, even to the detail of systematic courtesy, is a lasting one and evidenced most conclusively the ambitional apex of a master mind.

As our representative approached the main building on Wyoming avenue the beauty and solidity of the structure gave timely intimation of the never disappointing events that were to follow.

Entering its broad and friendly portal he was met by a courteous clerk, who upon learning the name, notified the proper officer by means of intercommunicating telephone, and with hardly a moment's delay he was in his presence.

After the usual formalities he was ushered through the general offices, each department being in charge of a competent head who had been trained to his special work in their own perfect organization.

Space will not permit of an adequate discription of the entire "plant," if we may be allowed the term, but passing over a vast amount of interesting exhibit, we came to the real work of the institution.

In a building a few blocks distant from the main offices, the real or fundamental work is conducted.

This commodious structure was designed, built, equipped and organized by the students and graduates of the schools and is a work of art as well as a most appropriate and efficient "shop" for the manufacture of really competent specialists in all branches of the trades and professions.

Verily, "line upon line and precept upon precept" permeates the mass and "leavens the whole lump."

Each week day 1,450 people, more than 1 per cent. of the total population of Scranton, are employed at the home offices of the I. C. S.

Each day they pay the Scranton post office about $500 for postage.

The mailing department handles 32,000 pieces of mail daily and the printery uses five and one-half tons of paper.

For six days a week the I. C. S. bindery uses the hides of 27 head of cattle and 20 goats for the leather corners and backs of I. C. S. textbooks and turns out 1,000 complete textbooks, averaging 500 pages each.

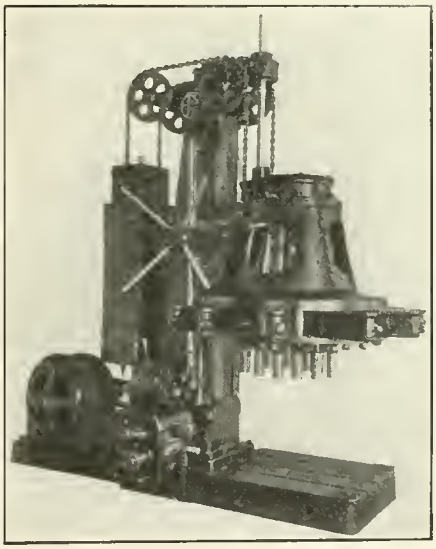
The instruction department examines and corrects over 2,000 lesson papers and 500 drawing plates per day, and a new student is enrolled every one and one-half minute.

Professional men everywhere now admit the wonder scope of this vast organization, and the graduates from the I. C. S. are pardonably proud of their diplomas.

New Multiple Spindle Drill, Motor Driven.

The Fox Machine Company, of Grand Rapids, Mich., has recently added to their fine line of products a new motor-driven multiple drill, as shown in the accompanying illustration. This machine possesses many points of merit. The bearings are all bushed with bronze, an oil pump provides a flood of oil on the gears, and the principal gears are made of 3½ per cent. nickel steel. All gears are correctly cut, as would be expected in any work turned out by this company, and altogether the machine is of the most excellent kind.

While massive and strong, it is easily operated, being perfectly balanced and adjusted. The illustration gives a good idea of the construction, and the manufacturers will be glad to furnish information.



FOX'S NEW MULTIPLE SPINDLE DRILL.

The Wood Firebox.

Very flattering accounts have lately been made concerning the durability of the locomotive boiler, designed by Wm. H. Wood, of Media, Pa. The boiler on engine 2481, of the New York Central, was used on very hard freight service, and after one year's work a thorough examination of the boiler was made and only two stay bolts were found broken, and the mud ring was absolutely tight. Ordinary fireboxes might be depended upon to have a dozen or more broken stay bolts on each side in that time. There was no indication of cracking, which testifies to the absence of strains that usually do so much to shorten the service of locomotive fireboxs. This style of firebox works its way slowly into favor with railroad officials, but it is bound to become popular in the long run.

Early Motive Power of the Baltimore & Ohio Railroad.

Mr. J. Snowden Bell, one of the best-known mechanical engineers in the country and an accomplished writer, has written a book on "The Early Motive Power of the Baltimore & Ohio Railroad," which constitutes a most valuable addition to railroad history, and ought to interest every person of intelligence connected in any way with railroads. The book is on the press of the Angus Sinclair Company. The price is $2.

This book contains descriptions and illustrations of all of the various classes of locomotives which were, or had been, in service on the Baltimore & Ohio Railroad, up to the close of the year 1860, together with boilers, valve gear and other details, and biographical sketches and portraits of early motive power officers. It is a comprehensive and accurate record of the interesting early motive power of this road, which was largely representative of that of others, and was prepared by the author from his personal experience in the machinery department in the early sixties, a large amount of data in his possession, and all the information obtainable from reliable sources.

There are chapters on the "Crab" and "Grasshopper" engines; the Norris "single driver" engines; the Mason and other "American" types; the "Mud Digger," the "Camel" and other eight-wheel connected engines; the six-wheel connected engines; the "Hayes" and "Tyson" ten-wheel engines, including the celebrated controversy between Winans and Tyson; the later designs of Thatcher Perkins, and the leading types of the present equipment.

The book contains fifty-seven illustrations of locomotives and details, showing all of the types of engines, and six portraits. The book is expected to be ready in a few weeks.

The Pennsylvania Railroad people are trying an experiment in locomotive designing that will be watched with interest by all railway men interested in the development of heavy power. They have contracted for the construction of a group of Mallet engines that have all the cylinders of the single expansion type with superheaters. It is expected that the superheaters will save sufficient steam to make the engines equal in economy the compound Mallet.

Life is no longer a festival, if one has to provide the ways and means.—*Taine.*

Everything that is noble is difficult of accomplishment.—*Cicero.*

Railroad Notes

Specifications have been issued by the Pittsburgh Coal Company for the construction of 1,000 to 1,200 steel underframes for coal cars.

The Illinois Steel Company has received an order for 7,500 tons of bessemer rails from the Wyandotte Construction Company and has also received miscellaneous orders from railroads in the West for about 6,000 tons.

The New York Central has ordered twenty Pacific type passenger locomotives from the Baldwin Locomotive Works for delivery in January. The Nashville, Chattanooga and St. Louis has ordered three locomotives of the same type also from Baldwin's. The Virginia and Southwestern has ordered one Mikado locomotive from the Baldwin Locomotive Works.

The Philadelphia & Reading is preparing to build a 40-stall roundhouse at Mill Creek, Pa.; it will be 400 feet in diameter.

When the steel is down on 128 miles of grading just completed the Union Pacific will have 241 miles more to double track. It will then have two tracks from its eastern to western terminus. It now has 375 miles extending from Omaha, Neb., to Julesburg, Col.

It is understood that plans have been perfected for extensive improvements at Altoona. Work is expected to begin within a few months. It is further stated that this will include the removal of the present passenger station and the erection of a new station.

The entire line of the Queen & Crescent between Cincinnati and Chattanooga, with the exception, of course, of the tunnels, is to be double tracked. The improvement will call for a large expenditure. At one point alone it will cost for 13 miles, $1,000,000.

Tracklaying has been completed on 95 miles of the Pingree-Wilton branch of the Northern Pacific. Construction work is being pushed on the terminus at Wilton, which is to be a division point for the western end of the road.

In Corpus Christi, Tex., a construction company is being organized to promote a system of railroads aggregating 1,000 miles which will include a line from Corpus Christi to Kingsville and from San Antonio to Brownsville. The primary object in view is to make use of the deep water obtained by the United State Government at Port Aransas.

William C. Brown, president of the New York Central Lines, announces that orders have been placed for a total of 120 locomotives and 17,400 freight cars for all the lines. The locomotives include thirty passenger and ninety freight. Freight cars include 14,000 box, 2,500 coal, 5,000 flat and 350 gondola cars and fifty cabooses.

President Finley of the Southern Railway Company announces that the company has contracted for 1,700 all-steel fifty-ton double drop bottom gondola coal cars, 500 steel underframe 30-ton ventilated box cars and 250 all-steel 50-ton flat cars.

The Canadian Pacific has awarded the contract for the 40-mile extension of its Esquimalt & Nanaimo Railway on the east coast of Vancouver Island, and it will be put through quickly by about 600 men. The Canadian Northern will shortly call for bids for constructing 40 miles through numerous timber limits on Vancouver Island; 60 miles are now under construction northward from Victoria.

The Aberdeen & Asheboro Railroad, with headquarters in Aberdeen, N. C., is 95 miles long, has 12 locomotives and 16 cars. It has been a sort of family property, H. A. Page being president; J. R. Page, vice-president and general manager; M. E. Page, secretary and treasurer; Frank Page, auditor and car accountant. The positions did not involve enormous duties but they were good for exchange of transportation. The road has now been swallowed by the Seaboard Air Line.

The Baltimore & Ohio has awarded contracts for 8,000 cars, costing in the aggregate $7,200,000. The equipment includes 2,300 box cars, 4,000 all-steel gondolas and 1,800 drop and gondolas. The South Baltimore works will build all of the box cars except 500.

The directors of the New York Central Lines have recommended the placing of equipment orders aggregating $20,000,000. The news caused a sensation in Wall Street. It was taken as proof that the future is not as black as it has been painted and that 1912 is likely to bring a fair measure of prosperity.

The New York, New Haven & Hartford Railroad and the Pennsylvania Railroad Companies have awarded the contract for the steel work for the Hell Gate Bridge and approach viaducts on their New York Connecting Railroad to the American Bridge Company.

The South Baltimore plant of the Standard Steel Car Company was awarded a contract to build 2,000 box cars to cost $1,800,000 for the Baltimore & Ohio Railroad. The normal capacity of the plant is 25 cars a day, but it can build up to 40 a day. The number of employees will be increased from 500, the present force, to about 2,500 by January 1.

The last rail has just been laid on the Pennsylvania-Hudson Manhattan Rapid Transit line between New York and Newark. The greater part of the line has been complete for some time, but there was a gap in the steel and concrete viaduct due to legal difficulties over a piece of the right of way near Front street, Newark. This was rapidly bridged as soon as the trouble was settled and now the connection between the business centers of the two cities by a direct electric road is complete.

Railway construction goes on in Canada, although it is almost prostrated among United States railways. We notice that a charter has been granted to D. J. McArthur, of Winnipeg, Man., to build a railway from Edmonton, Alberta, to Fort George, B. C., a distance of about 1,000 miles, part of it through a mountainous country. This seems to be a private enterprise, which is a novelty of big railway building in Canada.

An important piece of railway construction work has just been finished by the Great Northern Railway, which has double-tracked 14 miles of the line from Java to Summit, Mont., at the crest of the continental divide in the heart of the Rocky Mountains. This work, which cost $1,500,000, was begun October 1, 1909. During the two years it took to do this work there were as many as 1,500 men on the job at one time, and never were there less than 500 engaged. Not only has a double track been built, but the old line practically rebuilt in order to reduce curves and improve the grades.

During the year 1910 the Illinois Central Railroad system carried a total of 30,728,211 passengers without a fatality to a passenger as a result of an accident. The lines of the system on which this record was achieved cover some 7,000 miles, and computed as passengers carried one mile there were 799,238,174 persons carried one mile on the company's trains. In these figures are included some 14,000,000 passengers carried on the Chicago suburban lines, on which not a single person in fifty-five years has been killed while being transported as a passenger.

An important item of interest in railroad circles last month was the report that the Pennsylvania's inquiry for rails for 1912 would be 250,000 tons, or 100,000 tons more than last year. Railroad equipment orders were large, making up the vast bulk of the market. The New York Central system was said to have placed orders for more than 5,000 cars, divided as follows: 1,000 steel underframe box cars and 1,000 hoppers to the American Car & Foundry Co.; 2,000 box cars to the Pullman Co., 500 flat cars to the Barney & Smith Co., and 350 gondolas to the Standard Steel Car Co.

The Buffalo, Rochester & Pittsburgh placed orders with the Pressed Steel Car Co. for 1,000 steel underframe box cars and the Cambria Steel Co. reported orders for 300 hopper cars for the Cambria & Indiana Railroad. Other orders reported were 2,000 cars for the Chesapeake & Ohio to the Standard Co., 600 steel gondolas to the Pressed Steel Car Co., for the Southern, and 500 cars for the Burlington to the American Car & Foundry Co. These orders foot up to a total of 10,000 cars in addition to the large total of orders placed in October, estimated at more than 13,000. It is to be remembered, however, that the railroads restricted their equipment orders during the early part of the current year and their buying had been less than normal for the two years preceding.

"The Lands of Utah" is the title of a booklet issued by the passenger department of the Denver & Rio Grande. It contains a description of Utah's agricultural development and gives special mention of the principal private and government reclamation projects now under way and completed. The booklet is illustrated with orchard and dairy scenes. An up-to-date map of the State of Utah, giving counties, adds materially to the value of the publication.

The Canadian Northern has acquired the Carillon & Grenville, said to be the last of the broad-gauge lines on the American continent to pass into the hands of a large system. The Carillon & Grenville is run during the season of navigation in connection with the Ottawa River Navigation. It is thirteen miles long and is said to have retained in service for sixty years its original equipment brought from England.

Lapel buttons and watch fobs in place of service stripes are hereafter to be worn by men on the Santa Fe. These devices will bear an emblem in the form of a circle enclosing a Maltese cross, the color of the background indicating their length of service with the company.

It may not be generally known that the Northwestern Pacific Railroad of California has been using the telephone system in train dispatching for the last twenty years, in fact, from the time the road was originally operated at all. So far as we know, this is the first use of the telephone for train dispatching on steam railroads.

According to Signal Engineer J. A. Peabody, of the Chicago & Northwestern Railway, who investigated the matter on his own line, the cost of stopping a train of 530 tons and returning to a speed of fifty miles an hour, is 42 cents. The cost of stopping a 2,000-ton train from thirty-five miles an hour, is $1. The officials of another road estimate each stop of a six-car passenger train from forty-five miles an hour at 35 cents, and for a 1,500-ton train from fifteen miles an hour at 56 cents. The time that is lost for making a stop on a level, straight track has been estimated at 145 seconds by careful engineers.

The Long Island road reports that it has not killed a passenger in a train accident since June 1, 1893; and during that time its passenger mileage has been 4,904,736,994; and nearly all of these passengers have been carried on the suburban lines of the company, carrying a dense traffic to and from New York City.

The Public Service Commission has granted the petition of the Erie Railroad Company for authority to issue its gold trust equipment obligations to the amount of $4,600,000. The obligations are to be issued to secure the construction and lease to the Erie Railroad Company of 1,000 box cars, 2,000 gondola cars, 500 flat cars, 300 automobile cars, 200 refrigerator cars, 25 suburban passenger coaches, 10 through line passenger coaches, 5 accommodation passenger and baggage cars, 35 freight locomotives and 20 switching locomotives.

By means of an ingenious device the air brake car in a passenger train of the Canadian Pacific will be tested on the car ferry while being taken across the Detroit River. It makes for greater safety and economy of time at terminals. Any car found defective will at once be cut out.

The Mallet articulated compound locomotives built during the present year by the Canadian Pacific at their Montreal shops are doing excellent work. They are in use at Field, British Columbia, and run as far as Stephen. Another Mallet is under construction, differing from its predecessors in being a simple engine with four high-pressure cylinders, and making the sixth Mallet that will be put into service by the company.

The Jinja - Kakindu Railway, in Uganda, which will extend from Jinja on Lake Victoria, toward Lake Kioga, lying to the north, is being rapidly pushed to completion. The engineer in charge reports the length of the line as just over fifty-four miles. Steel ties are being used throughout, and rails have now been laid for sixteen miles. About 3,500 natives are employed in this construction. This railway when completed will form a link in a line from Cairo to Mombasa, and will play an important part in the development of a rich country, which is said to be well adapted to the growing of cotton.

New Type of Locomotive.

A new type of locomotive has been designed, says *The Engineer*, for the North-Eastern Railway by Mr. Vincent L. Raven, the company's chief mechanical engineer, and a series of these engines have been built at the works of the North British Locomotive Company, Glasgow. They are Atlanta type engines. The coupled wheels are 6 ft. 10 ins. in diameter, the bogie wheels 3 ft. 7¼ ins. in diameter, and the carrying wheels are 4 ft. in diameter. The cylinders are three in number, and are all cast together, one central and two outside the frames, and are 15½ ins. in diameter, with a stroke of 26 ins., and are fitted with piston valves. Ten engines are built for saturated steam and ten for superheated steam (Schmidt's system). The superheated engines have cylinders 16½ ins. in diameter; all other parts are similar to the saturated steam engines.

These engines are the first passenger engines built for any English railway with three cylinders and piston valve chambers in one casting. They are intended to deal with the heavy East Coast passenger traffic between York, Newcastle, and Edinburgh, and have for some weeks past been dealing satisfactorily with this service, hauling trains varying from 300 to about 500 tons behind the tender at average speeds up to 53 miles per hour. The consumption of coal by the saturated steam engines is lighter than that of the previous engines working the same traffic, while the consumption of coal of the superheated engines is considerably lighter still.

A want of individuality is the most dangerous sign of modern civilization.—*J. S. Mill.*

A Splendid Car Shop Tool.

It is gratifying to be able to call attention of Railway and Locomotive Engineering readers to another new H. A. Fay & Egan Company machine, as these people manufacture such a high grade line that every new tool they put out meets an interested body of users. This new tool is a Double Spindle Shaper, designed to meet the most exacting requirements of car shops and all kinds of woodworking plants where shaping is done.

In the company's large illustrated circular treating of this machine, particular attention is called to the extreme high speed of the spindles insuring perfect work and maximum output.

The phosphor bronze taper bearings with continuous oil flow permit the operation of the spindles on this machine at 7,000 revolutions per minute, which is 50 per cent. faster than is possible on any other heavy car shop shaper made.

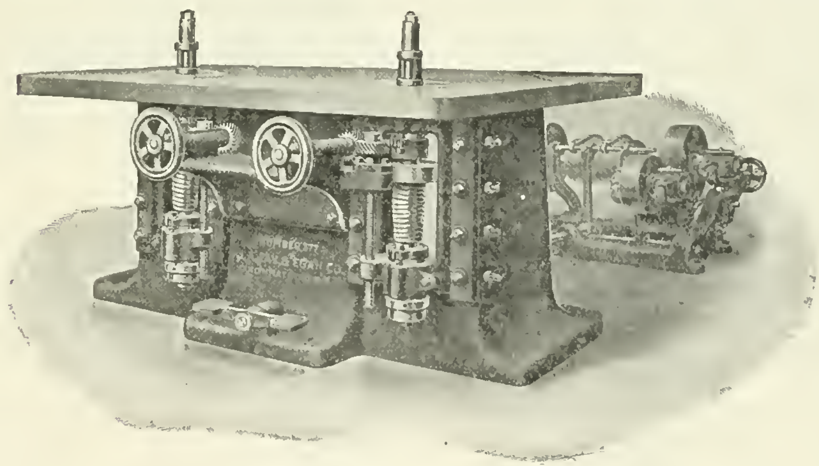
The spindles are made of forged crucible steel and are mounted in very rigid housings which are fitted into planed gibbed ways their entire length. These housings are adjustable vertically by hand wheel (as will be seen in the illustration) operating through cut spiral gears, thus requiring no extra locking device. Each housing is independent of the other. Both spindles drop below the table.

Another valuable feature of this machine is the construction of the countershaft, the base of which is cast in one piece, on which all the pulleys and belt shifters are mounted. This is a new feature distinctive of the Fay & Egan machine, and makes the most rigid construction, also eliminating all assembling on arrival at destination. Adjustable independent idlers are provided to take up the slack in either belt, maintaining the proper tension at all times.

The column is a single cored casting, very heavy and with broad floor support. It is of such design that it is not in the least in the operator's way, and it supports the working parts with absolutely no vibration.

The operator has perfect control of this machine at all times by means of the foot treadle at the front.

For further information concerning this machine, you are invited to address the manufacturers at 445 W. Front street, Cincinnati, Ohio.



FAY & EGAN'S DOUBLE SPINDLE SHAPER.

Fair Settlement for the Cow.

When Mr. E. Brady was general agent of the old B. & N. N. a considerable part of his time was occupied settling claims for stock killed, as very little of the line was fenced. Mr. Brady generally assumed a high stand with the claimant of damages.

Mr. Jan Jansen, an Iowa farmer and a new-comer, had a cow killed and Mr. Brady made a call the following day to feel how the land lay in regard to a claim. Addressing Farmer Jansen, he said:

"We understand, of course, that the deceased was a very docile and valuable animal," said the claim agent in his most persuasive, calm and gentlemanly manner, "and we sympathize with you and your family in your loss. But, Mr. Jansen, you must remember this: Your cow had no business being on our tracks. Those tracks are our private property and when she invaded them she became a trespasser. Technically speaking you, as her owner, became a trespasser also. But we have no desire to carry the issue into court and possibly give you trouble. Now then, what would you regard as a fair settlement between you and the railroad company?"

The farmer was quite frightened at the position he had fallen into by the trespass of the cow, and said, "Vell, Mr. Brady, a bane pore Swede farmer, but a willin' to gif two dollars.

People of our day and generation are very reluctant to admit that they are ignorant concerning any subject. Yet we should never forget that willingness to admit ignorance is a prime factor in developing wisdom and knowledge.

The Storle Brass Globe Valve.

A new Globe valve just being placed on the market is the Storle brass globe valve. This is a high-pressure valve built extra heavy throughout and of excellent metal especially adapted for that purpose. As shown in sectional cut, the taper plug and two seats, A and B, used in place of the single seat and disc of the old style valve, gives it the properties of a nearly balanced valve and makes it easily operated under pressure. The ports D in the bottom of the plug allow the pressure to get to the upper seat and counteract the pressure of the lower seat, so that it is practically a balanced valve, the difference between the area of the two casts being very slight.

The stem is made extra short so the valve can be used in places where a long stem would interfere with surrounding obstacles and has a removable hand wheel so that it can be conveniently packed when closed and hot. Another attractive feature is that this valve can also be packed when wide open by having the two seats, C, meet and cut off the pressure in the stuffing box. The stuffing box is made large enough to use ¼ in. stem packing without cramping it.

The inlet is apparently opposite to that of any other valve and has an obstruction bar S to prevent scale from hitting the opposite side of seat, B, with full force.

This valve has been carefully tested out over a period of five years, and the results show that it is permanently

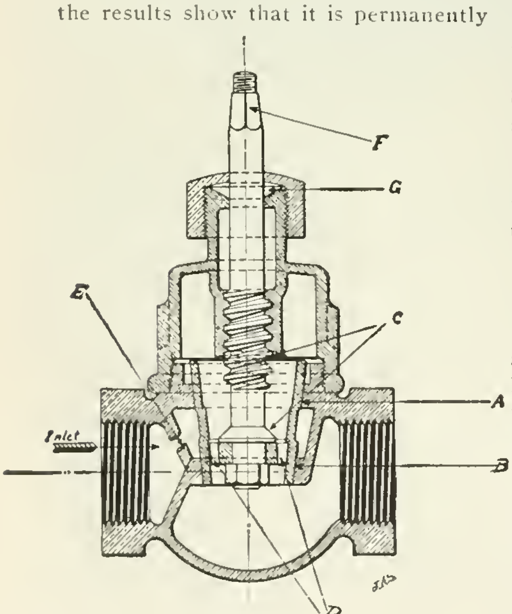
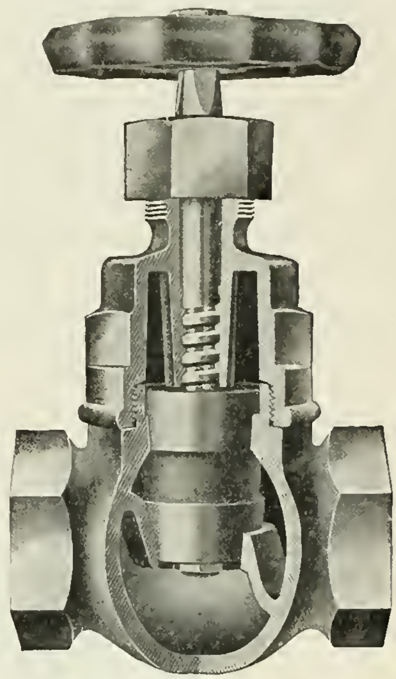


Fig. 1

STORLE VALVE, SECTIONAL VIEW.

tight and much more easily operated than the ordinary Globe valve. The taper plug, which forms the seat, does not turn when opening until it has freed itself from the seats, and when closing stops turning as soon as it touches the seats, and in that way never seats in the same place and eliminates all wear and cutting by friction, thus leaving the seats practically unchanged and giving the valve its long wearing qualities.

This valve is strongly recommended



STORLE BRASS GLOBE VALVE.

for steam, water, oil or other liquids under the most strenuous and difficult conditions. One of the first valves made, which has had five years of service, was recently tested at the factory and found to be absolutely tight under 800 lbs. pressure. All of the valves are tested to a hydrostatic pressure of 800 lbs. to 1,000 lbs. before being shipped.

The valve is being marketed by the Scully Steel & Iron Co., Chicago, Ill., who are anxious to secure live dealers to handle same throughout the country.

Setting Cams.

A good method in adjusting cams on a shaft is to have a small hole drilled lengthwise through the set screws holding the cams, and when the cams are set in their proper places a breast drill may be used through the screw to mark the exact location of the center of the set screw. On removing the cams the drilled marks may be enlarged and the pointed screws placed in position and the job is done.

The truth which another man has won from nature or from life is not our truth until we have lived it. Only that becomes real or helpful to any man which has cost the sweat of his brow, the effort of his brain, or the anguish of his soul. He who would be wise must daily earn his wisdom.—*D. S. Jordan.*

NEW CATALOGUES AND BULLETINS.

Springs.

The Pittsburgh Spring & Steel Company have issued a new illustrated catalogue, presenting in fine form the chief features of their excellent products. Their specialties embrace elliptical and coil springs for locomotives, passenger, freight and interurban cars and other requirements. Recently they have filled large orders for locomotive springs of vanadium steel, and the results are of the most gratifying kind. It may be added that the company do not only furnish the heaviest kind of springs, but produce an endless variety of springs of any weight and almost for any purpose imaginable. Copies of their new catalogue may be had on application at Farmers' Bank Building, Pittsburgh, Pa.

Couplers and Parts.

Couplers and Parts, Catalogue No. 2, has just been issued by the National Malleable Castings Company. There are nearly 100 pages of finely printed matter accompanied with beautiful illustrations, the whole forming a work of uncommon elegance, especially in the engraver's art. The views of the company's extensive works at Cleveland, Chicago, Indianapolis, Toledo, Sharon and Melrose give an idea of the vastness of their manufactories, and when we are reminded that the company manufacture the Sharon, Tower, Climax, Latrobe and Chicago couplers with all their variety of attachments, those familiar with the popularity of these couplers in America and other railroads can form an estimate of the output of the great industries that are owned by the company. Copies of the catalogue may be had from the company's main office at Cleveland, Ohio.

Acheson-Graphite.

"Seventeen years of Experimental Research and Development" is the title of a pamphlet by Edward Goodrich Acheson. It presents the interesting story of the discovery of carborundum and the development of what has grown to be a great industry. As a lesson on the subject of electrical action on the grosser elements of the earth, and the amazing story of the results, it is almost without a parallel and should be read by all interested in the use of abrasives. The manufacture of the justly celebrated Acheson-Graphite is also described and illustrated and a flood of light is thrown upon a subject the details of which are but little known to the engineering world. Copies of the pamphlet may be had on application to the International Atcheson Graphite Co., Niagara Falls, N.Y.

Industrial Safety.

The *Journal of Industrial Safety* is taking its place among the trade publications of our time and occupies a field peculiarly its own. The November issue presents a chapter on shafting accidents which should be read by all in charge of machine shops or factories. The subject of compulsory fire drills is intelligently discussed, while a number of new safety devices of a general kind are described and illustrated. Particulars in regard to the Industrial Safety Association and its work may be had on application to the office, Engineering Societies Building, 29 West 39th street, New York City.

From Spike to Locomotive.

The above is the title of the latest publication of the Railway Equipment Company, Portland, Ore., and a perusal of the catalogue justifies the claim. Every conceivable mechanical appliance in relation to railway equipment is listed and prices may be had on application. The enterprising company has also a thoroughly equipped repair shop where locomotives and other appliances may be repaired. The rapid growth of the works and the increasing demand for their products are the best guarantee of the business integrity of this enterprising company. Send for a copy of their latest catalogue.

Coaling Stations.

Roberts & Schaeffer Co., Chicago, have issued Bulletin No. 23, giving illustrations and details of a number of their coaling stations now in operation at the chief railroad centers in America. The balanced bucket type has been brought to perfection by this company, and having recently had the opportunity of seeing this coaling system in operation at the New York Central shops at Corning, N. Y., we can vouch for its efficiency and economy in operation. A description of this and other examples of this kind of coaling station will be found in the catalogue, copies of which may be had on application.

The Lightning Line.

Fay & Egan, the well-known manufacturers of wood-working and other machinery, have issued the first number of a bulletin descriptive of their fine products. The presswork and illustrations are of the best. The chief double-page illustration in this issue is a fine photogravure reproduction of a high-speed planer and matcher, No. 353. This powerful machine, the heaviest and fastest of its kind made, is guaranteed to finish 200 lineal feet per minute. There are other smaller but equally important machinees described and illustrated. Send for a copy of the new bulletin to the company's office, 400 West Front street, Cincinnati, Ohio.

Business Reassurance.

Railway Business Association Bulletin No. 2 is devoted to constructive railway policies in many States in 1911, and points out very clearly that the year has been notable for reassurance to capital in numerous legislatures. Only in a very few States has the spirit of restriction been marked, while there has been a marked decrease in railway laws. Requests of copies of this pamphlet will be welcome from all desiring to place it in the hands of their representatives, employees or friends. Apply to Mr. F. Noxon, secretary, 2 Rector street, New York.

Accident Bulletin.

The Interstate Commerce Commission has issued Accident Bulletin No. 40, giving details of the railroad accidents in the United States during April, May and June, 1911, and also a recapitulation of the accidents that have occurred during the year ending June 30, 1911. The bulletin is one of the best issued by the United States Government as it is entirely free from the tedious reports so common to governmental publications. While the number of employees of all kinds occupied on steam railroads amount to 1,648,033, it is gratifying to observe that the number of accidents have diminished. Copies of the bulletin may be had on application to the commission, Washington, D. C.

Franklin Institute Journal.

The November issue of this periodical has among other able articles an essay on "The Determination of Moisture in Fuel," from the pen of J. A. P. Canfield. It may not be generally known that coal exposed for even a short time during wet weather increases in weight about 13 pere cent. The gain in weight, of course, is a loss in every way. If the car was weighed before the contents were water-soaked, the purchaser suffers no loss from the increased weight, but the cost of boiling off the water must still be met. The paper cannot fail to be of interest to railway men, especially to those interested in coal consumption.

Johns-Manville Catalogue.

The railroad department of the H. W. Johns-Manville Co., 100 William street, New York City, is distributing a new 350-page catalogue—No. 252—which illustrates, describes and lists in an unusually attractive way their vast line of products supplied to steam railroads.

Among the products shown, most of which are made of asbestos, magnesia or indurated fibre, we note pipe and boiler coverings; packings; cements; roofings; waterproofing materials; heat, cold, sound and electrical insulators; Transite smoke jacks; Transite asbestos wood; Ceilinite insulation; conduit for pipes or wires; fuses; Linolite electric lamps and accessories.

The careful and systematic arrangement of the products to facilitate selecting and ordering them, the thorough indexing of material and the great amount of valuable data included, make this volume a veritable encyclopedia on the subject of steam railroad supplies.

Every railroad engineer and superintendent, in fact, everyone interested in any phase of steam railroad practice, should have this book.

Kerr Turbines.

The Kerr Turbine Co., Wellsville, N. Y., advises that over 700 of their machines, aggregating more than 50,000 h. p., are in active service and that more unfilled orders are now booked than at any previous time in the history of the company. Although their plant has been materially enlarged, a night shift has been necessary for the past two and a half years.

Among recent orders were two underwriter fire pumps driven by 200 h. p. Kerr Turbines for Stieger & Sons Piano Factory, Stieger, Ill.; one fire pump driven by 265 h. p. Kerr Turbine for B. M. Osbun Co., Chicago. This last named will be the only turbine-driven fire pump in the city of Chicago.

Standard Size of Catalogues.

During this period when railway supply men are pouring their annual catalogues upon railway companies and other purchasers, to say nothing of those expected to give them publicity, we would like to remind the framers of these catalogues that there are standard sizes long ago endorsed by the railroad associations. These are 3½ x 6 ins., 6 x 9 ins., and 9x 12 ins. Nearly all purchasers having filing cases for these sizes, an odd size received is generally consigned to the waste paper basket.

Pluck.

Pluck wins! It always wins! though
days be slow,
And nights be dark 'twixt days that come
and go.
Still pluck will win; its average is sure,
He gains the prize who will the most
endure;
Who faces issues; he who never shirks;
Who waits and watches and who always
works.