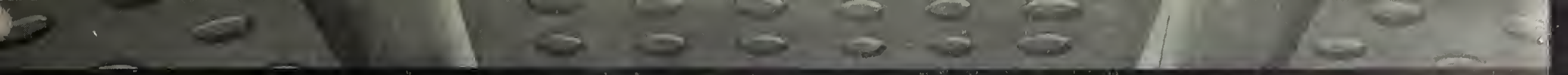

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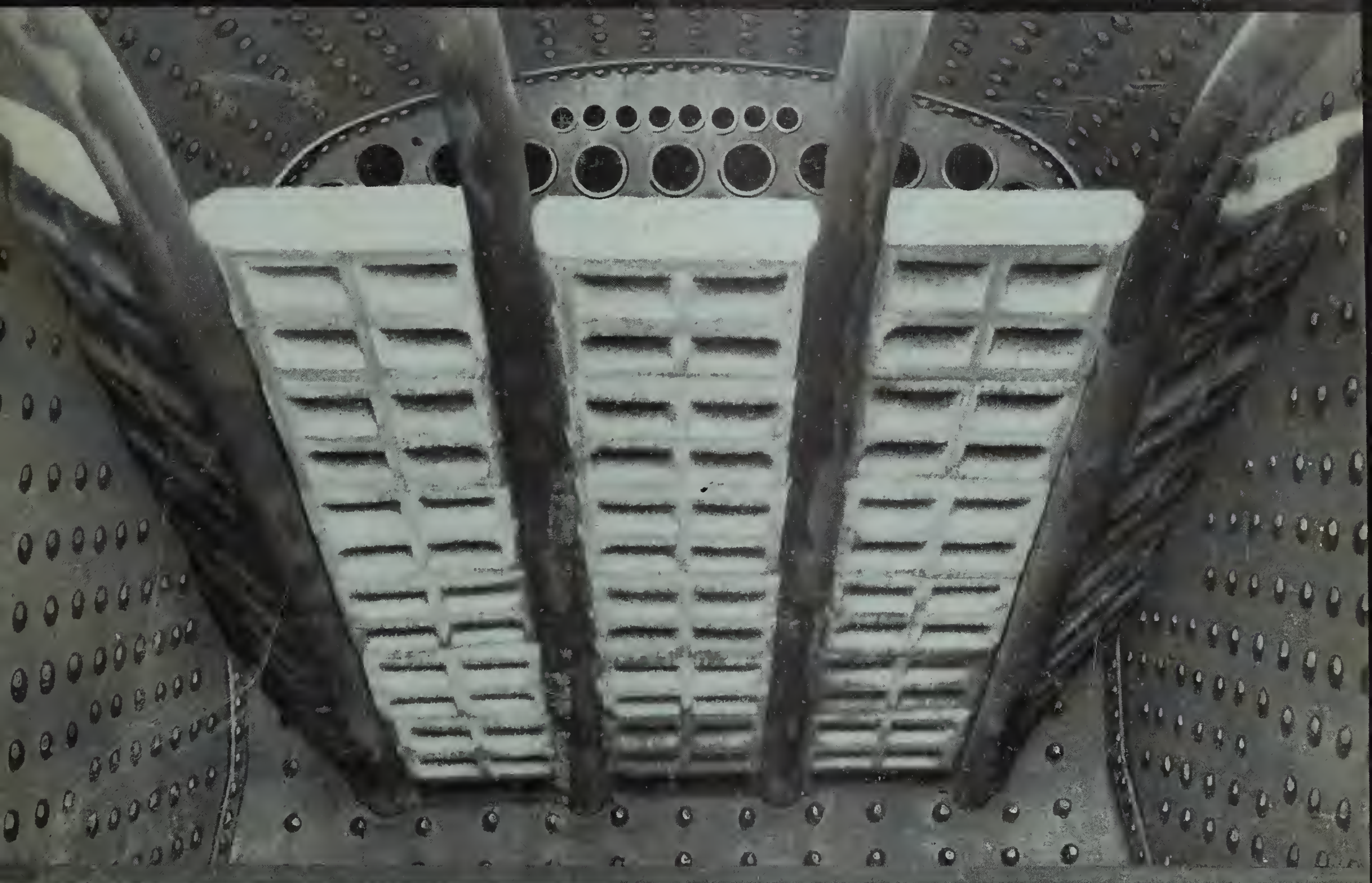

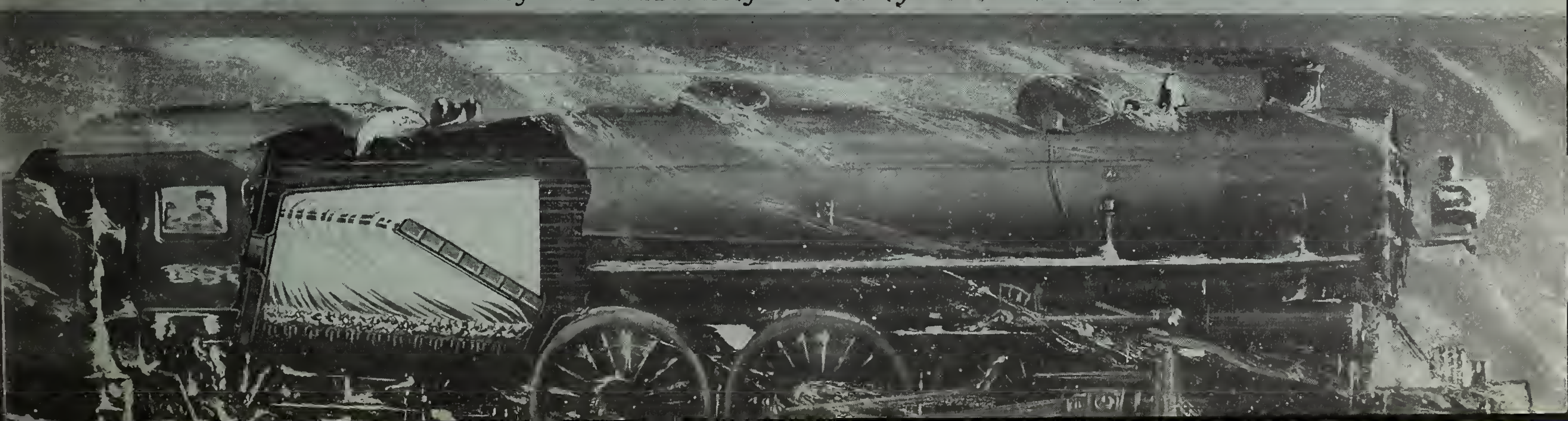

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RAILWAY MASTER MECHANIC

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New Year Greeting

To our readers and patrons whoever and wherever they may be we wish a Happy New Year. May the coming twelve months be full of happiness and prosperity to them; may the past year which has been unfortunately fraught with many perplexities and annoyances be forever forgotten, and may the joys of the future be limited only by the sky above and as far as the North, East, West and South extend. Let us all hope that the prosperity in sight will continue for many decades, and that the dawn of a new era will not be broken in its expansion by interrupting shadows.

—+—

Railroad Earnings

Since the beginning of the new fiscal year railroad earnings have been steadily increasing as compared with corresponding periods of the previous year. One hundred and sixteen of the largest railroads in the country earned gross $176,685,000 in the month of September, 1915, as against $165,020,000 in September, 1914. The operating expenses of the same roads in the same time were $109,645,660, compared with $109,695,-507 for September, 1914. The net revenue for these 116 roads was, in consequence, $11,714,000 more in September of this year than for the month of September, 1914. October returns show continued increases and every week since that month indicates that the railroad business is keeping pace with the improvement in all kinds of industries.

As these statements represent earnings covering all sections of the country, it is the best evidence that improvement is general. It is, therefore, gratifying to observe that affairs in the business world are certainly on the mend. The star of Prosperity has at last arisen and is beginning to shed its effulgence abroad. Hope now prevails where pessimism and disorder were uppermost, and once more joy is taking the place of gloom.

It has been a long, hard, cruel season—these past several years. Every business enterprise of whatsoever kind has combatted adversity until it seemed impossible to continue longer. The weary road is finally leading to a turn. Under the most exacting requirements, and more than fierce demands, the railroad companies have struggled courageously to meet the wants of the people and, at the same time, safely maintain their vast properties in the interest of security holders. Every railroad manager in the country, supported by his loyal army of assistants, is entitled therefore to more than ordinary commendation for these achievements.

Those wearing days of care and annoyance are gradually passing away; but there is much to be drawn from this page of history which has just been turned. We profit—if we are wise—by our experiences. We learn how to enjoy prosperity when it is at hand, and how to cope with adversity when it comes upon us; but during either period we are still wise if we plan for the future. We never know what a day may bring forth, so that under that apt precept, advanced by the father of his country, we must "prepare for war in time of peace." We must guard against adversity by using our energies and resources to that end in times of prosperity.

We are not yet in the seething cauldron of what are known as "good times," but we are headed that way. There will come the day when the railroads, after this long seige of economy, will rush in to provide much needed repairs and renewals and betterments and their earnings will then warrant it, especially if the needed relief in the way of increased rates is granted, and it probably will be. There will be a demand for cars and engines and bridges and rails and lumber and paint and every other known commercial product. Shops will be busy full time and beyond. Extra help will be required, extensions projected and new buildings erected. And this will make toward a general revival in all kinds of trade. In other words, the long expected season of great prosperity will open. Securities of all sorts will be issued and with money a-plenty extravagance will be the order of the day, in place of economy. The great influx of gold, resulting from the purchase of war materials here, foodstuffs and other commodities, and the war in general, is filling the coffers of the banks and bankers to overflowing. There will be money to borrow and money to lend and money to spend. "Mississippi bubbles" will be blown and all manner of schemes will be set afloat. The railroads will be among the "rainbow chasers," too. Hopeful fiscal agents will advise the output of bonds and notes and debentures and will encourage improvements and extensions. The railroads will gladly shoulder these demands, because they will be strong and lusty never mindful of the fatigue which always follows excessive exertion. The aftermath must be considered, because this momentous season, like all seasons, will close after a time. Summer succeeds spring and the cheerless weeks of autumn follow the delightful days of summer.

Now will be the time to prepare for the future; to "stop, look and listen" occasionally, as we move into and through this glittering field of prosperity. It will require many months to supply all the needs for which the railroads will spend their money. They have become sadly reduced, as we know, and will require much attention. Wornout equipment will be abandoned and replaced; tracks will require a general overhauling, and the demands for rails and bridges will be urgent. Ties will be renewed and everything on the line done over and put in thorough order. And all this not for safety only, but in order to meet the enormous traffic which will sooner or later tax their every facility. There is a likelihood, then, that expenditures may go too far, resulting in that excess of good things which produces indigestion. When business slackens the railroads will waken to the idea that they have overdone things; have borrowed too much and spent too much. Like the dancer, they will, in the end, have to pay the piper. This is the danger that attends good times. The pessimist turns optimist and the optimist lives in a still higher plane of hope than before. The idea is then abroad that hard times will never return; that prosperity has come to stay; that a thousand years of uninterrupted good fortune are at hand. This was the case when the twentieth century ushered in the most fruitful days this country had ever seen, and up to 1907, practically, there was nothing in the air to indicate that the season would ever wane. Staid and conservative bankers declared that never again would the old cry of "hard times" be heard. The railroads loaded themselves and the public with securities which later were wearily referred to as "undigested" and every one plunged into debt and spent money regardless of consequences and the way of the world. We all know what followed.

To secure eternal peace and everlasting prosperity, which we all desire, it will be necessary to remodel human nature, and no one but an all wise Providence can do that. The time is not yet. It is a mark of good judgment, then, for us to carefully consider these things so that in the few coming years of joy we may learn how to stand this prosperity, as we should, and not become obsessed with the belief that the millenium with its never ceasing glories has finally dawned.

Car Repairs on Industrial Tracks

There are advantages to be gained and a saving to be effected for the railway concerned by the inspection and repairs to cars which, coming from one road and intended for another, are placed on an industrial track to be loaded. There are certain difficulties in the way, of course, but these are not by any means insurmountable. When inspection is made and repairs done, when a car is on an industrial track, it saves two switching movements. This may not appear to be a very onerous burden to be carried by the receiving road, but it must be remembered that such an operation is repeated, perhaps on several cars, from day to day during the entire year. It is not the isolated instance which makes the saving noticeable, it is the cumulative effect of the large number of small savings which becomes visible as one of the things worth while.

If, as an example, one may suppose that several cars owned by the A. B. Railroad are returned in a city by the C. D. Railway and are put upon an industrial track for loading without going to the yard of A. B., they may have defects for which the owners are responsible. These cars come in after a trip on the C. D. Railway and are forthwith placed for load. If they have developed the kind of defects of which we speak they, do not bear a defect card, and they should receive the necessary repairs. In the ordinary course of events they reach the A. B. yard and are marked for the repair track. The movement to the repair track takes place and a second movement is required to bring them back to that yard after being repaired to be put in a train. There are the two switching movements, with car under load, with the accompanying loss of time going and coming to and from the repair track.

This kind of thing happens, not necessarily all the time, but it can happen and does happen. Inspection and repair on the industrial track may be the economical thing to do, though it may not conform to local rule or custom. If the cars reach the A. B. yard direct from the C. D. Railway and are inspected and marked off they may yet be delivered for load before repairs on the assumption that they are coming back to the A. B. yard, and the yard crew, following the line of immediate least resistance, runs them out to the industrial track and lets the future movements take care of themselves.

A method modified and adjusted to suit local circumstances may at least be worthy of consideration. At an industrial track where there is a constant stream of business, that is, where some cars are handled every day, there are many chances that cars requiring minor repairs will somehow or other be put there before the repairs are made. Under these circumstances would it not be wise to make the repairs while the cars are on the industrial track?

A competent man, perhaps inspector and repairman in one, could be detailed to take care of this and other similar situations within a limited radius, and if the industrial track was one on which a profitable business for the railway was done, the matter of saving time and reducing the switching movements would be of considerable importance. Such a repairman, if provided with a section man's tool box, with lock and key, could keep a few bolts, brasses, wedges, packing, brake shoes, brake levers, lag screws, hand holds, etc., etc., and be able to look after the needs of the cars with comparatively little trouble. He would use his blue protection flag when at work and the industrial track switch would be set and locked for the main line. The chances of his being taken unawares would be slight, indeed, and practically impossible if proper precautions were taken. Work done under these circumstances on a few cars with supplies close at hand would not consume much time and would eliminate switching movements and loss of time.

If these cars come into the yard to have repairs made safety demands that they be placed on the repair track, and from this there is no escape. If you have your shoes shined while you are being shaved you save time and may escape a walk to the next block to get a bootblack. You will eventually undergo both these operations—why not now? as the advertisements say.

We have dealt with the two possible methods of the delivery of cars to the industrial track. From the yard of the owning road, which is the usual way, and from the delivering road, which is a possibility. In either case the result is the same. The keeping up of supplies by the repairman and the replenishing of his tool box stock can easily be arranged for by pressing yard engine into the service once in awhile.

The Function of Laboratory Tests

Criticism often heard among practical railroad men of the amount of money and time spent on laboratory tests of locomotives raises a doubt as to whether or not the function of such a test is generally understood by the men who have not had the advantage of laboratory work in their preliminary education.

It can be claimed by an engine man that the amount of coal burned in a laboratory test to produce a certain draw bar pull at a certain speed gives no indication that out on a division the same amount of coal will pull the same load where the engine is radiating heat and where wind and weather affect the draft conditions.

What should be understood about a laboratory test is that a perfect laboratory equipment makes it possible to control and measure each factor entering into the performance of the locomotive. Then by holding all factors but one constant the effect of varying any one factor can be dtermined. For example, the relative efficiency of two models of valve gear can be determined in so far as they affect steam consumption, steam distribution, draw bar pull, etc., or the advantages gained by a brick arch, or a superheater, or softened boiled feed water, each factor as it alone affects the result. In such a laboratory test no cognizance is taken of the personal element in operation, the locomotive is considered apart from its driver—apart from its load. No witness to such a test can say that the results are unfair because one day it rained and the rails were slippery, or that a test train had a leaky air connection and demanded more than the usual amount of steam to maintain pressure in the reservoir.

The functions of the laboratory test of a locomotive become plain. It is possible to determine—on a percentage of total effectiveness basis—the effect of varying any one factor in the locomotive's performance. Or, it is possible, by duplicating all external conditions, to secure a comparative relation between the effectiveness of two types of locomotives under exactly similar service.

The exact data secured in laboratory tests do not represent the data to be secured in service. The relations and percentages based on laboratory data find their wide application in practical operation, not by setting a standard by which operating results shall be judged—but by indicating how far individual factors which cannot be isolated and measured in service affect the practical performance of the locomotive.

Something for Consideration

Whether Germany is better prepared than the United States in time of war, so far as railroad facilities go, considering the size of the two countries and their average density of population, may best be answered by the following comparative figures gathered from a recent report of the Bureau of Railway Economics at Washington. This report covers the years 1913 and 1914, respectively, which might be called average years, no later statistics having yet been compiled:

	Germany	United States
Area in square miles	208.825	2,973.890
Population	67,000.000	99,000,000
Total mileage, all tracks	78.000	377,000
Capital per mile	$120,000	$66,500
Gross revenues	$846.000,000	$3,000.000,000
Cost to operate	69%	72%
Total employes	786,000	1,700,000
Locomotives	29,500	61.200
Weight of locomotives, less tenders; tons	61	83
Passenger cars (small capacity) U. S. large capacity	65,000	33.000
Freight Cars	671,000	2,200,000
Capacity of freight cars (tons)	11,000.000	89,000,000
Tons of freight carried	680.000.000	1,000,000,000
Passengers carried	1,800,000,000	1,050,000,000
Average journey	14	34

To be especially impressed with the ramifications and marvellous extent of the railroads in the United States one most consult a map which shows plainly and in detail all the lines. He will see at a glance that no section of the country is neglected in the matter of railroad facilities. From the Atlantic to the Pacific and from the Gulf of Mexico to Canada are abundant and growing systems capable, in time of necessity, to move troops, munitions of war and supplies in every direction and between all points with rapidity and safety.

While distances here are long and the area vast, there is nothing to stand in the way of rapid service. Allowed suitable rates and fair, honest consideration, the railroads of the country will be enabled to furnish additional facilities when needed and be further prepared to act famously whenever the call comes. Then, under the control of a Board of Defense, in which should sit representatives from our various large railroad companies, this country can never be placed, in time of war, in an awkward position so far as the railroads are concerned.

Lackawanna Pacific Type Engines

Powerful 4-6-2 Locomotives for Heavy Passenger Service Over the Grades of the Pocono Mountains

Five Pacific type locomotives, believed to be the most powerful of the type, have recently been delivered to the Delaware, Lackawanna & Western Railroad by the American Locomotive Company.

The general introduction of steel cars in passenger service has necessitated the purchase of these heavy engines. They have been put in service between Scranton and Hoboken. This division crosses the Pocono Mountains and has a ruling grade between Stroudsburg and Pocono Summit of 78 ft. to the mile for a distance of 16 miles, with curves of 5 and 6 degs. Trains of nine steel cars are being handled over this district on the Lackawanna Limited trains Nos. 3 and 6, and this means a total train load of 600 tons hauled, at a speed of 30 miles an hour.

On other trains these engines are handling from one to two extra cars at schedule time on the grades. Also, all helpers on the mountain district have been dispensed with, on trains consisting of ten cars or less. Pacific type locomotives built three years ago and known as the 1,101 class, which have been replaced by these new locomotives, only handled 530 tons of train weight in the form of eight cars, moved at the same speed.

The new Pacifics have a total weight, engine and tender, of 471,300 lbs. and a tractive effort of 47,500 lbs. Pacifics of the 1,106 class have a total weight, engine and tender, of 449,800 lbs. and a tractive effort of 40,800 lbs. With an increase in weight of 4.8 per cent, an increase in power of 16.4 per cent was obtained.

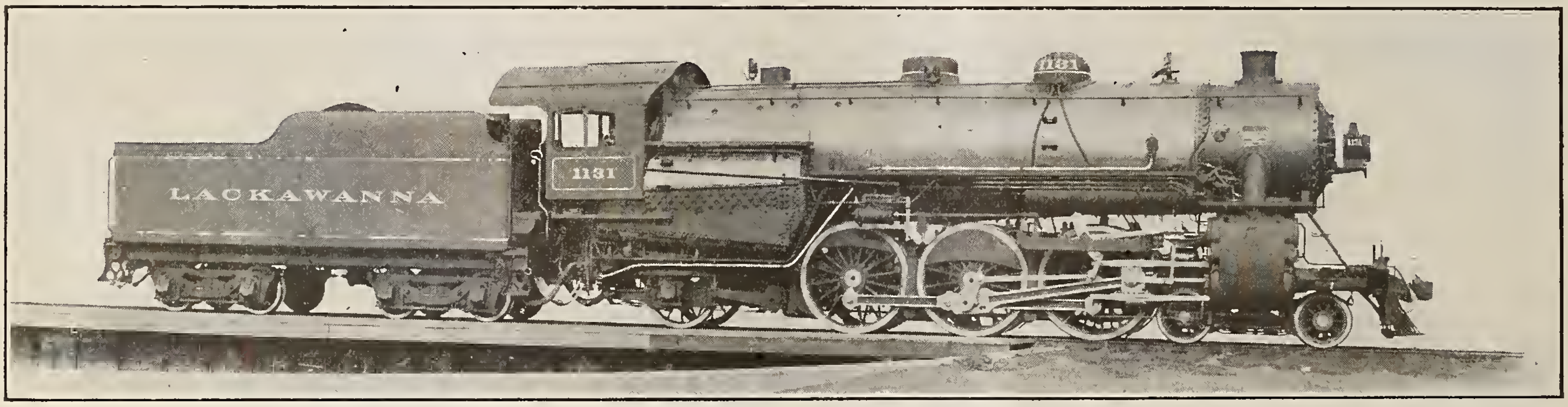
A tractive power of 47,500 lbs. on a Pacific type passenger locomotive requires an exceptionally large boiler. This one is of the extended wagon-top type. At the first course the barrel measures 79½ ins. in diameter outside, while the outside diameter of the largest course is 88½ ins. The barrel is fitted with 272 tubes, 2 ins. in diameter, and 38 super-heater flues, 5⅜ ins. in diameter and 17 ft. long. A combustion chamber 44 ins. long is included. The fire-box is 126⅛ ins. long by 104¼ ins. wide and has a brick arch supported on 5 tubes. All longitudinal seams are dectuple riveted. Tube and flue heating surface is 3,311 sq. ft., fire-box heating surface is 332 sq. ft., arch tube heating surface is 57 sq. ft., giving a total of 3,680 sq. ft.

The superheating surface is 760 sq. ft. and grate surface measures 91.3 sq. ft. One of the locomotives, No. 1,131, is fitted with a Riegel boiler. This boiler has the same tube, flue, and arch tube heating surface, superheating surface and grate area. The fire-box heating surface is reduced by 5 sq. ft. and 260 sq. ft. of water tube heating surface is added, which gives it a total heating surface of 3,935 sq. ft. Baffle plates are installed along both sides of the dome opening in boiler shell to prevent water washing up into the dome when the engines are rounding curves.

An interesting detail is the design of the throttle arrangement, known as the Woodard throttle and patented by the builders. The throttle rod is placed on the outside of the boiler shell and operates the throttle by means of a horizontal shaft which passes through a stuffing box on the side of the steam dome. The throttle valve itself has a stem projecting downwardly through the throttle box. The opening through which the stem passes is made steam-tight. At the lower end of the throttle stem there is a horizontal lever, one end of which connects through a vertical rod with the inner arm of the operating shaft on the side of the dome. The stuffing box on the side of the dome is of ordinary construction, suitable for a rotating shaft. It will be noted that this shaft has a motion of rotation only, and is not subject to the same objections as a backhead throttle rod which is pulled in and out of the stuffing box.

The throttle rod passes over the outside of the boiler jacket and in through the front of the cab, connecting to a special design of throttle lever. This throttle lever is so arranged that it has a differential leverage. At the beginning of motion the leverage is greatest, and the movement of the end of the lever is largest for a given motion of the throttle rod. The arrangement, therefore, offers a method of obtaining maximum pull at the beginning of the motion. After the throttle valve is unseated the leverage increases, with a corresponding decrease in the travel of the lever handle for a given lift of the valve. This permits of using the throttle lever with enough travel in the cab to keep it down to workable limits and at the same time the starting pull obtained is sufficient to easily lift the valve. The position of the throttle lever in the cab permits a better arrangement of the backhead fittings on the boiler to be made than can be obtained with the old style of throttle lever. The gauge cocks are unobstructed by the throttle lever handle, and the water glass and steam gauges can be placed in the position usually occupied by the throttle stuffing box and fittings of the lever.

All driving axles and main crank pins are of Cambria-



Pacific Type or 4-6-2 for the Lackawanna Railroad.

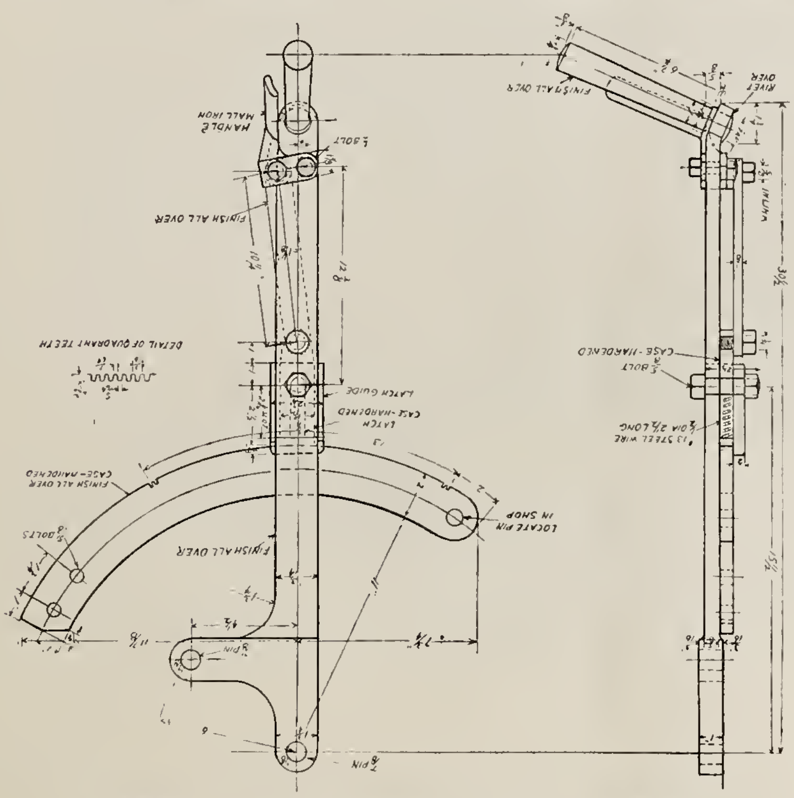
H. C. Manchester, S. M. P. Am. Loco. Co., Builders.

Coffin process steel, with a 3 ins. hole bored the entire length after they have been given the Coffin process.

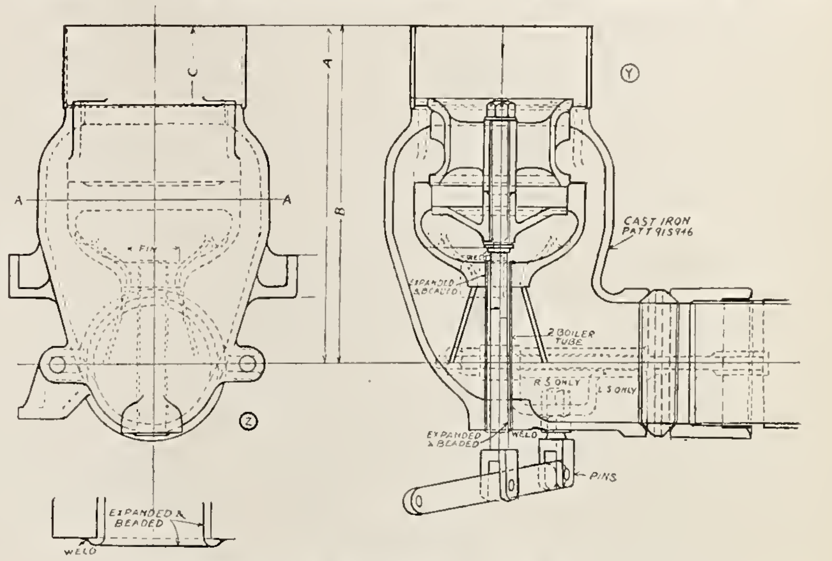
Some other interesting details are the Manchester-Riegel by-pass and drifting valves, the Walschaerts direct-drive gear, having the combination link attached to the cross-head wrist pin. The Schmidt superheater, brick arch, Ragonet power reverse gear, Foulder solid back end main rod, Woodard inverted link constant resistance engine truck, Cole long main driving box, self-centering valve stem guide, extended piston rods, radial buffer, and vanadium frames.

Some of the principle dimensions of this type is appended below for reference.

Track—Gauge, 4 ft. 8 ½ ins. Fuel—Anthracite coal. Cylinder—Type, piston; diameter, 27 ins.; stroke, 28 ins. Tractive power—Simple, 47,500. Factor of adhesion—Simple, 4.35. Wheel base—Driving, 13 ft.; rigid, 13 ft.—total, 34 ft. 5 in.; total, engine and tender, 67 ft. 1 in. Weight—In working order, 305,500 lbs.; on drivers, 197,300 lbs.; on trailer, 56,000 lbs.; on engine truck, 52,200 lbs.; engine and tender, 471,300 lbs. Boiler—Type: Extended, Wagon top, O. D. first ring, 79½ ins.; working pressure, 200 lbs. Fire-box—Type, wide; length, 126⅛ ins; width, 104¼ ins.; combustion chamber, with length, 44 ins.; thickness of crown, ½ in.; thickness of tube, 9/16 in.; thickness of sides, ½ in.; thickness of back, ⅜ in. Water Space—Front, 5 ins.; sides, 5 ins.; back, 4 ins.; depth (top of grade to center of lowest tube), 23½ ins. Crown staying—Radial. Tubes—Material, Char. iron, No. 272; diameter, 2 ins. Flues—Material, hot rolled S. S., No. 38; diameter, 5⅜ ins. Thickness—Tubes, No. 11 B. W. G.; flues, No. 9 B. W. G. Tube—Length, 17 ft.; spacing 11/16 in. Heating surface—Tubes and flues: Riegel, 3,311 sq. ft., ordinary, 3,311 sq. ft.; fire-box: Riegel, 327 sq. ft., ordinary, 332 sq. ft.; arch tubes: Riegel, 37 sq. ft., ordinary, 37 sq. ft.; water tubes, Riegel, 260 sq. ft.—total, Riegel, 3,935 sq. ft., ordinary, 3,680 sq. ft. Superheater surface—Riegel, 760 sq. ft.; ordinary, 760 sq. ft. Grate area, Riegel, 91.3 sq. ft; ordinary, 91.3 sq. ft. Wheels—Driving diameter outside tire, 73 ins.; center diameter, 66 ins. Wheels—driving material: main, C. steel; others, C. steel. Wheels—Engine truck, diameter, 33 ins.; kind, C. iron.; trailing truck: diameter, 50 ins.; kind, C. steel; tender truck: diameter, 36 ins.; spoke, solid rolled steel. Axles—driving journals: main, 11½ ins. x 21 ins.; other, 10½ ins. x 16 ins.; engine truck journals, 6½ ins. x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender truck journels, 6 ins. x 11 ins. Boxes—Driving: main, C. steel; others, cast steel. Brake—Driver, West. ET No. 6, Amer. WM-3; truck, Amer.; tender, West. ET No. 6; air signal, West. L; pump, one 11 ins. West.; reservoir, 2-18½ ins. x 102 ins. Engine truck—4 wheel Woodard. Trailing truck—Radial self-centering. Exhaust pipe—Double; nozzles, 3-7/7. 4-4⅛ ins. Grate—Style, rocking. Piston—rod diameter, 4¾ ins; packing, G. iron rings. Smoke stack—Diameter, 18½ ins.; top above rail, 15 ft. 3 ins. Tender frame—D. L. & W. style, 13 ins. channels. Tank—Style, water bottom; capacity, 9,000 gals.; capacity fuel, 10 tons of coal. Valves—Type, piston, 14 ins.; travel, 6½ ins.; steam lap, 1⅛ ins.; ex. clear., 3/16 in.; setting: 0 in full gear forward, Lead 9/16 in. in full gear back.



Design of Throttle Lever for the D. L. & W.



The Woodard Throttle. Am. Loco. Co.

Lubrication

Editor Railway Master Mechanic.

Sir—In my railroad experience I have often noticed that some roads have a lot of trouble with hot boxes, and that packing the box a second or even a third time does not remove the tendency to run hot. My idea is that a good deal of the trouble arises from improper packing.

If a journal runs hot and is repacked and a new brass put in, it may still be hot a few miles from the point where the original heating forced it to be attended to.

I have noticed a number of times, on one of our great trunk lines where journal bearings had been applied at three different points, and at the station where the last bearing had been put in, this same journal ran hot at a station 12 miles from where the bearing was applied. The inspector packed this journal, and no more attention was given to it. After it had gone 70 miles the inspector, who accompanied the car, found the box cool. A number of similar cases could be mentioned. All the boxes got cool after a proper method of packing had been resorted to.

One reason why the hot-box evil continues is that not enough oil is retained in the old packing when it has been used a number of times, because all the life has gone out of it, so that a certain amount of new packing ought to be used with the old but renovated packing. Many roads provide an instructor to school and educate the men who have been assigned to packing journal boxes, and much good work has thus been done. All roads do not follow the practice. If it was, I believe this hot-box question would be a thing of comparatively rare occurrence.

C. J. Parks,
C. C. C. & St. L., Shelby, Ohio.

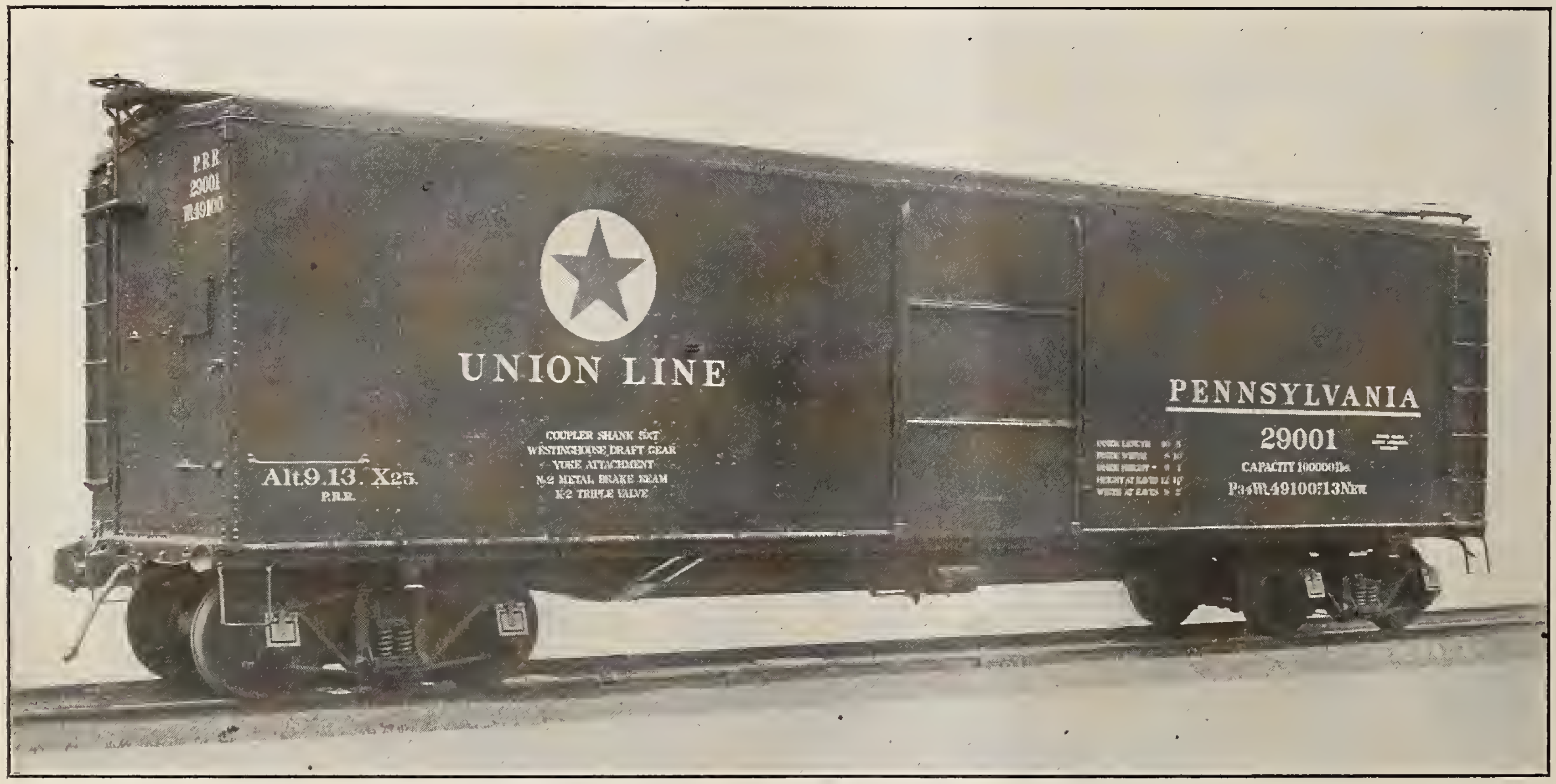
Steel Box Cars on the Pennsylvania Railroad

All-Steel 100,000-Lbs. Capacity Box Cars Built at Altona, With Heavy Steel Center Sill and Smooth Exterior Surface

The Pennsylvania Railroad has put in service some all steel freight cars which are not only comparatively light, considering this material, but are most serviceable and present a neat appearance that one is accustomed to think could only be obtained with the more easily worked material—wood. These cars have a capacity of 100,000 lbs. The inside measurements are 40 ft. 5 ins., width 8 ft. 10 ins., height 9 ft. 1 in. The height at the eaves is 12 ft. 10 ins., and the width at the eaves is 9 ft. 2 ins. The total weight when the car is new is 49,100 lbs. The equipment of the cars consists of Westinghouse draw gear, M. C. B. couplers with shank 5 x 7 ins., yoke attachment, No. 2 metal brake beams and K2 triple valves. These vehicles are also equipped with the United States safety appliance standards.

A glance at the cars would not be sufficient to give one an adequate idea of how the capacity of the car may be had, with what appears to be somewhat light construction for side sills and ends. The cars, however, depend upon a pair of deep reinforced channels as their center sills. These take the coupler pulling strains and absorb the transmitted buffing stocks. The channels with webs turned outward measure 20 ins. deep. They are $\frac{3}{8}$ in. thick and are spaced $12\frac{7}{8}$ ins. apart. The lower ends of the channels are reinforced by two angles 4 x 4 x 9/16 ins. These angles are riveted to the center sills and their edges, approximately balancing the 4-in. flange of the channel, have their edges turned inward. The top of the channel center sills has a cover plate 2 ft. 2 ins. wide, so that it overlaps the channel flanges by 2 9/16 ins. on a side. The angles, which are as stated, at the ends of car, are 4 x 4 x $\frac{3}{4}$ ins. in the deep central portion of the sill. The center sill while closed at the top by the cover plate is open a distance of $4\frac{7}{8}$ ins. on the underside. The center sill is made so that it is an 11-in. channel at the ends and this construction extends back to the needle beams, a distance of 12 ft. 4 ins. from the end sills. Here the lower side of the center sill dips down to its full depth of 20 ins. Between the body bolster and this point, that at which the first needle beam occurs, the center sill tapers up to 11 ins. deep.

The body bolster is composed of two diaphragms, which between the center sills contains a heavy centre casting which acts as a spacing piece as well. The side sill is composed of an angle 6 x 4 ins., with flange turned inwards, and on the outside of this is a bulb-angle 4 x $3\frac{1}{2}$ ins., the bulb being outermost. The body bolster diaphragms are 5 3/16 ins. on top at the center and taper toward the side sills. They are 7 ins. deep at the center, but come up to 6 ins. at the side sills. Friction castings for the truck are carried on the body bolster.

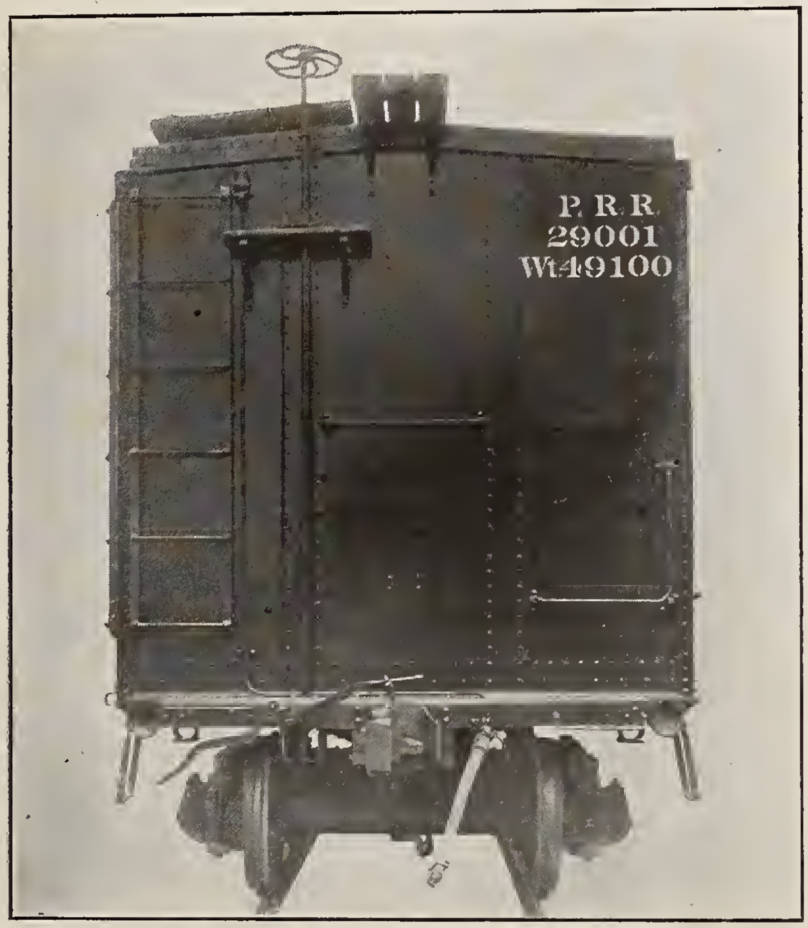


Side View of Pennsylvania Steel Box Car.

Suitable diaphragms between side and center sills appear every 3 ft. 2 ins. between the needle beams. The diaphragms are 3 ft. 8 ins. apart between body bolster and needle beams. At each diaphragm a suitable spacing diaphragm is interposed between the members forming the center sills. The needle beams are composed each of two members or diaphragms which taper from the full depth of the center sills, viz: 20 ins., to the side sills, viz: 6 ins. A cover plate 5 ft. 9 ins. long is riveted to the upper surface of the needle beam diaphragms. Four longitudinal diaphragms are placed in the center of the car, joining the transverse diaphragms at this point. These transverse diaphragms are 4 ft. 6 ins. apart under the side doors at the center of the car.

At a suitable place, and as far as possible removed from the contamination of dirt, dust and grease, boards are secured to the diaphrapms so that defect cards may be tacked on as required. High up on the side doors and on the ends of the car wooden pieces have been applied for tacking on the various routing cards used on the journey.

The roof of the car slopes from the center so that the fall amounts to 4½ ins. at each eave. Wooden running boards are affixed to the roof and these overhang 13½ ins. on each end. The running boards, made of three strips of wood, have a total width of 18½ ins. The side posts are pressed steel channel shapes and are anchored to the bulb-angles by a rivet passed through the bulb-angle and the turned-in end of post. The 6 x 4-in. angle member of the side sill is riveted to a



End View of P. R. R. Steel Box Car.

bent angle which also secures the cover plate which makes each side post practically a box in section.

The truck is of the ordinary diamond pattern with pressed steel bolster 15½ ins. deep at the center and 7⅜ ins. at the ends. The lower edge of the bolster is curved, and with empty cars the top of the bolster is 26½ ins. above the top of the rail. The truck springs at each side are two nests of four-coil springs each. The axle is a No. 7 and has a journal 5½ x 10 ins. The spring plank is a ½-in. Carnegie channel, 8¼ ins. from the rail. It is riveted to the spring-seat casting at each end. The arch bars are 1¼ x 5 ins. and the tie bar at the bottom is 5 x ⅝ ins. The entire car is composed of metal with the sole exception of the boards for defect cards and route tickets and the running boards. Our illustrations show the side of a Union Line car and its appearance at one end. It is needless to say that these cars are practically fireproof.

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Be courteous always. Courtesy makes the rough places much easier and helps to smooth away life's little difficulties. Courtesy is a business asset, a gain and never a loss. Courtesy is one mark of a good railroad man.—Howard Elliott.

Envelopes

An envelope has served its purpose, as a rule, once and for all time, as soon as it is sealed and sent on its way with enclosures. The consumption of envelopes on a railroad for correspondence among the different departments alone runs into hundreds of thousands annually. A comparatively cheap item it is, too, reckoned by the thousand when contracts for stationery are made; but when this account is determined at the end of the year it results in some extremely interesting figures, especially on a large railroad. Cheap manilla envelopes of large and small sizes are usually furnished and they are used with an unlimited prodigality about the general offices and all over the line.

Efficiency experts apparently have not burdened their brains with this seemingly unimportant subject. They have delved into the affairs of all departments on money-saving errands, lopping off in one way and another in larger fields; but have frequently left the smaller features of cost severely alone. Generally, correspondence between the different departments lays no claim to privacy and, therefore, need not, necessarily, be sealed. Documents and papers relating to current business are referred here and there by the president, general manager or heads of departments and the recipients may in turn be obliged to refer them to subordinates for their attention and reply. Finally all the correspondence comes back to its original source by the same channel through which it was started. All this may require the use of a dozen or more envelopes, which once having served their purpose find their way promptly to the waste basket. During the day, in various directions, hundreds upon hundreds of these manilla wrappers are put in service in the same way and help to swell the accumulation of old paper, while the monthly stationery bills show the expense involved.

The unfillable bottle was invented for a certain purpose and has proved its worth; but no fillable envelope which would serve its purpose in the opposite direction seems to have ever been considered. Here then is an opportunity for some clever individual to set his wits to work and in a direction which will be of profit to himself as well as the railroad company which may adopt the device when properly put on the market. If this idea has never been suggested why may not some of our readers take the matter up seriously as herein sugfested. Writing across the face of an envelope will permanently deface it so that it is unfit to use a second time. This is the main feature to be overcome.

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A Question of Loyalty

Senator Underwood, it is reported, has remarked, referring to the railroads, the Interstate Commerce Commission and the idea expressed that the Commission ought to be enlarged, that it is time business stopped serving 49 masters. Presumably he referred to the 49 states of the union. It is certainly true that the railroads today are under the tutelage of that many masters to whom, by law, they report and under whom they exist.

The Bible does not allow but one master. In case two direct one's affairs, there arises the proposition that he must love but one and consequently hate the other. If love and hate are sentiments in vogue today among the railroads, and they must be so far as their masters are concerned, it is time that regulation of the railroads be so unified that state and government interests will not conflict.

Sources and Methods of Manufacture of Rubber

Some Little Known Facts Bearing on the Principal Material of Air, Steam and Water Hose, Gaskets, Insulation, etc.

The hotel guest, who found serious fault with the management when he discovered a piece of rubber tire in that familiar mixture known as "hash," with which he was engaged, was promptly satisfied upon being told that "the automobile is gradually replacing the horse." And thus we see how rubber is coming into more than ordinary vogue. Its general use is almost as elastic as the nature of the product.

From the rubber eraser on the end of a lead pencil to the rubber mat, the automobile tire and that all-important necessity—the air brake hose—is a varied line of daily requirements which few people stop to think about. Rubber is quite as important a necessity in the world today as copper, iron or any of our table requisites, such as sugar or bread. It is a staple, a sort of staff of life, so to speak; an article which we cannot do without, unless some clever genius can substitute for it a synthetic compound or introduce something equally good by the exercise of his talents.

Of course, everything is possible now-a-days, and the time may come when dire necessity—our great mother of invention—will force us to employ a mixture which will entirely supplant what we now know as rubber. In our imagination, then, let us visit the source of this important need; spend a moment in the countries and among the trees or plants which bring it forth, and afterward consider the details involved before it is finally offered in the markets of the world for specific use. We will thereby learn that before one can look for a pair of rubber boots, a rubber coat or a lead pencil tip he must await patiently until all the details of their manufacture have been carefully worked out. It is the milk-like juice, or, more properly, "latex," which is the foundation of them all. The latex of the best rubber plants produces from 20 to 50 per cent of rubber, and the rubber of commerce comes from the rubber trees of South and Central America, and also from certain sections of Africa and Asia.

It might be said that Columbus discovered the rubber tree and the secret of the commercial value of rubber. At all events, soon after his memorable voyage Indians were found in some places in South America who played ball with a resilient substance produced by the coagulation of the juice from rubber plants. Hence the name, presumably, of Indian or India rubber, by which it is known to this day.

We must go to South America to secure the best rubber, which is commercially named Para. It is so called on account of the port of Para, at the mouth of the Amazon River, from which rubber was first, and now is, exported. The Amazon Valley, Peru, Venezuela, Bolivia and Brazil furnish all the so-called Para rubber. Other qualities, but inferior, bear the names of Ceara, Ule, Mangabeira, Assam and Lagos, depending upon the districts in South America, Mexico, Gautemala, Asia and Africa from which the rubber comes. In addition to these there are produced a great variety of inferior rubber. Plantation rubber (especially cultivated) is a name applied to the product which comes mostly from Ceylon, Singapore and Sumatra, where the trees have been grown from seeds brought from Brazil.

The methods employed to produce this very important commodity are substantially the same, however, in all these countries, and, what was once an interesting curiosity, is now an indispensable article of every-day use, developed as civilization has advanced and requirements have demanded. The toy ball, the air brake and the steam pipe hose, as well as other useful products depending upon rubber, all occupy places in the commercial world, where prices fluctuate with demand.

The rubber trees or plants are not, as a rule, tapped until they are well along in years, say, 12 to 15, and the tapping, when carefully performed, does not injure the tree. This operation somewhat resembles the method employed in securing sap for sugar from the maple tree. The milk or "latex" is then treated in such a way that, as different layers of it become coagulated, other layers are added by skillful manipulation, and the gathering is then hung out to dry, finally resulting in what are technically termed "biscuits." These are pure rubber. Many of us have doubtless observed that young housewives can produce a biscuit of dough which will find a stomach to digest it with quite as much difficulty as biscuits made of rubber might.

These biscuits are the raw material which is exported and comes to market to be used by the manufacturer in such way as the goods of one sort and another which he turns out may require.

"Wild rubber," so called, as distinguished from the plantation rubber, contains more impurities than its companion, but these are eliminated by washing and other treatments. Under analysis we find that the raw or pure rubber contains, in a general way, depending upon the district from which it comes: Caoucthouc, 75 to 90 per cent; resin, 2 to 12 per cent; proteids, 1 to 8 per cent; ash, 1 to 2½ per cent, and moisture, ¾ to 3 per cent. Caoucthouc is the main ingredient, and upon the preponderance of this depends the quality of the rubber, but until rubber has been vulcanized by heat and a union with sulphur, in proportions, it is of no practical use for ordinary purposes. Its resilience without such treatment is too pronounced, and it cannot withstand extremes of either heat or cold.

To Charles Goodyear we are indebted for inventing the process of vulcanizing rubber in vogue today. His first patent was secured in 1844, but, like most persistent geniuses, he died in poverty, while others later on enjoyed the fruits of his untiring industry. Unlike Virtue, Genius is not always its own reward.

At the factory the "biscuits" are sliced, then ground or mascerated and kneaded, until the mass resembles a huge sausage. It is later softened by heat and finally forced into moulds. The moulded forms are now cut into thin sheets and the sheets are fabricated into various articles of commercial use, after being vulcanized by the common processes adopted.

By employing textile fabrics, zinc in some cases and canvas of various grades, in combination with rubber, the manufacturer produces belting, hose, sheet rubber, mackintoshes and all the other rubber goods found in the market, including automobile tires and all the odds and ends used on a railroad and elsewhere.

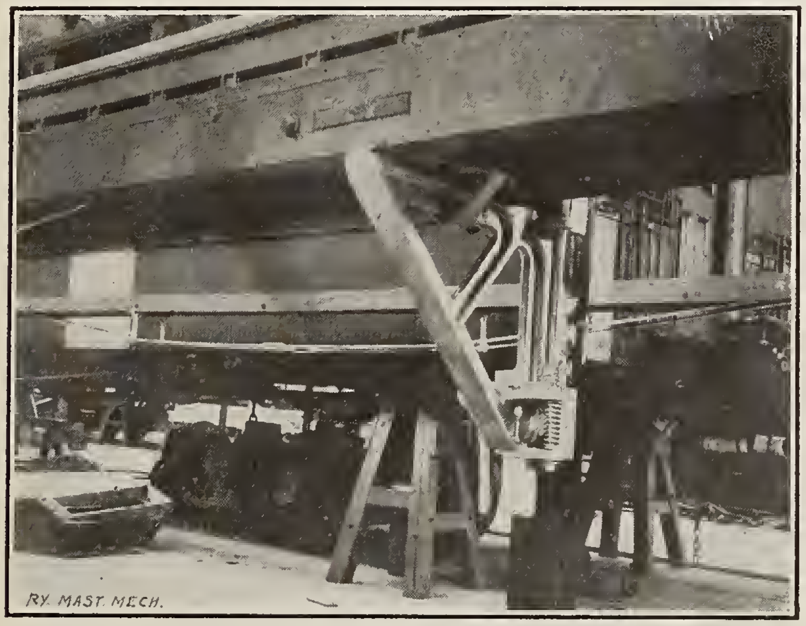
Today vulcanized rubber is used for insulating cables and electric wires. If the time comes (but it may not for many years, since the growth of the rubber tree is almost unlimited) when making rubber becomes a lost art, it will require genius of exceptional order to conceive something of equal merit to take its place.

Passenger Car Repairs on the Boston and Maine

The Equipment, Facilities and Organization of the New Shop at North Billerica, Mass., Where This Work is Concentrated

Since the comparatively recent building of the North Billerica shops of the Boston & Maine Railroad, all passenger car repair and painting work for the entire system has been concentrated in this one new shop. The experience of all the years of the road's history are embodied in its planning and equipment, and the results accomplished are of more than usual interest on that account. The shop as it now stands represents the often desired turning over of a new leaf, and building afresh from the ground up.

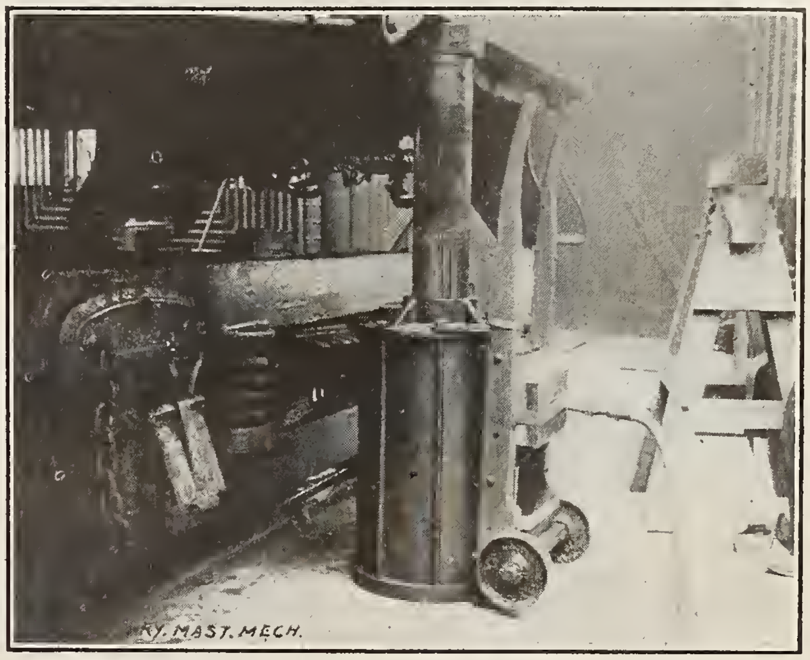
The shop is divided into three buildings; the first housing the machine shop and blacksmith shop, the second used for repairs to both car bodies and car trucks, and the third for car painting, inside and out. The last two, the car shop and the paint shop, each contain ten tracks long enough to accommodate three cars with space between for work on the trucks after they are run out from under the cars. Between the car shop and the paint shop is an electric transfer table serving both.



Bracket for Adjustable Staging

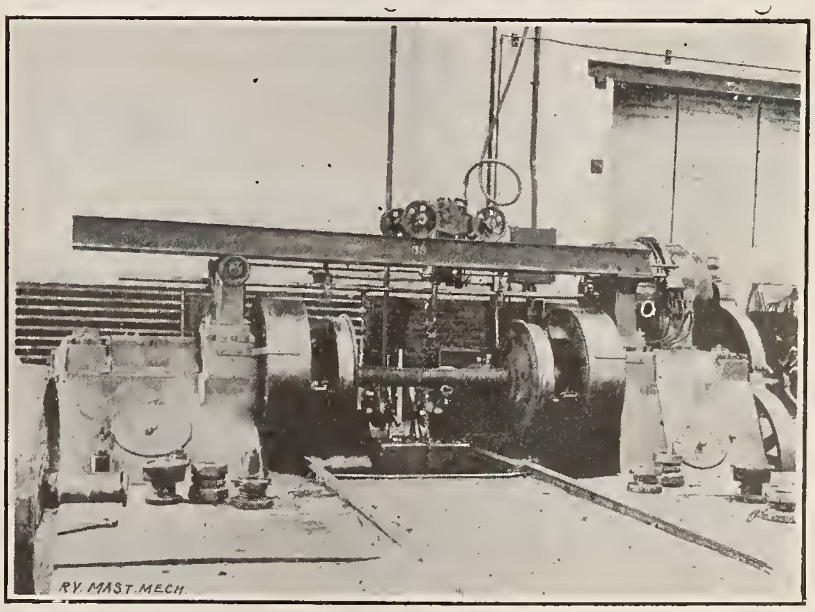
The repair shop and the paint shop are both equipped with adjustable staging that has been designed and made within the Boston & Maine organization, and has been adopted as standard for future work. Each "plank" of the staging is trussed, to give strength without unnecessary weight, and is supported by brackets from a vertical "I" beam post at each end. These "I" beam posts are 3 by 2⅜ ins. Notches about one foot apart are cut in one flange of each beam to support the staging, and the brackets are released to move up or down by withdrawing a pawl which engages in one of these notches when the staging is in use. Each pawl is so connected that it can be released from above or below the "plank," whichever is more convenient, and workmen can usually adjust the staging without leaving it. Counter-weights are provided to compensate for the weight of the staging, when it is to be moved up or down. A close view of one of the brackets is reproduced. The rod rising from the coiled spring can be pressed from above the "plank" to release the pawl or the small vertical hand lever just to the left of the bottom of the bracket can be used for the same purpose. Farther back in the illustration there can be seen the trussing of another "plank."

Cars to be shopped are delivered and stripped on the receiving track where they are thoroughly gone over and then set on three tracks in the paint shop reserved for washing. After being washed inside and out, a car is taken across the transfer table to the car shop, and run in on one of the ten tracks. As good judgment as possible is used in the placing of these cars on the tracks, to avoid placing of a heavy repair between a light repair and the door. After the car is placed, portable air jacks are used to lift it while the trucks are run out and horses placed to receive the car.



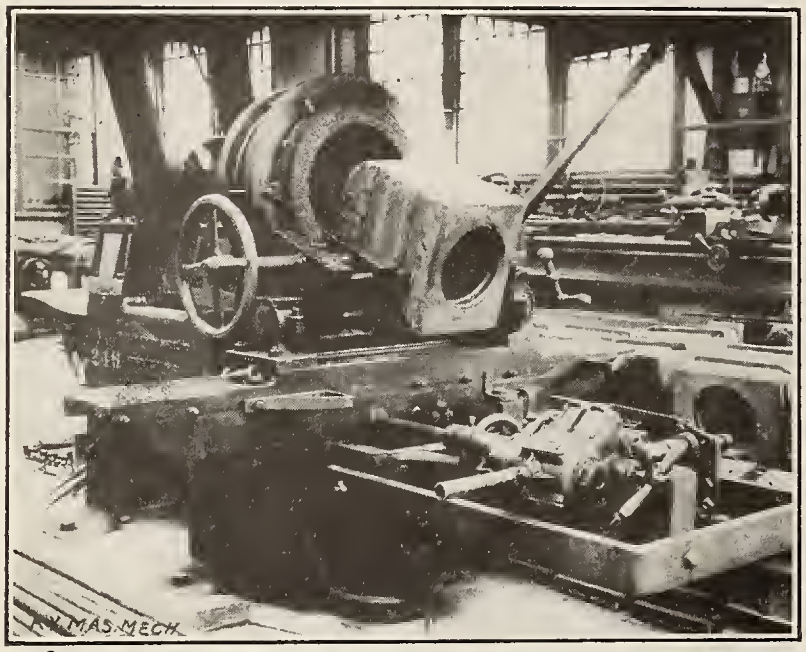
Portable Air Jack Lifting Car Off Truck

These portable air hoists were designed and built in this shop, and, as the illustration shows, are attached to hand trucks which make them very easy to shift from one part of the cement-floored shop to another as they are needed. Compressed air is available for each car position, and the time for coupling the air connection and raising a car is very short. While in use the jack rests on the broad base of the cylinder, and when it is to be moved, it is "broken over" to an angle, like a



Putnam Wheel Lathe With Air Hoist and Service Track hand truck, and is rolled on its own wheels to the next car to be lifted.

The trucks are run out between the ends of the cars, which are placed far enough apart on the track to leave plenty of room for the run out trucks, and the necessary work of the truck repair forces. The car body is

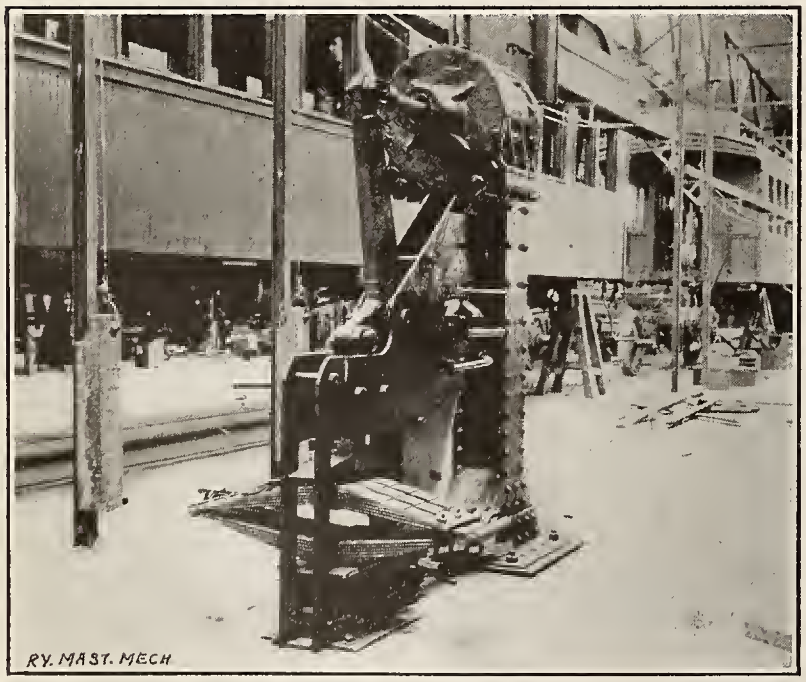


Journal Box Grinder With Air Motor Driven Table

now turned over to the body-repair forces, which are divided into two gangs, inside and out. When body and truck repairs are completed, the air jacks are again used to lower the car to its trucks and it is tested and delivered to the paint shop.

Small paint work is done in the repair shop, as soon as the car is far enough along to permit, such work including touching up and priming of repaired sheathing, etc., which can be done without interfering with the repair forces.

After the car reaches the paint shop, the first day it is cut in; the second it receives a coat of varnish; the

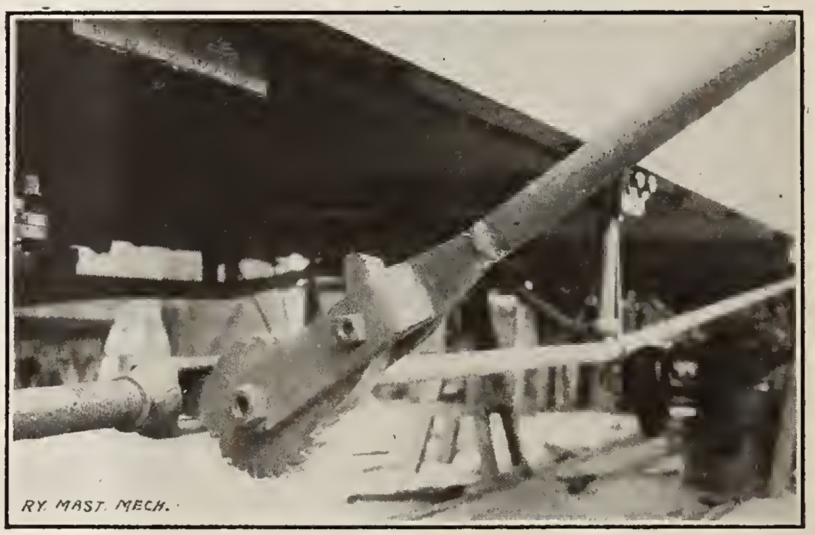


Spring Compressing Machine With Spring Compressed

third day the second coat of varnish is applied; the fourth day is devoted to trimming and the car leaves the shop. In case the paint is in such bad shape that a complete new coat of paint is required, one more day is allowed for the work. Where the paint must be burned off and entirely renewed, three extra days are required. This last time would also be consumed if new sheathing had been applied.

The machine shop is equipped with a 42-in. Putnam wheel lathe, illustrated, which has an air hoist for lifting and centering wheels, and for handling them to and from the lathe. Special driving chucks have been designed, which grip the wheels in such a manner as not to interfere with turning the tread or the flange. These chucks grip each wheel at three points, and have only one moving apart at each grip. This gripping dog is so placed that the greater the power required to turn the wheel, the greater is the grip of the dog on the wheel. No adjustments are necessary, and the gripping action is automatic in action and time-saving in results. This lathe not only takes care of the passenger car wheel work for this shop, but does this work for tender and truck wheels for the locomotive shop, and similar work for the outlying inspection points.

One of the features of this shop, which makes for efficiency, is the success with which turntables at intersecting points in the shop tracks have been avoided. One example of this is in handling mounted wheels to and from the wheel lathe. Wheels enter at one end of the shop, and to reach the lathe it is necessary to transfer them to an intersecting track which serves the lathe. The turning is accomplished by an air hoist set in a concrete pit beneath the floor. A bearing which will lift and steady the axle is mounted on the piston rod of an air cylinder in such a way that when not in use it lies flush with the floor. Then a pair of wheels is to be turned, the axle is run over this bearing and the air turned on in the cylinder by a foot-



Ratchet Lever for Tightening Turn-Buckles on Truss Rods

actuated valve, flush with the floor. The axle and wheels are lifted clear of the track and floor, and can be turned with one hand, and in almost no time at all.

In the machine shop there are also a Sellers car wheel borer, with automatic self-chucking attachment, two Bridgeford axle lathes, two Woods wheel presses with recording gauges, and the necessary drills, small lathes, threading machines, etc., to complete its equipment.

A "Safety" grinding machine for grinding journal boxes has been fitted with an operating mechanism that saves a great deal of the operator's time. The illustration shows a special chuck gripping the box, and in the foreground on the right an air motor can be seen which is connected by a pinion with a rack on the table of the machine to give the necessary reciprocating motion to carry the box back and forth across the abrasive wheel. The lever controlling the direction of travel of the air motor has been connected to an arm which rises next to the table, and two brackets, clearly seen in the illustration, are fastened to the table at opposite ends, which push the arm from side to side at the end of each stroke and reverse the direction of table travel by reversing the direction of operation of the air motor, rendering the operation of the machine automatic. This attachment enables the machine to grind a journal box every five minutes—floor to floor.

In the blacksmith shop, in addition to the regular passenger car repair work, all the safety appliances material for the freight cars of the whole road are manufactured. All forgings are also made here that are used in applying the twelve hundred steel sub-underframes that are being placed under wooden freight cars at all freight repair points as fast as that class of cars come in for general repairs. The actual underframes, that is, the steel center sills and bolsters, are

Corner of Plating and Lacquering Room

bought fabricated, but the needle beams, cross-ties, coupler yokes, brake reservoir and cylinder brackets, etc., are being made here and distributed to the points where the underframes are being applied.

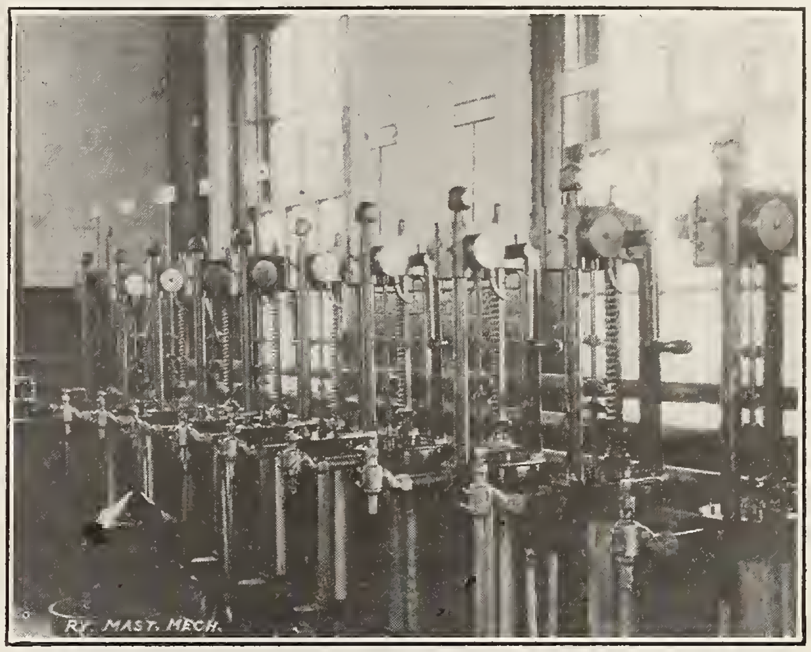
The blacksmith shop is equipped with seven double McCaslon forges, a number nine Ajax bulldozer, five-inch and two-inch Ajax forging machines, an eye-bolt bender and a one thousand pound Niles-Bement-Pond drop hammer.

The forces at work in the whole shop comprise 6 machinists and 5 helpers, 13 blacksmiths and 15 helpers, 7 pipers and 5 helpers, 8 upholsterers and 5 helpers, 6 tinsmiths and 1 helper, 6 cabinet makers, 34 painters, 14 washers, 11 men in the mill room, 3 in the lacquer room, 15 in the stripping and trimming gangs and 21 laborers. This force is turning out a minimum of five cars a day, general repairs and painting. The possibilities of the shop have not been realized since it was opened, as before it had been in operation long enough to realize its full capacity, reductions in forces to the present complement became necessary.

In the repair shop a simple and successful spring compressing machine has been built against one of the columns, consisting of an old driver brake cylinder with suitable levers. When an eliptical spring is to be placed in a truck, it is first taken to this machine, where it is compressed and a clamp, shown in the illustration, is fitted to hold it until it can be released in position. Another time saver in a truss rod turn-buckle tightening ratchet, illustrated, which consists of a ratchet wheel with a short lever to be inserted in the turnbuckle, and another lever containing a dog that engages the ratchet teeth. Over the end of this last lever a length of pipe can be slipped to give any desired length of lever.

The metal finishing room where plating and lacquering is done is shown in part, on account of the advantageous way in which it is laid out. Broad aisles give access to every tank and oven, and the room is unusually well lighted, both by daylight and by artificial light.

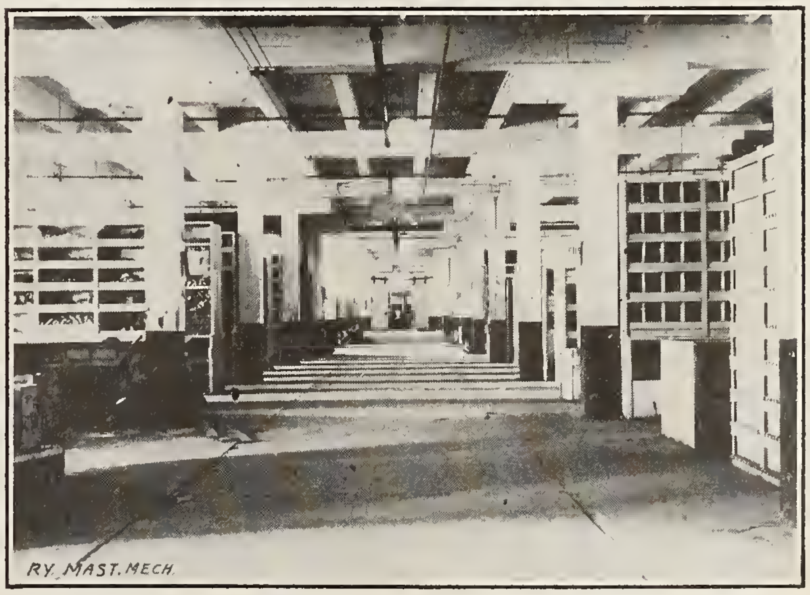
A view is given of one wall of the paint storage room, which is equipped with Bowser tanks and pumps.



Battery of Bowser Pumps in Paint Store Room

In the basement are braced and heated tanks for the storage of paints, oils, varnishes, etc., and registering delivery pumps not only keep an accurate record of the paint given out, but greatly reduce the fire risk, and give the room a fine clean, open appearance. Over each of the pumps, which line three walls of the building, is a plain card showing the contents of the connected tank, and making it impossible for errors to be made, between oils or varnishes similar in appearance, but differing in purpose.

Two views are shown of the storehouse, the first showing the broad clear center aisle, and the second, the

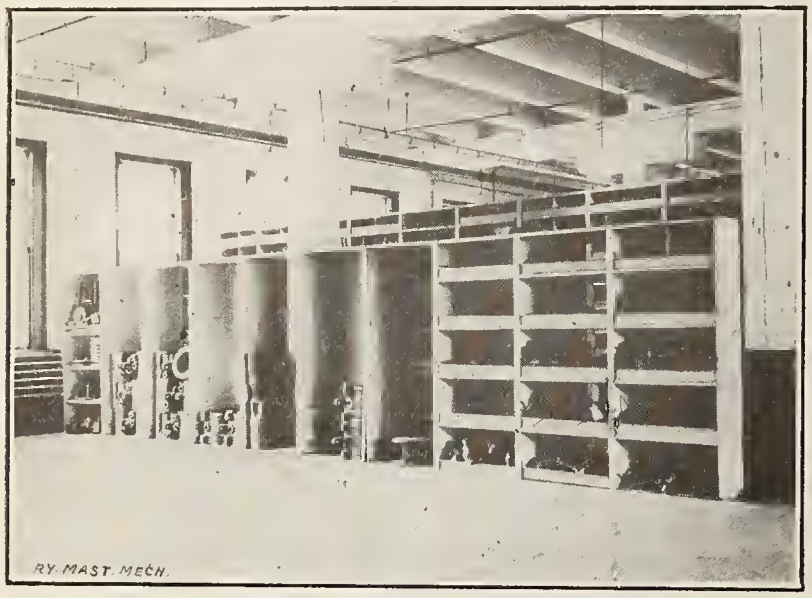


Wide Clear Center Aisle in Stores Department

arrangement of one cross section of the steel shelving. The whole stores department is equipped with this shelving, and any desired vertical spacing between shelves can be quickly made whenever it is advantageous to change the spacing. The room is light, and the equipment permanent and substantial.

The whole passenger car repair department is well laid out, and the freedom from congestion is one of the chief sources of efficiency. All the machines and equipment were new with the shop's construction, and are as admirably selected for the work as such unusually advantageous circumstances would suggest.

The writer wishes to acknowledge his indebtedness to the men who gave him every assistance in preparing this article, including the superintendent of motive power, Mr. Wiggins; the shop superintendent, Mr.



Section of Adjustable Steel Shelving in Stores Department

Jennings; the assistant superintendent, Mr. Nowell; the general foreman of passenger car repairs, Mr. Pynne, and the foremen and assistant foremen under whose supervision the work is going forward.

Tonnage Rating and Results Therefrom

Method of Computing Train Resistance with Cars of Mixed Capacity, Loaded and Light

The New York Railroad Club recently listened to some remarks by Mr. J. M. Daly, general superintendent of transportaton on the Illinois Central. The abstract here presented is in substance his idea on the matter. Tonnage resistance has factors; gravity, wheel friction, wind, temperature, speed, track and gross weight of cars. Light cars create more resistance, per gross ton, in curves, wheel friction, wind and temperature than heavy cars do, and allowances must be made for cars of different weights. Tests were made of 32 ordinary freight trains, the average weight of cars, per train, varying from 16 tons to 70 tons, and in only two cases was the average weight of all cars in trains the same.

The results obtained were on only three trains, but these three are representative.

At 15 miles per hour a 25-ton car has 7 lbs. of tractive power per ton; at 15 miles per hour a 50-ton car has 4¼ lbs. of tractive power per ton; at 15 miles per hour a 75-ton car has 3½ lbs. of tractive power per ton, hence it requires double the tractive power to move a gross ton of a 25-ton car, as compared with a gross ton of a 75-ton car, at a speed of 15 miles per hour.

At 30 miles per hour a 25-ton car has 9 lbs. of tractive power per ton; at 30 miles per hour a 50-ton car has 5½ lbs. of tractive power per ton; at 30 miles per hour a 75-ton car has 4½ lbs. of tractive power per ton.

These results represent the number of pounds of tractive effort required for each ton of the train, in order to keep it in motion, on straight and level track, at uniform speed, and in still air. It does not represent the pounds of draw-bar pull used on grades or in curves.

To undertake to equate the draw-bar pull of each car mathematically, would entail too much labor and delay to trains, at an initial terminal, hence it has been my lot to endeavor to perfect a device that would automatically equate and compute the draw-bar pull of each car in the train, making proper allowance for all fixed resistance.

To accomplish this, it was necessary to combine an adjusting device, with an adding or computing machine, in order that yard clerks may use it with speed and accuracy. Machines constructed on this basis, permit of indicating to a ton all the locatable resistance that can be obtained from the most accurate dynamometer car test possible, for the reason that the adjustment is positive, and in accord with the results obtained from such tests on that particular division. By locatable resistance, he meant the standard accepted factors, not the additional resistance due to defective equipment, soft track, wind, or weather conditions.

On a recent dynamometer test, made in Kentucky by the I. C. R., on draft gear appliances he took 25 new coal cars, equipped with one design of gear, and 25 with another, all cars being built at the same plant and the same week. These cars were hauled 453 miles in the same train. All the cars were loaded with the same gross tons of coal, hauled over the same piece of track by the same engine under similar weather conditions. With the University of Illinois dynamometer car, the 25 cars of one design of draw gear showed 7 per cent less resistance in curves than the other. This was clearly noticeable by the enginemen. No device, however, can detect such unknown factors.

To install this method it is necessary to know the number of feet, per mile, of the ruling grade. It is also necessary to ascertain the rating of the engines. This can be done by making two or three pulling tests with cars weighing approximately 40 tons each. If an engine hauls 60 cars of 48 tons gross, its rating will be 2,400 tons on the equating machine.

After the first rating test is made with the 40-ton cars, it is immaterial whether cars in future weigh 15, 20, 40, 60 or 85 tons each, and all mixed in the train. The machine is so adjusted as to cause it to equate and register the draw-bar pull of each gross weight of car in the train.

Mr. Daly stated as a matter of information that he did not wish to be understood as laying claim to the discovery of any new factor of resistance to a car or a train. His object was to present a simple, accurate and economic device that will permit an ordinary 40 dollar per month clerk to put into practical operation the results of higher technical knowledge of the subject, and the results obtained from the most thorough and accurate dynamometer test that can be made. Further, he desired to state that these same results can be obtained through the use of a printed chart, showing opposite the actual weight of each car, its equivalent tons in draw-bar pull to be used in lieu of actual tons. This plan, however, creates additional clerical expense and delay to train crews.

The tendency on roads, in recent years, is to provide automatic devices to reduce manual labor to the minimum—automatic stokers on engines, electric trucks in freight houses, computing and registering machines in local and general offices, all of which reduce the cost of the service, and obtain more accurate results for the company providing them. Why not provide the yard clerk with an equating machine, when you stop to consider that an accurate equating of your train tons will bring to you an increase of from 5 to 8 per cent? This in the direction of heavy traffic means a saving of from 10 to 16 per cent in train service, in addition to insuring accuracy and a more prompt dispatch of trains from important terminals. Every train that is permitted to move in traffic direction with 5 per cent less tons than the engine should haul creates 5 per cent of a train returning in the direction of light traffic, all of which should be saved.

There has been a constant evolution in the rating of engines in the past thirty years. Thirty years ago the standard capacity of cars was 30 tons, whereas today it is 50 tons. With all cars 30 tons each it was an easy matter to get them loaded nearly to their capacity, and the old basis of having an engine haul a given number of loaded cars, and base two empty cars as equal to one loaded car, was reasonably correct, until the new 50-ton capacity cars came into use, which made it impracticable and necessitated going to a gross ton basis for rating engines; this was about 1895.

During 1899, while I was with the Lackawanna, Mr. Daly said, we made tests, and before each I made a cigar bet with the conductor in charge of the train; he won twenty out of twenty-four tests, and then gave me his system of adjustment, which was to take into account the number of cars in train as well as the gross tons, and he demonstrated that with heavy cars he hauled more than his rating, whereas with light cars he stalled with less than his rating. This made it clear to me that it devolved on somebody to devise ways and means for computing the resistance of each weight of car, in order to enable the average yard clerk to give to each train its 100 per cent of tonnage, which accounts for my spending a lot of time working out this plan.

As officers in charge, it devolves on us, especially at this time, to know that every tonnage train, moving in direction of heavy traffic, hauls 100 per cent. It is clear from the writing on the wall, that the Commissions are going to devote more attention to economic operation of roads in future, as indicated at the recent 5 per cent hearing. The rate adjustment and competitive conditions having been in the past 10 years reasonably well-leveled up, future concessions will be obtained largely on the basis of "cost" of transportation.

Tool Foremen's Year Book, 1915

The 1915 year book of the American Railway Tool Foremen's Association has just been received. It is a clearly printed book of 140 pages, with illustrations. The officers for 1916 are: President, Mr. J. J. Sheehan, of the Norfolk & Western Railway, Roanoke, Va.; vice-presidents, Messrs. C. A. Shaffer, of the Illinois Central, Chicago, Ill.; J. C. Bevelle, El Paso & Southwestern, El Paso, Tex.; C. T. Brunson, Wabash Railroad, Decatur, Ill.; secretary-treasurer, Mr. O. D. Kinsey, of the Illinois Central, Chicago, Ill.

The association, now seven years old, was projected and established for the purpose of promoting higher efficiency in the railway tool service. Mr. Henry Otto, the retiring president, in addressing the meeting, said that the association had come to the point of standardizing and systematizing the methods of making tools, checking tools and the use of special devices and jigs in locomotive repair shops. To do this work means a gain for employers and gives a better basis for commercial contracts to the purchasing departments of railways.

Mr. B. W. Benedict, director of the shop laboratories of the University of Illinois, contributed a paper on the "getting the most out of the tools." The contrast, he said, between the ancient and modern forms of tools is so marked that little confusion results in distinguishing one from the other, or in separating obsolete from up-to-date practice, but the tool problem of today still lacks definite information about service, performance and cost.

"Special Jigs and Devices" was handled by Mr. C. T. Brunson. His paper is well illustrated and is a small mine of shop "kinks" and labor-saving devices which are easily made and when put in service are time and money savers. "Crosshead Shoe Babbitting Jig" was the subject taken up by Mr. C. Helms, of the C., M. & St. P. This paper is very clearly illustrated by line cuts and exemplifies his road's method of accomplishing results. Mr. Adolph Elkert, of the M., K. & T., followed with a paper in which he showed the M., K. & T. universal joint for flue cutting machines and a gang punch for jackets.

Mr. B. Henrickson, of the C. & N. W., read a paper on "Dies for the Manufacture of Piston-rod Nuts." Mr. Shaffer contributed valuable information in his paper on "Special Jigs and Devices," in which a number of devices were described and illustrated. The discussion which followed added considerably to the list. "Safety First" came next, being handled by Mr. R. D. Fletcher, of the Belt Line, Chicago. Mr. Gust Gstoettner, of the C., M. & St. P., followed, dealing with the same subject. Mr. George Nutt, of the C. & G. W., Oelwein, Ia., also took up "Safety First." All these papers supplied information concerning labor-saving devices and those with protective features for the handling of work by men in the shop. The discussion, which was a long one, brought out many more comments on and descriptions of devices of the same kind, so that altogether a wide field was covered.

The "Maintenance of Pneumatic Tools, Special Tools and Equipment for Same," formed the subject of Mr. J. J. Sheehan's paper, read by the secretary, Mr. J. C. McFarland, of the N. Y. C. & St. L., took up the same subject, and Mr. August Meitz, of the M., K. & T., handled the "Care of Pneumatic Tools." Mr. A. F. Baker, of the C., N. O. & T. P., continued the subject. Mr. E. V. Nabell, of the Southern Railway, closed the symposium on this important matter, which was the occasion of a lengthy and interesting discussion.

"Grinding Machine Tools" was the subject presented by Mr. G. W. Smith, C. E. O. R. R. Mr. J. B. Hasty, of the A., T. & S. F., and Mr. J. C. Beville, of the E. P. & S. W., took up the subject of "Distribution of Machine Tools," in two papers which brought out an instructive discussion.

The topics for discussion at the 1916 meeting are to be: 1, the heat treatment of steel; 2, special tools for steel car repairs and the reclamation of material; 3, special tools and devices for the forge shop; 4, emery wheels as applied to locomotive repairs; 5, jigs and devices for engine houses.

The year book may be had from the secretary-treasurer, and it is well worth perusal by those who are interested in the many labor-saving and safety-producing devices now in use in so many railroad shops on this continent.

In all ages and all countries, reverence has been paid and sacrifice made by men to each other, not only without complaint, but rejoicingly; and famine, and peril, and sword, and all evil, and all shame, have been borne willingly in the causes of masters and kings; for all these gifts of the heart ennobled the men who gave, not less than the men who received them, and nature prompted, and God rewarded the sacrifice.—The Stones of Venice.

Pacific Engines for Richmond, Fredricksburg & Potomac

Two High Speed Heavy Passenger Locomotives With 47,400 Pounds Tractive Force, With Unusual Frame Design and Special Materials and Equipment

The Baldwin Locomotive Works has recently completed, for the Richmond, Fredericksburg & Potomac Railroad (Richmond-Washington Line), two Pacific type locomotives which, in hauling capacity, are the most powerful of their type thus far constructed by the builders. The following table is of interest in this connection, giving the leading dimensions of six Baldwin Pacific type locomotives which each exert a tractive force exceeding 42,000 lbs.

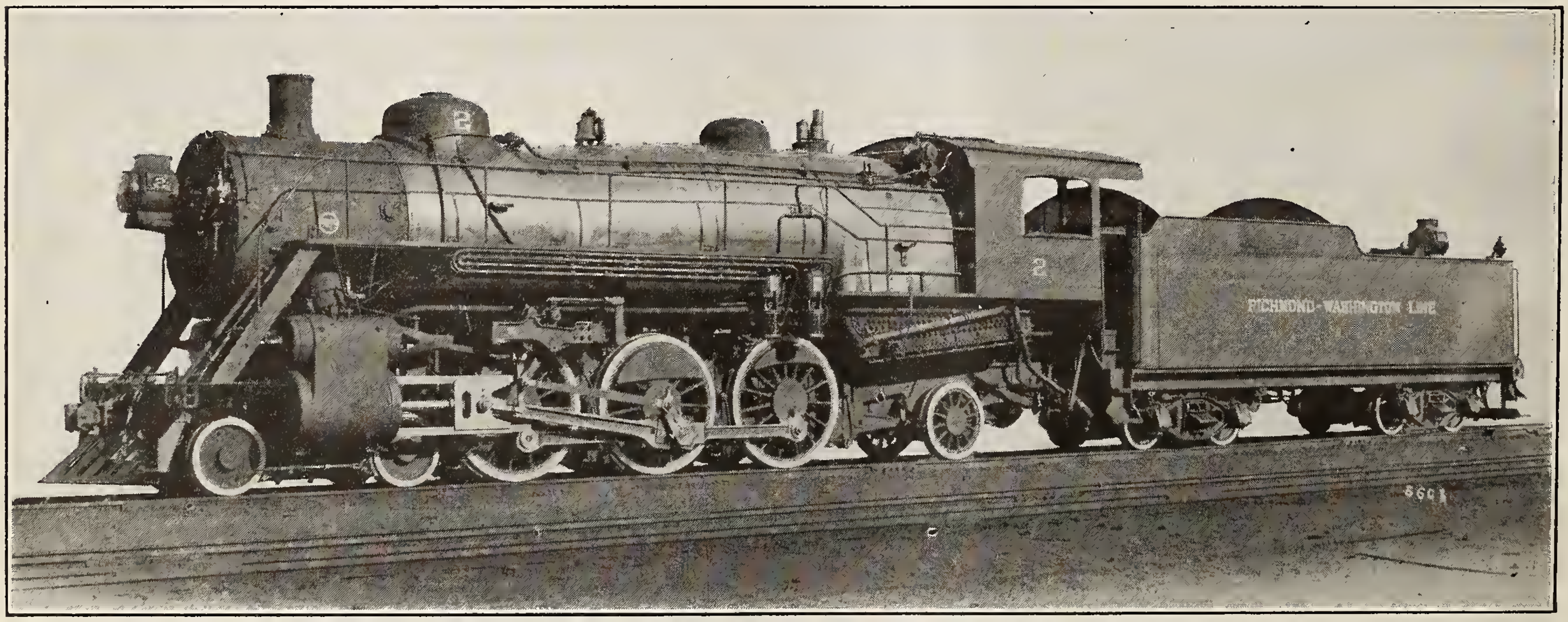
The Richmond, Fredericksburg & Potomac is a double-track line connecting the cities of Washington and Richmond. The distance is 116 miles, and besides local traffic, the road handles all the through northern connections of the Seaboard Air Line and the Atlantic Coast Line. Passenger trains, especially during the winter tourist season, are frequently very heavy, and are hauled at an average speed, including from two to six stops, at about 36 to 42 miles an hour. Including the new engines, four classes of Pacific type locomotives have been built for this service by the Baldwin Locomotive Works. Compared with the first of these, which were built in 1904, the new locomotives show an increase in tractive force of 82 per cent.

The boiler is of the extended wagon-top type, measuring 80 ins. in diameter at the first ring and 89 ins. at the dome ring. It is equipped with a Security sectional arch and a 40-element superheater. Among the details of construction may be mentioned the dome, which is of pressed steel, made in one piece, measuring 33 ins. in diameter by 13 ins. in height; and the longitudinal seams of which are welded at the ends and have a strength equal to 90 per cent. of the solid plate. A complete installation of flexible stay-bolts is used, and the front end of the fire-box crown is supported by three rows of Baldwin expansion stays. The fire-box is carried on vertical plates at the front and back, and the boiler barrel is supported by waist sheets at three intermediate points.

A Chambers throttle is applied, and the steam distribution is controlled by "Jack Wilson" piston valves, 14 ins. in diameter. The Baker valve gear is used, in combination with the Lewis power reverse gear, as furnished by the Compensating Specialties Company of Richmond. This device is operated by compressed air. The cylinder is supported in a horizontal position on the right-hand side of the boiler, above the rear driving wheels. Graphite lubricators are applied to the steam-chests.

A considerable amount of special material is used in the construction of these locomotives. The driving and engine truck axles are of heat-treated steel. Nikrome steel is used for the main and side rods, the crank pins, and the cross-head pins; and Hunt-Spiller metal for the cylinder and steam chest bushings, and piston and valve packing rings.

The main frames are of vanadium steel, 5 ins. wide, each being cast in one piece with a single front rail. They are spaced, transversely, 42 ins. between centers. The rear frames were furnished by the Commonwealth Steel Co., and are cast in one piece with the back foot-plate, trailing truck pedestals, radius-bar cross-tie, and other projections and braces. This constitutes an elaborate casting, with an over-all length of 15 ft. 4¼ ins. It has a slab fit in recesses formed in the main frames, and is secured to the latter, on each side, by 13 horizontal bolts, each 1⅛ ins. in diameter. Throughout the greater part of its length this rear frame, on each side, has a Z-section with walls 12 ins. deep and 1⅛ ins. thick. A transverse brace is placed over the rear truck pedestals. The holes for the engine-truck radius-bar pin, equalizing beam pins, etc., are bushed. The rear truck is of the Rushton type, with inside journals. In this design the truck swing links are pinned to a pair of yokes which constitute part of the equalization system, and these yokes are prevented from moving laterally by the truck pedestals. In the present instance, the pedestals are fitted, on each side, with renewable wearing plates 3-16 ins. thick. There is no cross-connection in the driving equalization system, as the driving and rear truck journals are in line; and the equalizing beams between the rear drivers and the truck connect directly with the spring hangers.



Engine of the 4-6-2 Type for the Richmond, Fredericksburg & Potomac
W. F. Knapp, S. M. P. Baldwin Loco. Wks., Builders

The main frames are braced transversely by the guide yoke, valve motion bearer and waist-sheet cross-tie; the last named part being a broad casting placed between the main and rear pairs of driving-wheels. The front and main driving pedestals are also braced transversely. The brace at the front pedestal is used as a fulcrum for the driving-brake shaft.

The arrangement of the running-boards and hand-rails is suggestive of the practice found in certain parts of Continental Europe. The hand-rails are placed outside the running-boards, the total width over the latter being 10 ft. 3 ins. A flight of steps leads from the running-boards to the front bumper. This arrangement adds materially to the convenience and safety of the engine crew, and reminds one of the practice of 35 or 40 years ago. Many of the engines of those days, not only had the hand-rail, as shown in our illustration of the 4-6-2 engine on the R. F. & P., but the old type had the front foot-plate guarded by a hand-rail outside the place for walking or standing. It was thus possible for a man to come out of one of the cab windows, walk along the running-board, cross the front foot-plate and return to the cab by the other running-board, and have a hand-rail outside of him all the way.

These engines are equipped with Schmidt superheater; superheating surface, 975 sq. ft.; gauge, 4 ft. 8½ ins.; cylinders, 26 ins. by 28 ins.; valves, piston, 14 ins. diam. Boiler—Type, wagon top; diameter, 80 ins.; thickness of sheets, 13/16 ins. and 15/16 ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial. Fire-box—Material, steel; length, 114⅝ ins.; width, 84¼ ins.; depth, front, 83 ins.; depth, back, 67¼ ins.; thickness of sheets: sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube, ½ in. Water space—Front, 5 ins.; sides, 4½ ins.; back, 4½ ins. Tubes—Diameter, 5½ ins. and 2¼ ins.; material, steel; thickness, 5½ ins., No. 9 W. G., 2¼ ins., No. 10 W. G.; number, 5½ ins., 40, 2¼ ins., 230; length, 20 ft. 6 ins. Heating surface—Fire-box, 232 sq. ft.; tubes, 3,942 sq. ft.; fire-brick tubes, 31 sq. ft.; total, 4,205 sq. ft.; grate area, 66.7 sq. ft. Driving wheels—Diameter, outside 68 ins., center 62 ins.; journals, 11½ ins. by 13 ins. Engine truck wheels—Diameter, front, 33 ins.; journals, 6 ins. by 10 ins.; diameter, back, 42 ins.; journals, 8½ ins. by 14 ins. Wheel base—Driving, 13 ft.; rigid, 13 ft.; total engine, 34 ft. 1 in.; total engine and tender, 72 ft. 4 ins. Weight, estimated—On driving wheels, 188,000 lbs.; on truck, front, 53,000 lbs.; on truck, back, 52,000 lbs.; total engine, 293,000 lbs.; total engine and tender, 472,000 lbs. Tender—Wheels, number, 8; diameter, 33 ins.; journals, 6 ins. by 11 ins.; tank capacity, 10,000 gals.; fuel capacity, 15 tons; service, passenger.

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The Commission, which is likely to be selected to investigate the Commerce Commission under the President's suggestion, will have a trying duty to perform when it sets out to get information upon which sound recommendations may be made, looking to improvement in the methods of regulating the railroads.

Comparative table giving important dimensions and specifications of six recent Baldwin Pacific type locomotives exerting a tractive force exceeding 42,000 lbs.

Road	Cylinders	Drivers	Steam Pressure	Grate Area	Water Heating Surface	Superheating Surface	Weight on Drivers	Weight Total Engine	Tractive Force
Chicago, Burlington & Quincy	27″ x 28″	74″	180	58.7	3,364	751	169,700	266,400	42,200
Erie	25″ x 28″	69″	200	58.	3,966	879	184,300	281,600	43,200
Baltimore & Ohio	24″ x 32″	74″	205	70.	3,936	833	166,200*	263,800*	43,400
Chesapeake & Ohio	27″ x 28″	73″	185	59.6	3,786	879	179,900	282,000	44,000
Carolina, Clinchfield & Ohio	25″ x 30″	69″	200	53.8	3,982	955	176,900	280,300	46,000
Richmond, Fredericksburg & Potomac	26″ x 28″	68″	200	66.7	4,205	975	188,000*	293,000*	47,400

*Weights estimated.

Proper Routing and Repairing of Equipment

Reasons for Making the Repairing of Owner's Defects Obligatory Rather than Permissive

It is generally admitted among men in touch with the subject of the proper handling of cars that the present practice for handling foreign cars by the transportation and mechanical departments results in great loss to the railroads. Under the present practice of using cars regardless of ownership it is of common occurrence that their absence from home lines is indefinitely prolonged. These are the opening words used by Mr. E. E. Betts, of the Chicago & Northwestern Railway, at a recent meeting of the Western Railway Club at Chicago. Mr. Betts went on to point out that these away-from-home cars run without proper attention from one road to another, their condition growing steadily worse until they become a menace to the safety of trains and dangerous to life and limb. They are then taken out of service. They may be patched up and sent home for the owner to rebuild or destroy, or perhaps that is done by the road having the car in its possession when it finally can go no farther, but in any event the owner pays the bill. Ordinary experience teaches us that neglect of whatever kind is paid for with compound interest.

The wear and tear on freight cars is heavy and depreciation rapid; for that reason the present policy of neglect of repairs to cars is not only inimical to the interests of all railroads, but it is wrong in theory and practice and wasteful in effect.

Some of the bad results directly chargeable to the failure to keep cars in repair are shown in the increase in per diem expense and empty mileage and in operating expenses, but undoubtedly the worst features are mechanical results which fall on the owner. He cannot secure the return of his cars that he may keep them in repair, even though he is able and disposed to do so, and others will not do it for him.

A car absent from the home line, say, six years becomes afflicted with what are then old defects, some of them owners' defects, others users' defects. The car is finally taken out of service and offered to the "home route"; that is, a link in the chain by which the car has a recognized right to return to the owner. The home route line rejects the car on account of its condition, and, pending a settlement of the question as to who is responsible for its condition and should make the repairs, it is held at the interchange point until the per diem accruing thereon is frequently many times greater than the cost of the repairs would amount to. In other cases, especially in large terminals like Chicago, the failure to inspect and properly repair cars and the attempt to pass them from one road to another in defective condition creates a heavy terminal expense where belt lines are used as intermediate links, and greatly increase the per diem earnings of idle and unserviceable cars.

The failure to keep cars in repair applies to all railroads in greater or less degree. Probably no railroad is free from that charge. In some cases it is undoubtedly a studied policy; in others it is chargeable to a lack of facilities, indifference and carelessness of employes, and various other reasons, but under any circumstances it is a mistaken policy, because what injuriously affects one injuriously affects all. One of the fundamental principles of the Master Car Builders' Rules is that "Each railway company must give to foreign cars, while on its lines, the same care as to inspection, oiling, packing, adjustment of brakes and repairs, that it gives to its own cars." This virtually makes the attention which a road gives to its own cars the standard for that attention it shall give to foreign cars. If this is a declaration of principles, it is open to interpretation by the individual; it is of little or no value for the government of such interests as are combined in this statement and which the Master Car Builders' Association is supposed to protect and to properly provide for. It may be that the latitude conferred on the individual recognizes his rights above all others, and this perhaps is as it should be, but one cannot make a fixed rule that will slide, and following out this line of thought suggested by these contradictory terms, we must conclude that rules intended to govern a community of interests must, in the nature of things, be abortive if subject to the will and caprice of the individual, and it must go without saying that such rules would better be rubbed off the slate.

The Master Car Builders' Rules make owners responsible for and chargeable with the repairs to their cars necessitated by ordinary wear and tear in fair service, so that defect cards will not be required for any defects thus arising, and if we are able to construe this rule properly it is based on the idea that cars having defects that owners are responsible for may be returned to the owners for repair, and here we believe is the cause of all our difficulties where the mechanical department is involved, because it virtually permits railroads to avoid making repairs to cars and permits them to be sent home for that purpose. This seems to be a fatal defect in the Master Car Builders' Rules.

We reach the point where, in theory, a given rule is just and equitable, while in actual practice the rule works hardship and loss. This state of things caused the creation of the Arbitration Committee. The theory of the proximity of owners' connection lines works out well on coal cars and others having owners in Chicago. It is quite apparent that under such conditions of operation the theory is correct and logical, but when the actual practice is pictured on box cars as we see them shown in car accountants' offices, then we appreciate the fatal defect in the M. C. B. Rules on account of these rules not containing a positive and definite order that proper repairs must be made.

Box cars are loaded promiscuously by railroads which have no direct connections at Chicago. When they enter the Chicago territory they are pooled, loaded anywhere and everywhere, and their absence from owners covers long periods. The result is that cars lose the channels of "home" except by circuitous routes resulting in excess mileage, plus the unwillingness of each handling line to repair them, each railroad basing its justification for the refusal to repair cars upon the short period the cars are in its possession. The long period of absence from the home line soon forces the cars under the sheltering wing of M. C. B. Rule No. 120 and is nothing more than "let the other fellow do it," but he does not do it. In large terminals like Chicago some one should have arbitrary power to schedule cars for repairs under Rule 120 and see that they are properly made. Then the theory and practice under M. C. B. Rules 1 and 120 become consistent and effective.

Another principle fully set forth in the Master Car Builders Rules is that cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge. The owners must receive their own cars, when offered home for repairs, at any point on their line, subject to the provisions of the rules. A car may be in safe condition to handle, but not be in condition for service, and here is another defect in the Master Car Builders' Rules. This rule is open to criticism as being indefinite. It confers a latitude upon the receiving road which everybody recognizes as being eminently proper. If, for any reason, it does not wish to accept the car, there is no standard of principle in such a rule, and it can only result in endless disputes, delays, useless expense, and just as soon as a road appeals from the decision of the receiving line it takes away the right conferred by the rule, and the rule then becomes void.

It is a truth that the mechanical department is involved in a practice which results in great waste to railroad property, because it neglects to make proper repairs to cars. It is also a truth that the transportation department is involved in a greater waste by the present method of handling foreign cars whose movements are not hampered in any way by mechanical restrictions. We refer now to the practice of making foreign cars follow what is known as the home route. Illustrations are not wanting to show that the amount of unnecessary mileage incurred by railroads in moving cars in an opposite direction from home in order to get them home is so enormous as to be almost beyond belief. The colossal proportions of this waste is beyond our ability to accurately determine or even approximate.

Among the many cases which serve to emphasize the point is that of a car which was loaded for Toledo, Ohio, via the Pere Marquette at Milwaukee. The car went to destination, 340 miles, and when empty was returned to the delivering line at Milwaukee. At Toledo it was about 660 miles from an interchange point with the owners. When it returned to Milwaukee it was 1,000 miles away. This car was received from the Rock Island and returned to that line at Kansas City. Then it was 1,500 miles away from home. The Rock Island rejected the car on account of its condition, and it was hauled back 300 miles to shops in order to make repairs, and then the car was 1,200 miles away from home. After repairs were made it was hauled empty to Moline, Ill., and delivered to the Rock Island at that point. Then it was 1,200 miles away from home. Each road gives the wanderer a lift which sends it farther away from home.

The present practice of handling empty foreign cars in an opposite direction from home instead of keeping them moving in a homeward direction according to their initials is not justified by any requirement or necessity the railroads are called on to deal with. This is a railroad proposition in which all the railroads are interested. They are all suffering from a lack of co-operation, and a failure to protect their interests, and these practices will have to be entirely abolished if we are to bring about changes necessary to prevent a continuation of the great losses we are now talking about. The speaker continued, we have asserted that if we are to secure proper and unrestricted movement of cars and be able to employ them to their fullest extent, they must be kept in repair by the mechanical department. This seems to be a simple proposition, and as repairs that owners are responsible for can be charged with a profit to the road making them, the work should be done; otherwise the cheapest, best and most rational thing to do, before the car becomes in a dilapidated condition, is to send it home direct to the owners and let them repair it. The judgment of the mechanical department is accepted by the transportation department in all cases where the safety and serviceability of cars is concerned. This is as it should be.

Cars offered in interchange under load not in serviceable condition should have the load transferred and the empty returned to the delivering road, but if the transfer of the shipment is impracticable some arrangement should be made to send the car through to destination, and when unloaded, if wanted for a return load or a load in another direction, the road using the car should make the necessary repairs or should return it to the road it was received from to send it home. There should be a standard of excellence for a freight car which should govern inspection, regulated by well-defined mechanical rules containing no obscurities or uncertainties. The remedy for the troubles that afflict the car supply is to be found in the movements of empty cars in a homeward direction by the shortest and most direct route. The practice among railroads is now, and has been for many years past, to indiscriminately use foreign cars without regard to ownership. When a road allows its cars to be loaded to points on other roads it surrenders all rights of ownership in them, except the right to pay for repairs and the right to collect the per diem earnings so long as there is a demand for their service on other lines.

When there is no demand for the cars the roads having possession of them are willing to recognize the rights of ownership, but they do not make any attempt to return them to the owners direct. In their desire to stop the per diem earnings on the cars and reduce that expense they deliver them to the roads they were received from, unless it is more convenient to do otherwise.

The traffic distributes the cars, and the problem is to redistribute them to their owners. This involves to a certain extent the movement of empty cars to equalize load movements, but it is not necessary that all foreign cars should be returned empty. The majority of box cars can and should be loaded, but we will probably not get away from the obligation to move a certain per cent of the equipment empty, as that would seem to be at all seasons necessary not only to prevent railroads from being short of cars, but to avoid congestion on other lines.

Huge Train Movement Explained

It is reported that the Pennsylvania Railroad moved between 185,000 and 190,000 cars over its Middle Division during the month of September, this being the greatest car transfer in the company's history. The real magnitude of such a movement is but vaguely expressed in the large figures given for the reason that we have become so accustomed to large figures that a few hundred thousand, more or less, make little impression upon us. However, the vastness of this achievement may be better emphasized by the following popular illustrations, their manifest absurdity supplying their own apology.

Suppose these cars were 188,000 in number and all were made to pass by a given point in thirty days (September), each car would have but 13.7 seconds in which to make its transit. Assuming that each car was 35 ft. long, and all cars were coupled up into one train, the length of train would be about 1,262 miles. With the caboose, in New York City, the engine would be in Des Moines, Iowa.

Assuming a two-cylinder locomotive having 30 ins. stroke and 56 ins. driving wheels, and carrying 200 lbs. working steam pressure, the diameter of cylinders would have to be 53 ft. each, to haul this train. The area of the heating surface would approximate about 62 acres. The grate area would have to be nearly one acre in size. If the fire-box was 72 ins. wide, and in order to burn sufficient coal to generate the necessary steam for moving this train, the fire-box would have to be about 1 2/5 miles long. After raking the fire, the handle of the rake or hook would extend back to the 207th car.

Using a good average kind of coal, and having the firing done economically, the fireman would have to throw 1¾ tons at each shovelful every three seconds. The advocates of the automatic stoker may therefore feel some encouragement. To feed sufficient water to the boiler, the injector pipes would have to be about 5 ft. in diameter, and both injectors would have to be working most of the time. If the engineman should whistle the flagman back, and if the sound would carry that far, 1¾ hours would have to elapse before the blast would be heard at the caboose and the flagman would drop to the ballast. Allowing 6 ins. total slack between cars (3 ins. in each direction), the total amount of slack would be 18 miles.

With the slack all extended, if the locomotive was to back up at the rate of 2 miles an hour, 9 hours would be required before slack was entirely bunched, and the locomotive would be standing on the spot where the 2,610th car had stood. At a sustained speed of 12 miles an hour, about 4 days and 12 hours would be required for this train to pass a given point. The switchman in his shanty would bid "Goodbye!" to the engineer Sunday night at midnight, and the shop whistle would be blowing for noon hour the following Friday before the watchman could shout "Hello!" to the conductor in the caboose.

Our Railway Securities Abroad

President Loree, of the Delaware & Hudson, has compiled figures relating to our railway securities held abroad, by investors, which are especially interesting, at this time.

On July 31 last, there were $2,223,510,229 of such securities in foreign lands. Since March 31 $480,892,135, out of $2,704,402,364.19 then held abroad, had been sold back to us, and strange to relate these were so readily absorbed as in no wise to disturb our markets. As a matter of fact, while this liquidation was going on, prices generally, on the New York Stock Exchange, advanced.

As the European war continues there will be a further return of securities; but figures which involve billions, in these days, seem to startle no one. Should every share of stock and every bond, held abroad, be sold back to us, they would all be absorbed here, without creating even a ripple on the great financial sea of the United States.

The harvest of friendship is gathered only by those who have sown the seeds of a kindly purpose and trust. Every man should have a fair sized cemetery in which to bury the faults of his friends.—Henry Ward Beecher.

The Use of Cast Wheels Under Freight Cars

Wheel Defects Defined and Causes of Formation Discussed Owners' Defects Distinguished from Those Occuring in Fair Usage

Not long ago the Niagara Frontier Car Men's Association listened to some remarks on the method and practices of handling chilled cast wheels under freight equipment, by Mr. J. P. Yaeger, of the Lehigh Valley Railroad. He believed that the wheel question was one of the most important features to be considered about the running gear of a car.

In the matter of shop inspection, whenever a wheel is received from the foundry a careful inspection has to be made for cracked chill, cracked flanges, cracked plates, thin flanges and other defects. It is the practice on the Lehigh Valley to take ten wheels of each kind at random and a sample of very fine borings of each wheel placed in an envelope with the number of the wheel and submit them to chemical analysis.

Wheels get their start in life when placed in service under the car and are guaranteed and expected by the manufacturer to outlive their service which is usually five years under fair usage. If the wheels fail to make this guarantee and have defects for which the manufacturer is responsible, such as worn hollow, worn through chill, seams, shelled out or cracked plates, the wheels are preserved after being pressed off the axle and at the expiration of the month, the manufacturer is given due notice; a joint inspection is then made by a representative of the foundry and the wheel inspector to determine what wheels will be replaced. Gentlemen from the foundries are usually "from Missouri," they want to be shown and it has sometimes been necessary to put the wheel under the hammer to convince them of the conditions.

When cars are received at an inspection point on the road, the car inspector should make a very careful examination for wheel failures, confining himself to M C B Rules 68 to 83. Worn flanges form a very important item with reference to safety for the reliability of the wheel flange is an exceedingly serious thing. The flange directs the truck and therefore one flange or the other is in almost constant contact with the rail and subject to friction or grinding under considerable pressure. This is especially true when traversing a curve. The continuous grind in the absence of lubrication results in flange wear. Worn flanges are usually the cause of many derailments that occur in the yard where cars are handled frequently. If the point of a switch is worn or if there is a slight opening at the point, between the two, a dangerous combination is formed and the wheel, owing to its worn condition, mounts or splits the point and the result may be a costly derailment.

Broken flanges are mostly due to seams which develop below the surface of the metal and this is termed a blue fracture and cannot be detected until the surface metal is broken through, disclosing the seams below. This defect is usually found to exist on wheels under the heavier class of equipment, and when striking a curve about two-thirds of the flange would break off. To make it more clear why this condition should exist more on the heavier class of wheels, it is his understanding that when the iron is poured into the mould, it first fills the lower part of the hub, then travels through the bottom plate and brackets, filling up the flange. The section of the mould forming the flange is thin and the upper part is formed by the metal chiller. It will be readily seen that the metal in the flange would be cooled somewhat by passing over the cold sand of the mould, and in coming in contact with the chiller. The more rapid cooling and contraction of the metal in the flange, as compared with that of the tread, tends to cause a separation or seam. As previously explained this is an inherent defect and develops much more quickly on the higher capacity wheels than that of the lighter capacity wheels for the reason that the contour and conditions being alike, the friction due to the increased load would bring this about so much sooner.

Wheels slid flat are easy to distinguish from worn through chill by observing the fine hair lines which are caused by the separation of the chill due to the friction between the wheel and the rail. This is a delivering company's defect and should be charged on a defect card when received from a connecting line.

Wheels worn hollow is the amount of wheel wear on the tread sufficient to warrant its removal from service. This is left largely to the judgment of the inspector. A good interpretation of M C B Rule 76, should provide for wheels being removed when worn sufficiently to permit the rim to sink far enough below the top of the rail to render it liable to breakage when passing over frogs or crossings or when the flange becomes so deep that the apex is likely to strike the bottom of flange-ways. It is the practice in track work to allow a minimum of 5/8 in. for flange clearance at the bottom of flange-ways in frogs, crossings and guard rails. This allows the tread to wear down 5/8 in. before the flange would strike frog and crossing filler. The minimum amount a wheel shall be allowed to wear hollow is not specified but it is generally conceded to be 3/16 in. In the Master Car Builders' Rules wheels may be allowed to wear down 3/8 in. before condemning them unless worn through chill. Wheels of the ordinary taper can become worn 3/8 in. from the original contour at the throat before they become worn hollow 3/16 of an inch.

In brake-burnt wheels the tread breaks into fine hair lines running across the tread, often covering a considerable portion of the circumference, and if kept in service the continuous pounding produced thereby causes the metal to drop out little by little. The shelled out spot is where metal has dropped out of the tread in such a way as to leave a raised spot in the center with a more or less circular cavity around it. Broken rims are usually caused by wheels being worn hollow or having seams or a hollow or "blowhole" edge outside the line of the chill.

A wheel worn through the chill. This is a maker's defect and can often be discerned by its appearance. If the wheel tread is worn irregularly, that is, deeper at some place or places than at others, or if worn flat it will be found that the chill has been destroyed. Breaking the flange off opposite a part where the wheel is worn, it becomes at once easy to determine the depth of the original chill. If the wheel had been slid it would make itself apparent by the discoloration of the chill.

In the discriminative care of wheels there is a dollar and cent side of the matter which should not be overlooked. An overzealous inspector could send many wheels to the scrap heap which have not reached their limit of usefulness. It, therefore, behooves car inspectors and repairers to study the subject and not only acquire correct ideas of what each particular defect is but to know the danger involved in permitting defective wheels to run. The wheel gauge and some common sense must be applied in determining whether or not any wheel should be taken out or kept longer in service.

In the discussion which followed Mr. J. M. Getzen pointed out that in the matter of handling wheels before using them which if attended to would prevent future trouble. He referred to the handling of wheels after they are mounted to be shipped from shops to the smaller interchange points, where the supply if stored on a track that is not spaced wide enough the wheel flanges of one wheel come in contact with the journal of the following pair and so on down the track. Each time these wheels are handled the movement dinges or damages the journal. Where there are no unloading devices a skid is used to run the wheels off the car. When skids are not available the car is placed at a point where there is not the necessary runway, the next thing to be done to unload the wheels would be to get a tie and drop the wheels onto it. This is bad practice, as there are many cases where the flanges are chipped, though not noticed immediately, but when the wheel is put in service the metal loosens up and there is a defect.

Mr. E. Howe said that the interchange inspector is placed with the Master Car Builders' Rules in his hands, and it may be mentioned here that there is a lot of difference of opinion as to defects of wheels. An inspector at one point may pass wheels which he considers perfectly safe and another man along the line will consider them as wheels that should be condemned. It is a matter of opinion very largely. As to the question about cracked plates, he thinks there are two reasons that may be assigned for that. It is more or less due to the metal in the wheel, and again due to heating caused by heavy brake applications.

Mr. George Gibson, referring to overzealous or careless inspection, said: It sometimes happens that a car comes into the shop chalked by car inspectors for defective wheels. After the car is jacked up and the truck removed, the wheelman inspects the wheels and finds them to be in perfect condition and does not allow the wheels to be taken out, as it is his duty to see that the company gets as much mileage out of its car wheels as possible, without running any risks. All this trouble and annoyance, because of inferior inspection, could be avoided by getting together all the inspectors about every month and teaching them the fine points about car wheels.

Mr. William Shone, vice-president of the association, read an extract from a paper presented to the Richmond Railroad Club by Mr. F. K. Vial, of the Griffin Car Co., as follows: The term "shelled out" refers to spots on the wheel where the metal has dropped out from the tread in such a way that a raised spot is left in the center, with a cavity more or less circular around it. In this case, in addition to the radial lines of cleavage, there is a cleavage parallel to the surface of the tread, and therefore the bottom of the defect is more or less smooth, somewhat resembling an oyster shell. The cause of shell-outs does not seem to be as self-evident as that of comby wheels. The conditions which exist and give rise to shell-outs arise from brake action.

The maximum air brake pressure is adjusted for the light weight of the car, hence wheels are not as likely to slide under loaded cars. Sliding often occurs just before a train comes to a standstill. This is occasioned by the greater efficiency of the brake shoe as the velocity of the wheel decreases. The greatest frictional resistance between the wheel and brake shoe occurs just as the wheel is about to stop revolving, and often at this point exceeds the frictional resistance between the wheel and the rail, in which case the wheel begins to slide. After the wheel once begins to slide the friction between the wheel and the rail is very much lessened, and sliding will continue until the brake pressure is reduced.

When the sliding is over a distance of only a few feet before the car comes to rest, the term "skidding" is applied when a small flat or skidded spot the size of the area of the wheel in contact with the rail is produced.

Mr. Shone said: You will find that a regular shelled out wheel always has a raised center and the metal has dropped out around it, while the brake-burnt wheel shows more or less a series of checks on the tread of the wheel.

Railway Trespassers

The Atchison, Topeka & Santa Fe has recently issued a warning to trespassers on railway property. It mentions that there were killed on the steam railways of this country 10,302 people last year, and that more than half of them—5,471, to be exact—were what are known as trespassers, intruders upon railway property without right. They included men, women and children, killed in various ways and under various circumstances. In addition to this large number of trespassers killed there were 6,354 who were injured in the same time and under similar conditions.

On the average, to bring the matter more forcefully to our attention, 16 trespassers are killed every day throughout the country and 17 are injured. In the past 24 years more than 108,000 people have been killed and 117,257 injured while walking upon tracks without right or boarding cars when they were moving. To bring the matter still more forcefully to our notice, let us imagine this great number of killed and injured in the past 24 years made up into an army, four abreast, in squads of eight, marching at intervals of five and one-half feet. To pass a given point this army, more than 42 miles long, thus arranged, moving uninterruptedly at three miles per hour, would require 14¼ hours. One's eyes would tire with this vast horde continually in sight. No parade, on any occasion, has been stretched out as long as this. The great German army which invaded Belgium in the early days of the present war was no larger, so that we can well appreciate what the Atchison is doing in the public interest when it urges more substantial laws and their rigid enforcement against this overwhelming army of what might be called peaceful invaders.

Women Work on Railways

During the war in Europe the managers of the railroads, who find it difficult to keep their roads running in the absence of their men, say that the women are employed in many departments of the business. They do manual work in the yards, and on one of the roads the women have worked so well that some of the stronger and more capable have been put to the cleaning locomotives. Enginemen are very careful of their locomotives, but the French engineers are quite satisfied with the way the women care for their machines.

Denver Joint Car Interchange and Inspection Bureau

By WILLIAM HANSEN, Chief Interchange Inspector

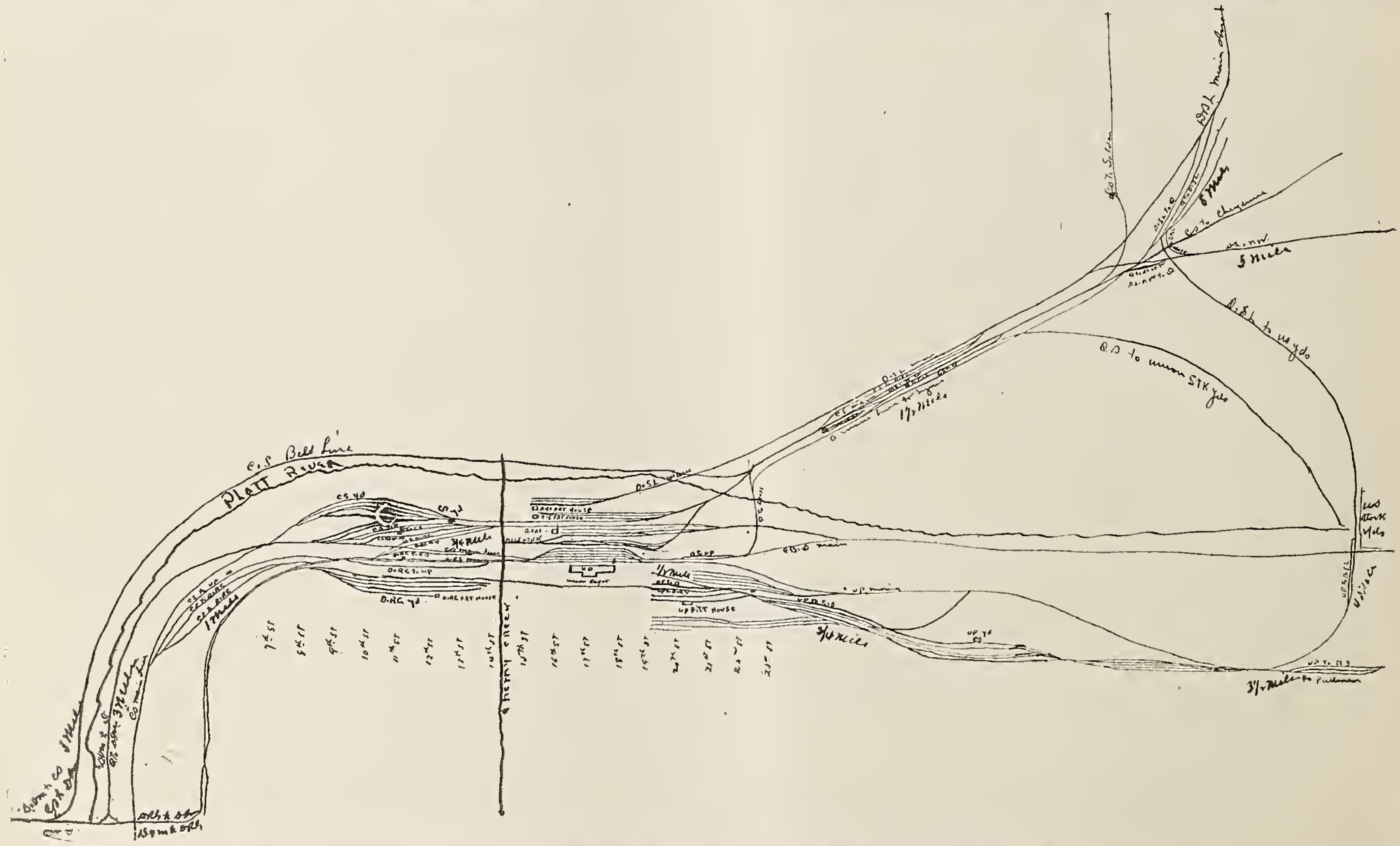
A Description of the Inspection Facilities and Their Effect on Reducing the Cost of Interchange Inspection and the Number of Cars Set Back

The Denver Joint Car Interchange and Inspection Bureau was organized March 1st, 1912, under an agreement signed by the management of all the roads interested, for the purpose of getting transportation and mechanical records of cars interchanged. The old Denver Car Interchange Bureau, which was merged with the new bureau, had been operated by a joint agent, who employed one stenographer, one messenger and eight interchange clerks. These employees were all relieved and the work complete is now being performed by the inspectors.

Previous to March 1st, 1912, mechanical inspection was made by each individual railroad through its own inspectors, and as nearly as can be ascertained at this time about twenty inspectors were employed in interchange work. These inspectors and the force employed by the Denver Car Interchange Bureau would make a total of thirty-one men.

The present bureau started with one chief interchange inspector, one chief clerk, one stenographer, one messenger and nineteen inspectors, employed directly by the chief interchange inspector. About thirty days later it was found necessary to employ an additional typist for the purpose of working out interchange reports at night, making a total of twenty-four men. After the new plan had been in operation a short time and had been thoroughly organized it was found that the inspection force could be decreased to thirteen men, making the average working force of inspectors and other employees a total of eighteen.

Inspectors at the various interchange tracks use form eleven (carbonized paper) for making original records. The first copy goes to the chief interchange inspector's office to be used in making up interchange reports on form ten for the agents, master mechanics and car accountants. This form ten is the same as form eleven except larger in size and filled out from form eleven on a typewriter. The second copy of form eleven is held over by the inspectors on transfer until the cars have been pulled by the receiving lines. The second copy is then sent to the chief interchange inspector's office to complete his reports. The third copy is secured by the agent of the receiving line, and the fourth copy goes to the agent of the delivering line. These two copies are deposited by inspectors in boxes marked for the various agents, whose messengers gather them at different times during the day. This form furnishes the agents with valuable information as to what through loads and industry loads are on transfer tracks, giving them a chance for quick car movement if so desired.



Sketch Showing Relative Location of Classification and Interchange Yard in Denver

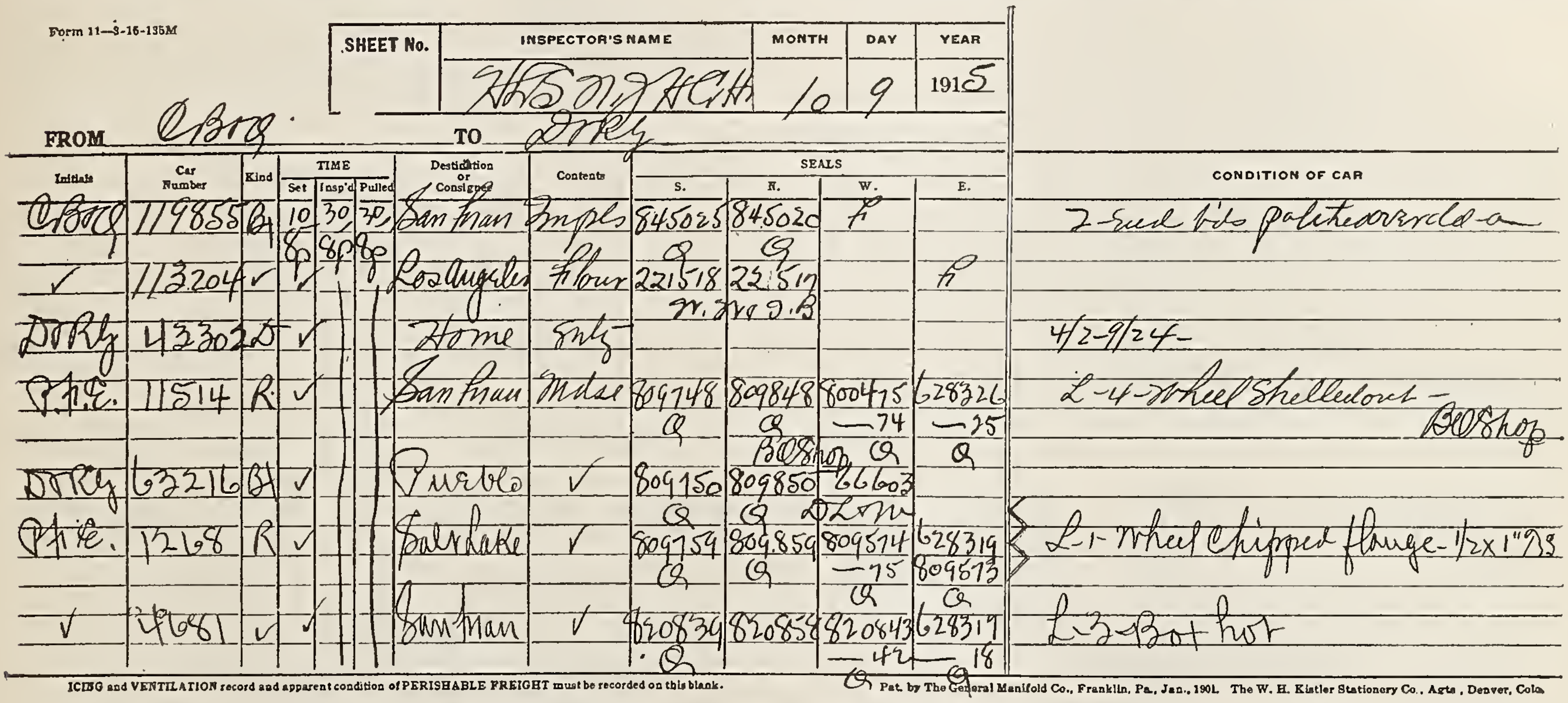
Interchange reports, form ten, are sent to agents, master mechanics and car accountants of the nine lines, not later than 7 o'clock on the morning of the day after cars are interchanged.

The bureau has its own telephone exchange connected with all yards as well as the city exchange. This is used by the inspectors to advise yardmasters and agents of receiving lines immediately after perishable or live stock has been delivered and inspected, so that they can arrange for prompt handling. Shippers and consignees also frequently call upon the bureau for information in regard to movement of cars consigned to them. They claim that being able to get this information through the bureau is of considerable benefit. In addition to the reports mentioned, the inspectors telephone yardmasters of all lines at seven in the morning, twelve noon, six at night and twelve midnight, giving in detail the cars and destination of cars that are on transfers for them at these hours.

The annual reports for the years ending February 28, 1913-14-15, show that there has been a considerable decrease in the number of bad order cars set back, as well as decrease in general cost of operation. A check was made of bad order cars set back for the month of February, 1912, one month previous to the organization of the bureau, which showed that 704 cars were returned to the delivering lines account bad order. A check was again made of the corresponding month in 1913 and the result found was that 189 cars had been returned to delivering lines, account bad order, during that period.

This decrease can be attributed to the fact that cars were handled by one set of employees, giving impartial inspection for all lines. It has been the experience for years that this is not possible under several sets of employees of individual railroads, it being hard to find two men of the same opinion covering defects on equipment.

A check was also made of the number of loaded cars interchanged which were transferred by receiving line account bad order during the last six months previous to the organization of this bureau, and it was found that 339 car loads of freight had been transferred. A comparison was made for the first six months under the new bureau, with the result of 128 loaded cars having been transferred account bad order. As the agreement covers the transferring of equipment particularly, and all the roads agreed to abide by the decision of chief interchange inspector, this evidently had something to do with the decrease in transferring of loaded cars, inasmuch as no transfer authorities are given unless it is impossible to repair equipment under load or where the delivering line is unable to furnish proper material with which to make repairs.


Form 11—3-16-135M

FROM C.B.&Q. TO D.&R.G.

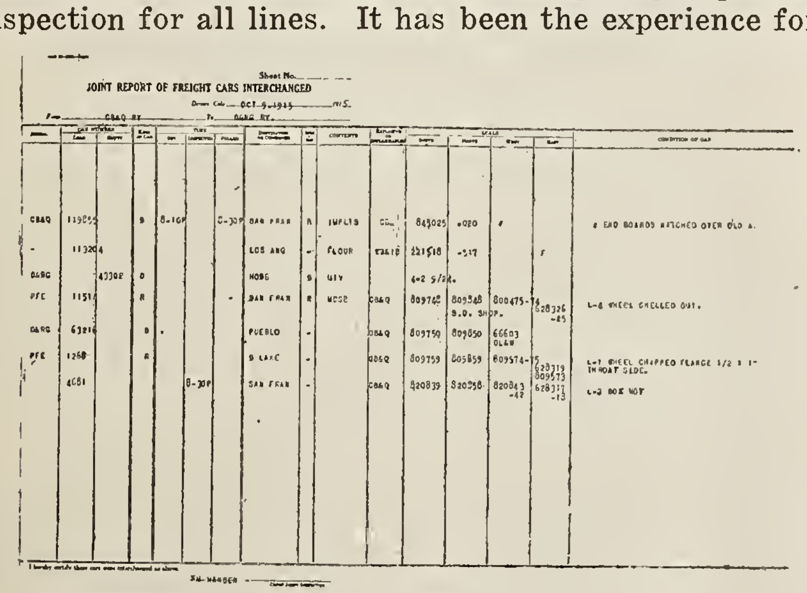
SHEET No.	INSPECTOR'S NAME	MONTH	DAY	YEAR
	[illegible]	10	9	1915

Initials	Car Number	Kind	Time Set	Time Insp'd	Time Pulled	Destination or Consignee	Contents	Seals S.	Seals N.	Seals W.	Seals E.	Condition of Car
CB&Q	119855	B	10	30	30	San Fran	Inpls	845025	845020	F		2-End bds patched over old-a
✓	113204	✓	8-10p			Los Angeles	Flour	221518 Q	22517 Q		F	
D&RG	433022	D	✓			Home	Enty					4/2-9/24-
P.F.E.	11514	R	✓			San Fran	Mdse	809748 Q	809848 Q	800475 —74	628326 —75 Q	L-4-Wheel Shelled out — BO Shop
D&RG	63216	B	✓			Pueblo	✓	809150 Q	809850 Q	66603		
P.F.E.	12168	R	✓			Salt Lake	✓	809759 Q	809859 Q	809574 —75 Q	628319 809873 Q	L-1-Wheel Chipped flange-1/2x1" [illegible]
✓	4681	✓	✓			San Fran	✓	820839 Q	820858	820843 —42 Q	628317 —18	L-3-Box hot

ICING and VENTILATION record and apparent condition of PERISHABLE FREIGHT must be recorded on this blank.

Pat. by The General Manifold Co., Franklin, Pa., Jan., 1901. The W. H. Kistler Stationery Co., Agts., Denver, Colo.

Form 11.—On Carbon Paper filled Out by Inspector


JOINT REPORT OF FREIGHT CARS INTERCHANGED

Form 10 Filled Out in Office From Form 11

From the three years' experience in operating the bureau it appears that the present system of operation of a joint car interchange and inspection bureau is entirely successful in all respects. It has, however, been found necessary at all times to give impartial decisions, strictly following the M. C. B. Rules, as well as Transportation Rules, and particularly the Articles of Agreement.

Bureau digest of annual reports for years ending February 28th, 1912, 1913, 1914:

	1912.	1913.	1914.
Total cars interchanged	513,612	477,093	496,952
Total expense of bureau	$25,353.82	$22,957.92	$22,052.37
Cost per car...........	$0.0493	$0.0481	$0.0443
Defect cards issued against roads........	4,765	2,158	2,795
Transfer and readjustment authority issued	375	224	62
Cars set back to roads..	6,381	3,558	2,395
Per cent of cars interchanged set back....	1.24	0.74	0.48

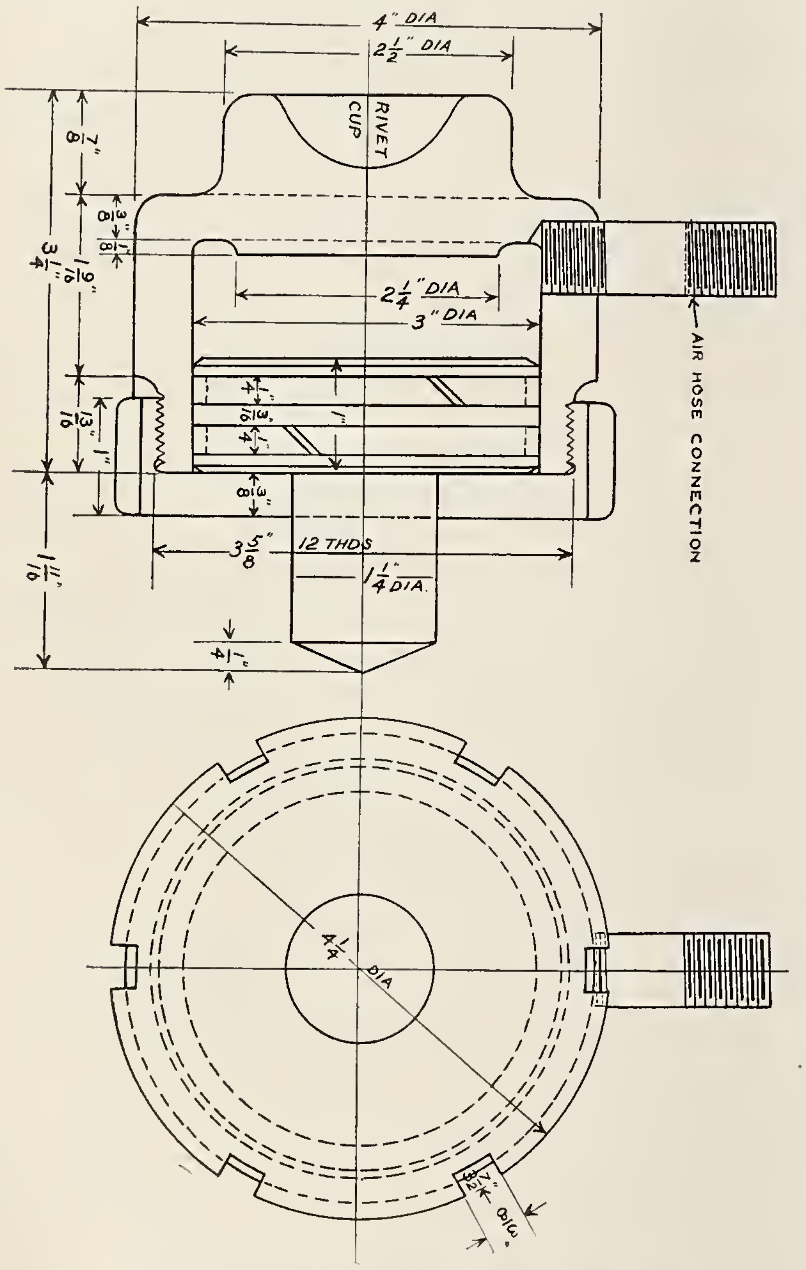
While men possess little and desire less, they remain brave and noble; while they are scornful of all the arts of luxury, and are in the sight of other nations as barbarians, their swords are irresistible and their sway illimitable; but let them become sensitive to the refinements of taste, and quick in the capacities of pleasure, and that instant the fingers that had grasped the iron rod, fall from the golden spectre.—Cambridge School of Art.

Practical Suggestions from Railway Shop Men

An Air Riveting Jack

By F. G. LISTER
Chief Draftsman, S. P. & S. Ry.

An air riveting jack, as shown in the accompanying illustration, is being used in the boiler shop of the Spokane, Portland & Seattle Railway, at their Vancouver, Washington, shops, for driving rivets into the crown seam of the fire-box. Boilermakers know the inconvenience and slow process used in driving rivets in the crown seam, where the space is limited and it is neces-



Section and Plan of Air Riveting Device.

sary to insert the rivet and clamp it in, during which time it is getting cold.

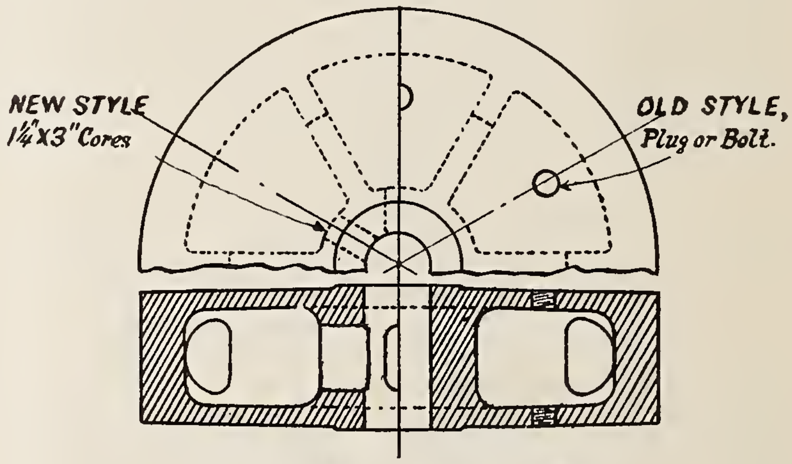
By the use of the air jacket, which is quickly adjusted to place, the rivet is driven while hot, and the jack quickly removed and ready for another rivet. No time is wasted, and about 75 per cent. more rivets can be driven in the same length of time than with the old method. The tool room should be equipped with about three of these jacks, each having a different length of spindle, to allow for the different spaces in water legs in boilers of various classes of engines. This might be taken care of, also, by using extensions of different length for spindles.

A release spring might be inserted back of the piston, which will automatically release the piston when the air is shut off.

Piston Heads

By A. H. WILTSHIRE
Draftsman A. G. S. R. R.

Several hours of labor are saved on each new piston head turned out of the machine shop. This should appeal to every efficiency man. The illustration represents a box piston head that has no holes to be tapped



Labor Saving Piston Head

and plugged. When the rod is in place it makes a good, tight fit that will not leak, and so carry core sand into the cylinders. The lightening core is supported through openings into the rod hole instead of by six or eight small cores through the face of piston.

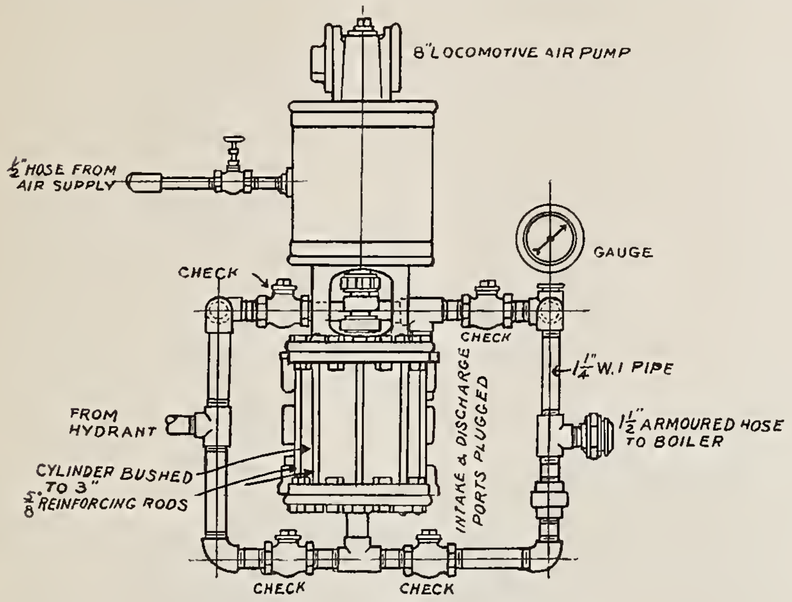
Hydrostatic Test Pump for Testing Locomotive Boilers

By F. G. LISTER
Chief Draftsman, Spokane, P. & S. Ry., Portland, Ore.

When the Rules of the Interstate Commerce Commission for the inspection of locomotive boilers went into effect in 1911 requiring locomotive boilers to have an annual hydrostatic test, it became necessary to provide some means for making hydrostatic tests with the least possible expense. It is not always possible nor convenient to have an extra locomotive in the roundhouse to furnish steam for pumping water into the boiler.

A very simple arrangement for making these tests has been in use in the Vancouver shops of the Spokane, Portland & Seattle Railway Company for over two years and has been the means of saving a great deal of labor and voided the necessity of tying up an additional locomotive. It consists of an 8-inch air pump equipped as shown in the illustration. The air cylinder of the pump is bushed to 3 ins. diameter and is used as the water cylinder. The air intake and discharge ports are plugged and in place of them 1¼ ins. check valves are used.

The water is fed into the boiler at hydrant pressure of 100 lbs. a square inch. When the boiler is full the air pump is started and run at 80 lbs. pressure in addition to the hydrant pressure. The desired water pressure may be obtained by throttling the air, and maintained until boiler is gone over and caulked. The time



Pump for Testing Boilers.

of running the pump varies from ten to forty minutes, depending upon the conditions of the boiler.

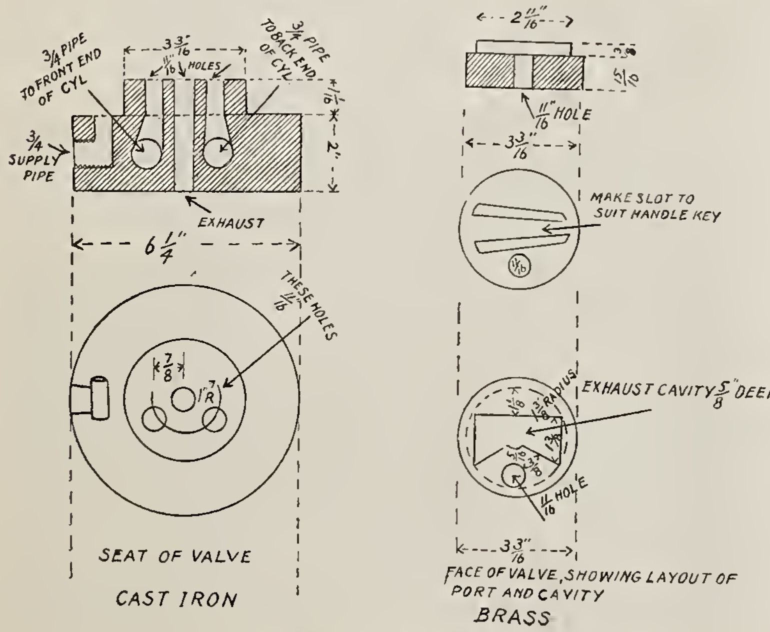
The pump is mounted on a two-wheel shop truck so that it may be readily moved to any desired position in the roundhouse, and tipped on end ready to be connected to the boiler. In the piping arrangement care must be taken to see that the check valves are put in correctly, otherwise the pump will run with no pressure. This arrangement may also be used for testing air drums or for any other test where hydrostatic pressure is required.

Rotary Four-way Valve

By E. H. Wolf

Air Brake Mach. A. C. L., Waycross, Ga.

Air cylinders are used about locomotives and car shops for power for a variety of bending, straightening and forming operations. Generally the air pressure is



Rotary 4-Way Valve.

admitted only on one side of cylinder, but in many cases it is used on both ends. In such a case two three-way cocks are used to admit air to the ends of cylinder. The valve here described takes the place of two three-way cocks and is easier to operate and does not leak. It is inexpensive to make; the only parts requiring finish are the valve and seat, and for this reason they are the only parts shown on the sketch.

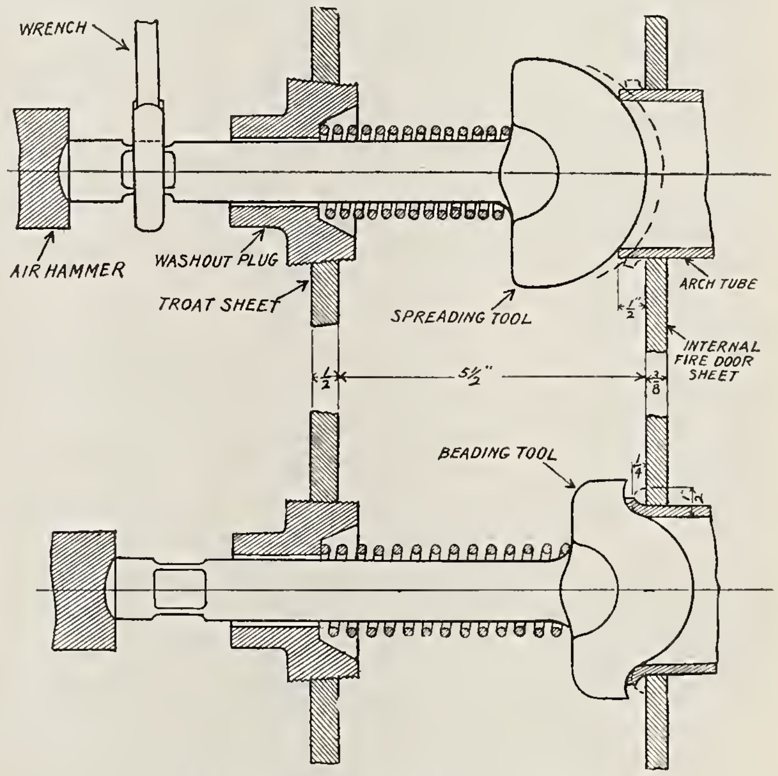
The valve may be used with the cover, key and washer, gasket and handle of Westinghouse G-6 engineer's brake valve, which is in general use. The valve seat is cast on, the valve being made of brass. The supply ports through both are 11/16 ins. diameter. The valve is so placed on its seat that in its central position the supply port is between the two cylinder ports,—the cylinder ports are then both open to the exhaust to atmosphere. By moving the handle in either direction from its middle position the piston is forced back and forth by air pressure as desired. The device can be used with cylinders up to 18 ins. or 20 ins. in diameter.

Arch-Tube Beading Tools

By JOHN P. POWERS

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

I am sending a blue print of a tool which we use in the Escanaba shops of the Chicago & Northwestern Railway for beading over the ends of arch-tubes. This is used in connection with the long stroke air hammer and is especially handy where spring rigging, air drums, eccentrics, etc., are very close to the arch-tube hole, and where a sledge hammer is quite difficult to use by hand. The sketch shows two tools. One is for turning the bead over or belling it, or as we say, "spread-



Detail of Tube Beading Device.

ing" it. It has a large semi-circular head, and its action on the tube is not violent, as it lays it over with a large, easy curve. This tool has a holder or guide which is screwed into the throat sheet and the spreader, when forced in by the hammer, lays over the end of the arch-tube in the internal firedoor sheet.

The other tool fits the same holder which is left in place in the throat sheet, and with its recurved contour, it finished the bead on the arch-tube neatly and quickly and does a good workman-like job. This we call the "beading" tool.

Grade Crossing Accidents

The Interstate Commerce Commission has reported that in the last 10 years there have been 9,479 persons killed and 21,917 injured, by being run over at railway grade crossings. These figures, like those elsewhere mentioned in this issue, relating to trespassers, are startling.

New Dining Cars on the Canadian Northern Railway

Novel Features of Construction, Side Framing, Independent Double Unit Vestibule Construction, Weather Proof Deck Sash, and Sound and Temperature Insulation

Seven new diners have recently been delivered to the Canadian Northern embodying a number of new features in design and construction, and a number of modifications of Canadian Northern standards to meet conditions which are not found in standard passenger work. The cars were built in the Amherst, N. S., Works of the Canadian Car and Foundry Company from plans completely worked out in the offices of the railway company at Toronto.

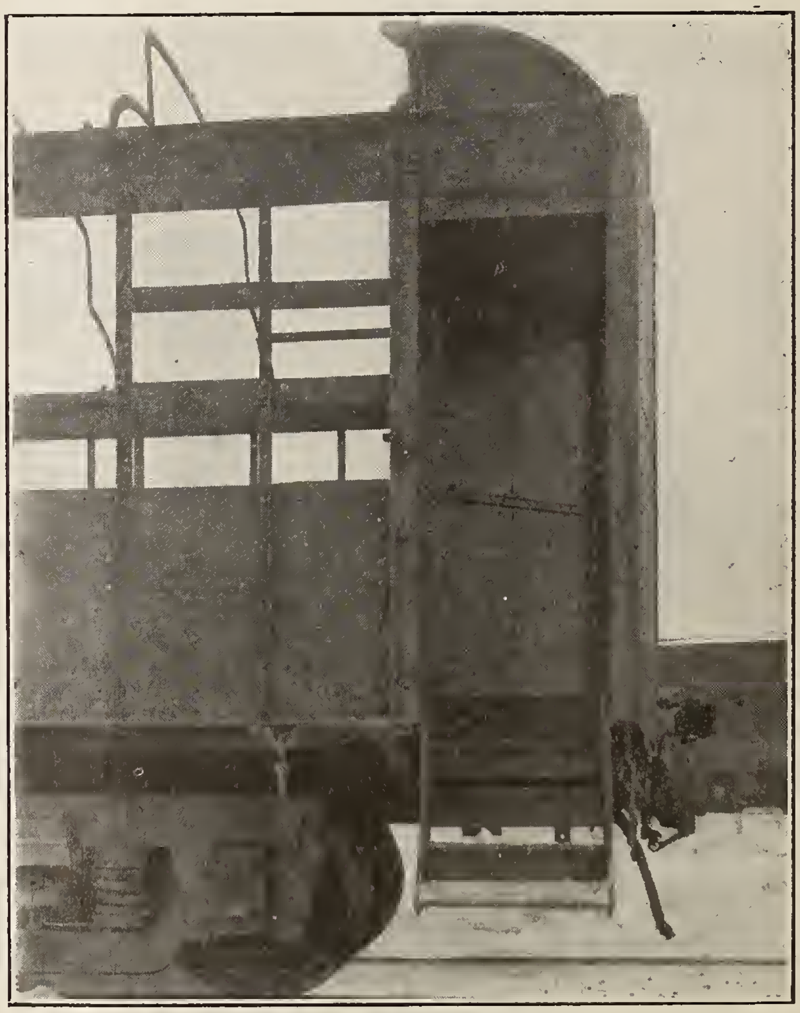
Framing

The underframe, which is of Canadian Northern standard construction, consists of two 15-in. rolled steel channels 77 ft. 10½ ins. long, weighing 33 lbs. per foot, fitted with continuous top and bottom cover plates, supplemented by an auxiliary top cover plate at the centre of the car. The top cover plate is 23 ins. wide, ¼ in. thick, and 77 ft. 4⅛ ins. long, the auxiliary cover being of same size, but extending 12 ft. 6 ins. each side of centre of car. The bottom cover is 23 ins. wide, 5-16 ins. thick, and 68 ft. 2¼ ins. long. The draft gear is rivetted directly to the centre sills, and is of the Miner A-2-P type, having a capacity of 150,000 lbs., with a movement of 2⅛ in., and works in unison with the Standard Coupler Company's platform attachment, which has a capacity of 42,000 lbs. The centre sill construction will resist a buffing shock of 400,000 with a factor of safety of four and one-half regardless of the spring buffer or the draft gear. The end sills are ⅜ in. pressed steel diaphragms, fitted with a top cover plate 12 ins. wide by ⅜ in. thick. The general arrangement of the underframe and the most prominent characteristics are illustrated, the length of cover plates varying in the different types on account of construction details. It will be noticed that a unit type of bolster has been provided in conjunction with four crossties. It was assumed, and from experience gained in the performance of a large number of cars in service, it has been proven, that it is possible to support the centre sill structure from the side girders so as to maintain the initial ¾ inch camber at centre of car considering 56 ft. 6 in. truck centres. The details of construction have been very carefully worked out. The centre sills have had their original cross sectional and flange area restored in all cases where holes had to be cut for piping, etc., so as to maintain a maximum amount of material properly distributed to withstand impact. This was also considered in providing the connections for the end sill H-beam located immediately behind platform buffer block.

Main Room of Canadian Northern Diner

The centre diaphragms are of ¼-in. pressed steel plate with top cover plates 7 ins. wide, ⅜ in. thick, and bottom covers 7 ins. wide, 7-16 in. thick extending across the car and connected directly to the side sill in each case.

The floor supports are of 3-16 in. pressed steel with 3-in. flange and 4 in. deep all around, with closed corners, located to suit the equipment under car, where necessary.



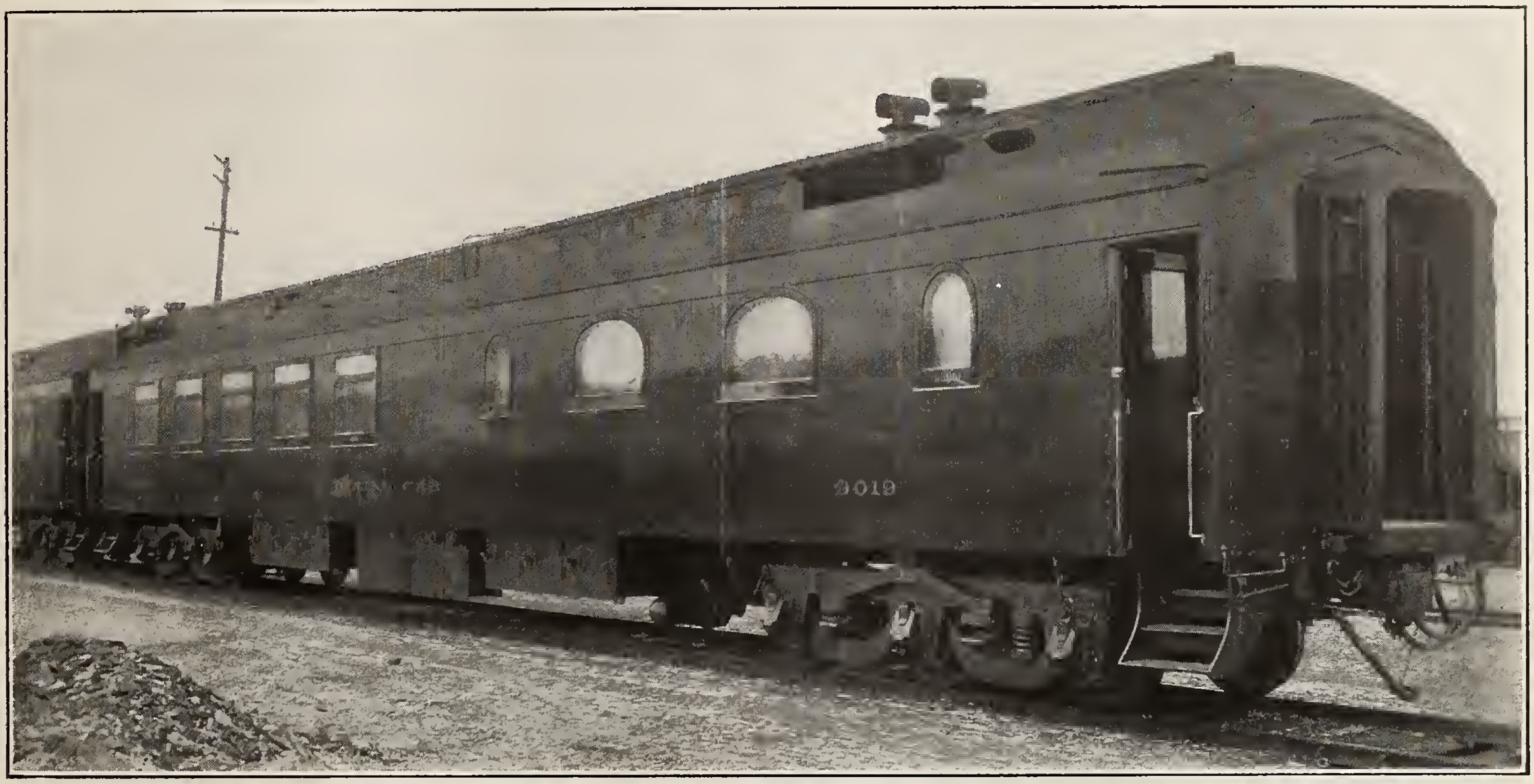
End Framing and Vestibule

The body bolsters are provided with 5-in. pressed steel diaphragms having top and bottom cover plates 24 ins. wide tapered to 15 ins. at the ends, which are connected directly to the side girders. The top cover is ⅝-in. thick and the bottom plate $\frac{7}{8}$-in. thick. A substantial cast steel filler casting is provided at the centre of the car to form a solid bearing for centre plate. The bolster diaphragms are made with a 3-in. flange clear around and spaced 9-in. back to back. Intermediate longitudinal floor supports of 3 ins. by 6 ins. 7 lb. Z-bar are provided between centre construction of side girder.

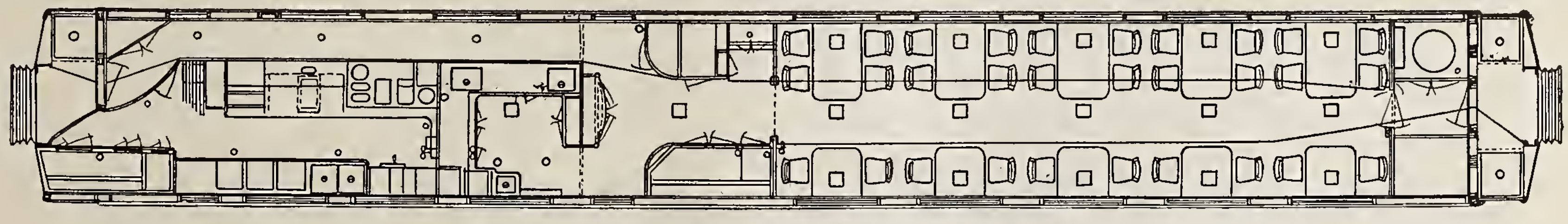
The side girder, which is 7 ft. 8 3-16 ins. in height, is formed from a 4-in. 10.3 lb. Z-bar side sill, 3 in. by $2\frac{1}{2}$ in. by $\frac{1}{4}$ in. floor support angle, $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{1}{4}$ in. truss plank angle, 4 in. by $1\frac{3}{8}$ in. by 7-16 in. belt rail dropped bar, $36\frac{1}{4}$ in. by 3-16 in. girder plate, 2 in. by $\frac{3}{8}$ in. letterboard bottom stiffener plate, 11 in. by $\frac{1}{4}$ in. letter board plate and a $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $\frac{3}{8}$ in. side plate angle. The steel framing complete with vestibule less trucks weighs 52,000 lbs.

The end frame of the kitchen end of the car is formed from a 4-in. x 13.8 lb. Z-bar corner post on the passageway side, end door post of 4-in. 8.2 lb. Z-bars on the passageway side, and 4-in. 7.25 lb. channel on the partition side 4-in. 7.25 lb. channel at the kitchen refrigerator, and 8-in. 13.75 lb. channel at the side girder on the kitchen side.

At the eating end of the car the framing is similar, two 4-in. 13.8 lb. Z-bar corner posts, two 4-in. 13.8 lb. Z-bar intermediate, and two 4-in. 8.2 lb. Z-bar door posts are employed. The end sill diaphragms are set back so as to allow the end posts to pass down in front of them and be rivetted directly in place, forming a strong anti-telescoping member. The hood framing is so arranged as to present a girder construction in end shear, and the top deck is entirely protected against fire by light steel panelling.



New Dining Car in Use on the Canadian Northern Railway



Floor Plan of Canadian Northern Dining Car

Each corner of the underframe is tied square and reinforced by 6-in. 10.5 lb. channel diagonal braces extending from corner of body frame to intersection between bolster and centre sill. The buffer beams are U-shaped pressings so connected as to allow one side only of the vestibule to be demolished at a time, that is, the two sides of the vestibule are independent members. This construction has been found satisfactory from a maintenance point of view. No windows are used, and no woodwork is to be found in the vestibule structure except the doors and roof. Four tread steps with composition treads have been applied, and Canadian Northern pattern and design of trap doors were provided. The body and truck are locked together by the use of a combination Wood's Rolled Centre Plate and Coleman Centre Pin, all fitted with a removable cover.

On account of climatic conditions, it was found necessary to provide a car of maximum strength in conjunction with a wooden roof, exterior and interior, this feature was also influened by prevailing shop conditions and equipment. The cars have demonstrated their fitness for service by preserving all the good qualities of a wooden car without the nuisance of the slightest measure of squeaking, the latter being mainly contributed to by the steel construction and an ample use of quilted cotton for the contact of all framing and finish.

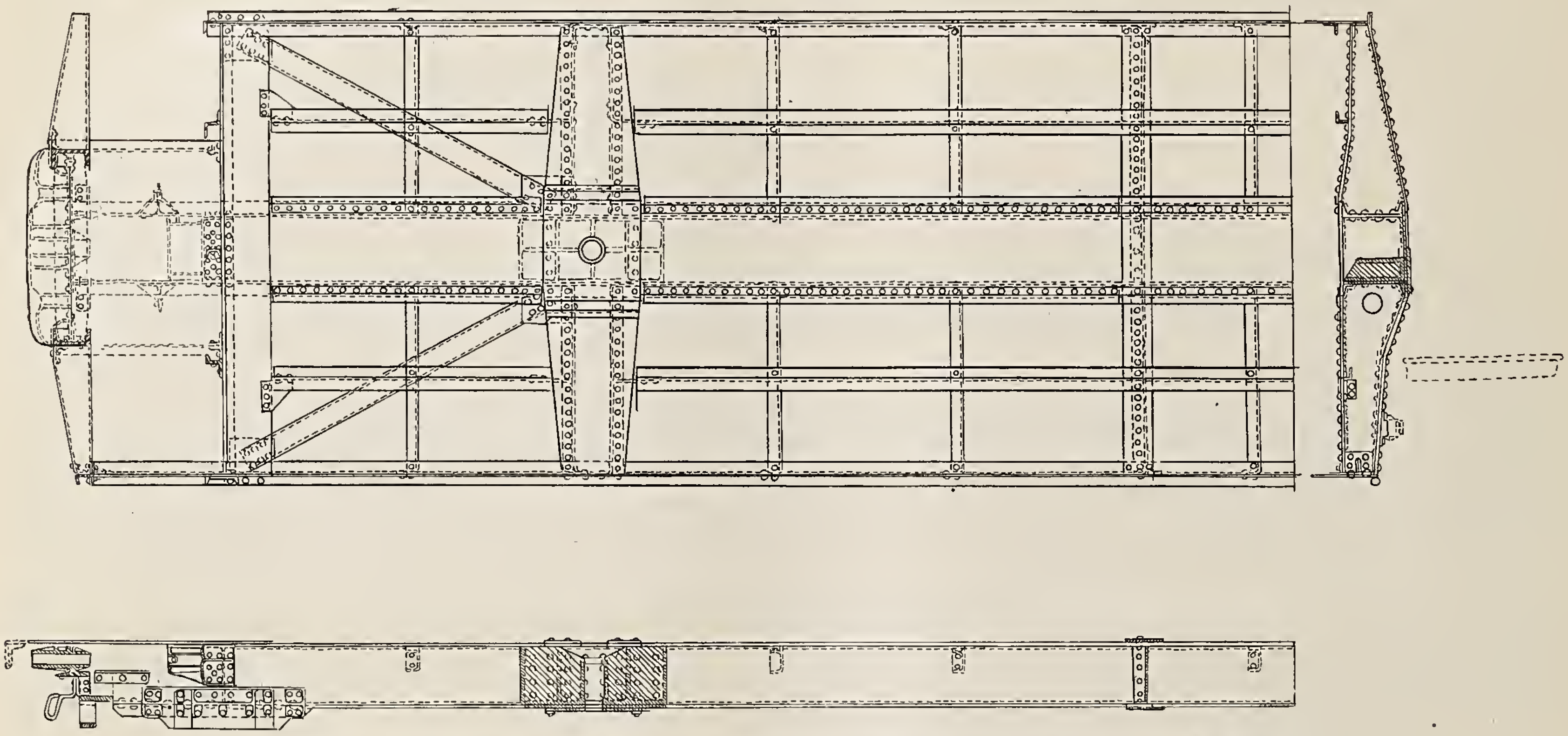
So much trouble was experienced in the past that a new design of letterboard splice had to be developed which has overcome many cases of loose or broken joints between the various sections of letter boards.

In the application of the woodwork to the steel frame double dead air space is provided under the sectional steel flooring by the use of standard deafening boards and waterproof tar paper and two layers of 3-ply Salamander, a single layer of the latter being spread over the centre sill, crossties and bolsters.

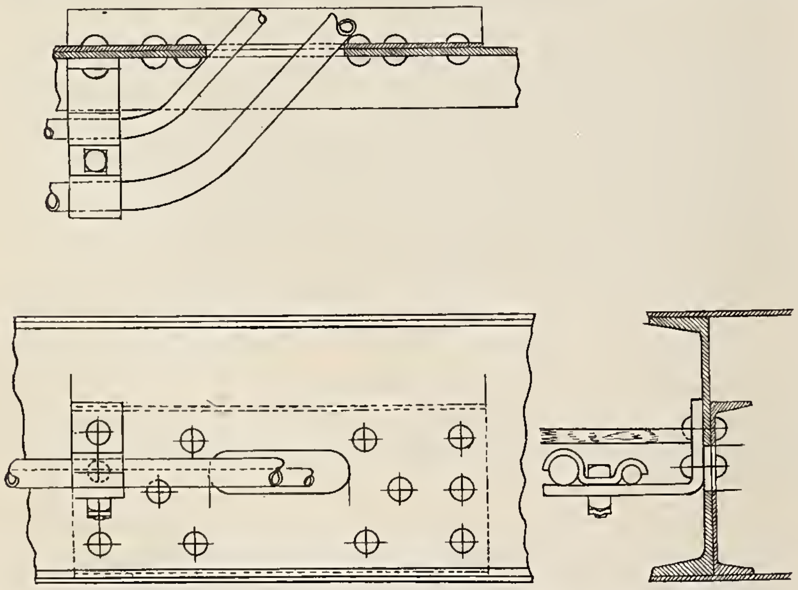
The deck is closed in tightly and glazed on account of the difficulty of keeping rain out where deck sashes are not screwed tightly in place, the prevailing winds being north and south over a greater part of the transcontinental route. No. 6 canvas laid in white lead and oil forms the outer covering of the roof and 10-oz. deck sill flashing is provided full length of car.

Composition flooring formed from magnesite, sawdust and magnesium chloride is spread over the whole interior surface of the car, the corners are extended up one inch high and round corners provided to aid in keeping the car clean and avoid the possibility of water reaching the steel frame work. It was considered advisable to have a supplementary floor covering of cork one-half inch thick, so that carpets might be removed during the summer months.

The exterior of the new cars while not exactly in accordance with past practice of the road coincides principally except that a square instead of an elliptical type of elevation was decided upon, principally from the fact that if cars having steel exterior were to be subsequently introduced it would be the logical step to take to meet those conditions.



Half of Underframe, Showing Vestibule Construction, Bolster and Diaphragm



Center Sill Re-inforcement at Pipe Holes

General Dimensions

Gage	4 ft. 8½ in.
Length over body end frame	72 in. 6 in.
Length over buffers—free	80 ft. 9¼ in.
Width over side sill stringers	9 ft. 10½ in.
Width over buffer angle	4 ft. 0 in.
Width between deck sills	5 ft. 6 in.
Height top of floor to bottom of sash rest cap	2 ft. 4 in.
Seating capacity	30
Light weight of car in working order	152,000

Trucks

Steel throughout 11 ft. 0 in. wheelbase.

Wheels of M. C. B. pattern, lipped tires, 36 in. diameter.

Journals 5 in. x 9 in.

Cast steel centre plate support.

Brakes

The air brakes are of the Westinghouse Air Brake Company's Schedule LN-1812, with slack adjuster, less supplementary reservoir, arranged to brake the light weight of the car at 90 per cent with 60 lbs. cylinder pressure. Air brake and signal hose were tested in accordance with M. C. B. latest requirements and 1¼-inch extra heavy train line pipe was provided. The hand brake gear was designed to develop 40 per cent of the normal braking power under air operation. B-3-A type of Conductor's valve was used with exhaust pipe to atmosphere and cord attachment running full length of car body. Schedule K air signal apparatus was installed.

Heating

The Gold Car Heating and Lighting Company's 2-in. by 1in. duplex coil system of hot water circulation was installed. A 26-in. diameter heater was used and piping arranged so that each system of car piping could be split on both sides of car independently of each other with cross-over inside of car. In order to thaw out drips a 50-ft. length of steam hose is carried in every baggage car and connected to a steam valve. Basin and sink drips are thawed out by a special device. A very efficient end valve locking device avoids any possibility of valve becoming accidentally closed.

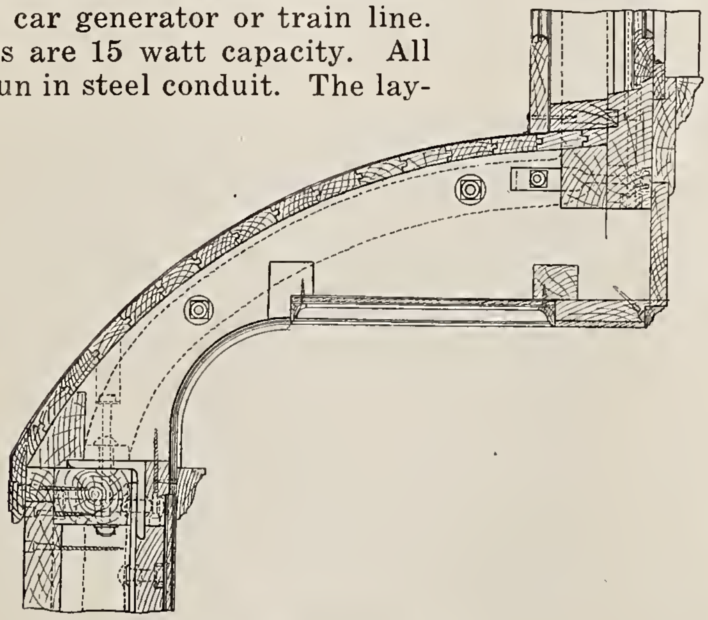
Ventilation

The kitchen is provided with a Sturtevant Electric Exhaust set having a capacity of 400 cu. ft. of air per minute. The range hood is ventilated by the use of a specially designed ventilator which has proven a great satisfaction.

The remainder of the car is fitted with Arnoldt 4-in. exhaust ventilators. A special flush Canadian Northern type Taylor thermometer is provided in the main room. Window screens are fitted to main room sashes, and all storm sashes have sliding ventilators in the bottom rail.

Lighting

A 2.6 kilowatt belt driven generator and double bank of storage batteries provides current for the lamps and fans. A complete steel-cased marble switch board is provided to operate on current supplied from the car generator or train line. All lamps are 15 watt capacity. All wire is run in steel conduit. The layout is one entirely developed on the Canadian Northern and admits of easy inspection and yet the conduit itself is not exposed. The junction boxes carry the lamps. Candle lamps are provided for use in case of emergency.



Section Through Lower Deck

The following Safety Car Heating & Lighting Company's fixtures were used:

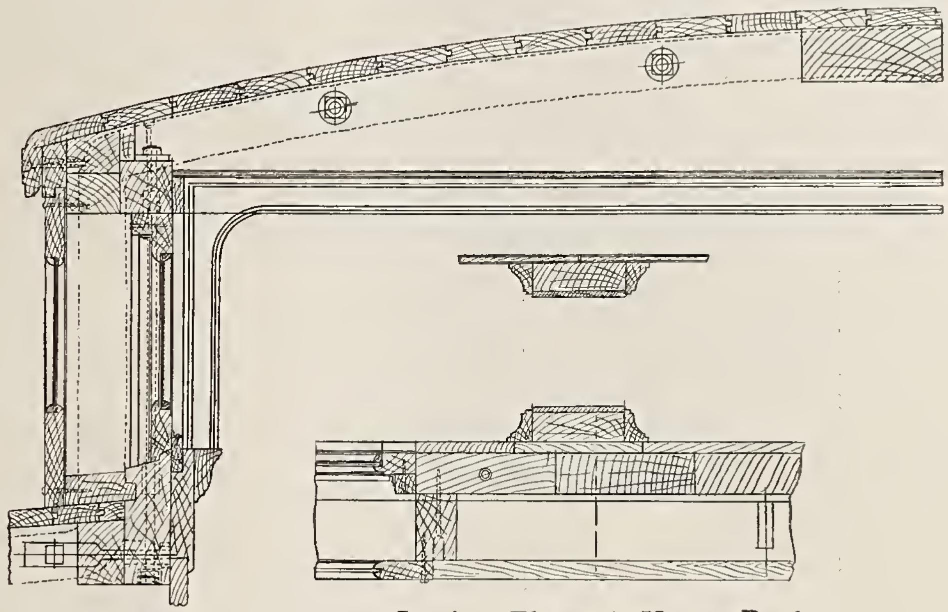
Centre lamps	No. 3666
Deck lamps	No. 3889
Passageway	No. 1921
Kitchen	No. 2124
Pantry	No. 2115
Heater and Refrigerator	No. 2426
Vestibule	No. 9060

A very practical design of steel battery box has been provided which has been practically snow proof on account of the wedging effect of the inspection door catches. The hangers ensure an absolutely rigid support, besides being very simple construction, considering the dimensions of the box, the weight of each of which is slightly more than 500 lbs. without the cells.

All fans are 12-in., non-oscillating type, being connected up with pin and socket attachment which allow them to be removed for repairs. Dummy train connectors are installed.

Glass

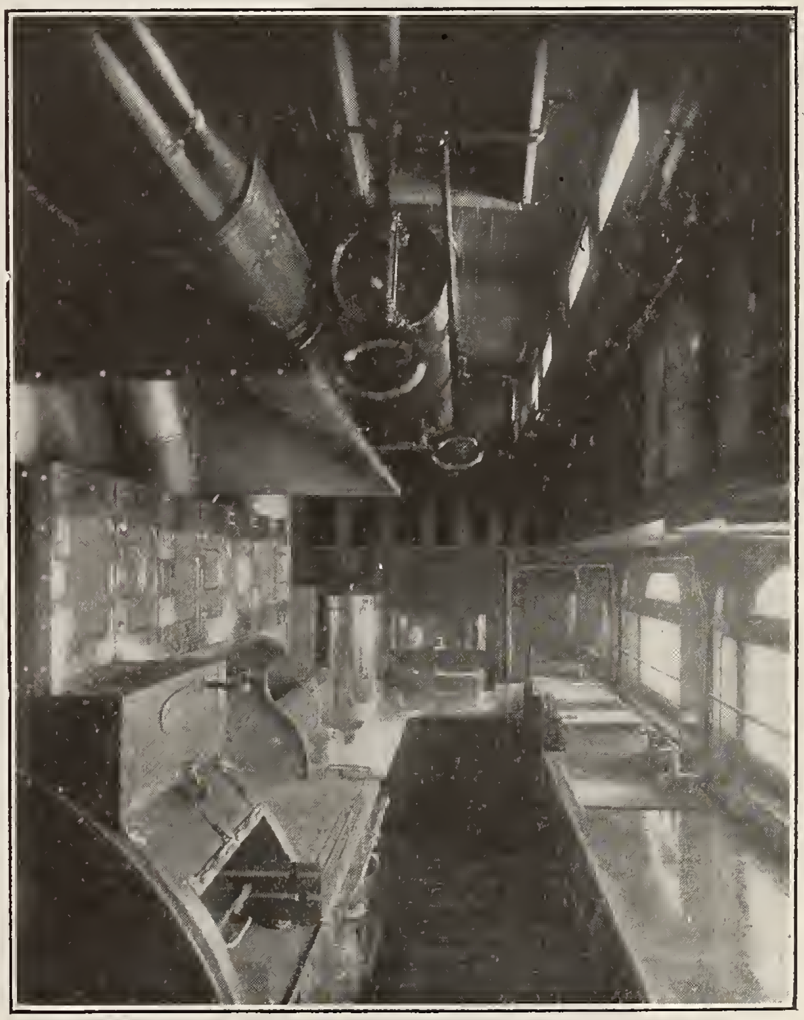
All body sash are provided with 3/16 in. thick polished plate glass. Outside and inside Gothics, inside deck sash, and all interior glass is of a special design of pressed prism plate glass, the interior lights having ground backs to diffuse the light. Storm sash glass is of 32-oz. sheet glass. Sash locks are of Canadian Northern design and pattern. Sash balances and anti-rattlers



Section Through Upper Deck

are installed for all large body windows. Kitchen windows are made with glass and screen section.

Pantasote silk-faced curtains pattern 4-2, color 77 are located in the main room and passageway.



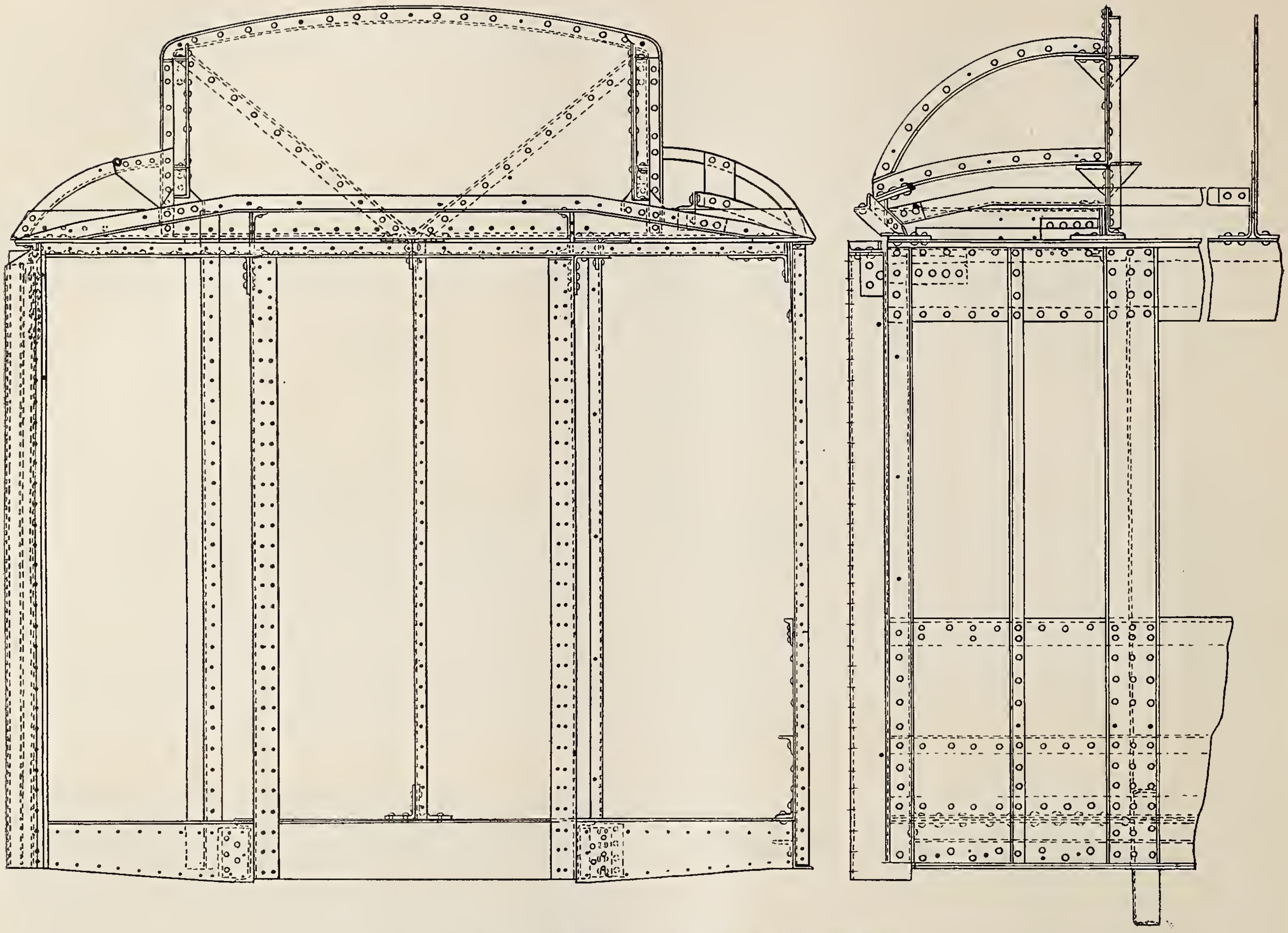
Kitchen, Showing Range and Butler's Pantry

Interior Finish and Arrangement

The use of marquetry has been entirely dispensed with, and inlay lines are employed.

Beam ceiling finish is carried out in main room, pantry and passageway. Woodwork is of mahogany throughout except kitchen, which is cherry. Ceiling of 3-ply poplar veneer, canvas faced, painted pale willow.

No gimp on chairs, plain and flush, light and strong, padded cushion and back. Table light smooth and strong.



End Elevation of Steel Work, Showing Vestibule

Floor Covering

The main room floor besides being covered with cork tiling is fitted with standard carpet and aisle strip. Red and green diamond pattern rubber tiling is provided for vestibules. Wool border mats are furnished for end doors. The kitchen floor is covered with No. 24 cold rolled copper and cross slats.

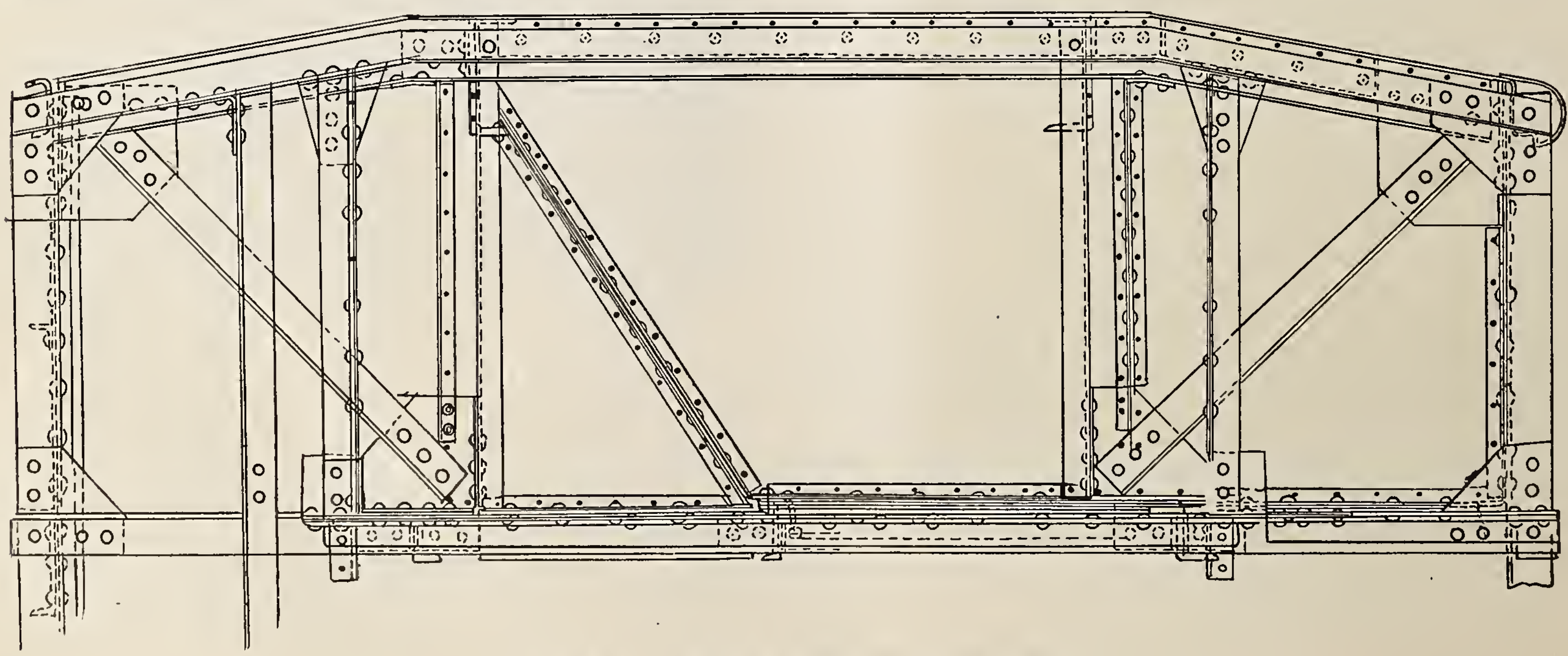
Water Supply

Canadian Northern standard air pressure water raising system is provided under the car in connection with a battery of three overhead tanks in the kitchen. A Jarvis filter with cooling tank is connected throughout to the water supply and located near the entrance to the pantry. The hot water boiler over the range serves the dish washing machine as well as the sinks in kitchen and pantry. All sink drains are provided with steam thaw-outs.

Kitchen Details

Range and heater insulation are both worked out with the greatest care. The charcoal is being stored in a special compartment adjoining the broiler and the coal for kitchen range is carried below the broiler.

A combination garbage chute which avoids carrying



Details of Vestibule Platform Construction garbage can is provided, and a deflector is designed to avoid any possibility of refuse being blown back into the car. A drop door in front allows for the kitchen being flushed out.

Two supply boxes per car are provided and an especially good handle admits of locking by seal or padlock.

Bohn white enamel refrigerators with syphons are used.

The vegetable bins in the kitchen are unit locked as well as all lockers throughout. The cup warmer is of especially good design. The humidor locker at conductor's desk is another novel feature. Pressed prism glass having matted back is provided as a light burns in the cigar locker at all times.

New Methods and Appliances

The Van Dorn Electrical Tool Company, Cleveland, Ohio, have recently placed on the market a combination electrical tool adapted for use either as a portable tool

Tool Used as Portable Grinder

or a bench tool, designed for both drilling and grinding.

At one end of the tool the shaft projects and a 6 x 5/8-in. emery wheel fitted with a guard can be directly con-

Tool Used on Stand for Grinding

nected, making an excellent tool for portable grinding as shown in the first illustration.

A bench grinding stand, making a practical bench grinder and lathe head can be used which converts the tool into a stationary grinder. The stand for bench grinding is heavy and compact. It holds the machine firmly. The machine will drill up to 1/2 in. in steel. When used for drilling an attachment plate is fitted over the grinding end to hold the spade handle, feed

Tool Used as Portable Drill

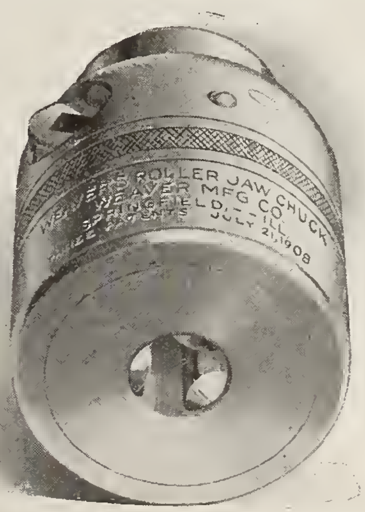
screw or pressed plate, according to the character of the work.

The tool is supplied for direct current only and may be had for 110 or 220 volts.

Tool Used on Bench Drilling Stand

The Weaver Manufacturing Company, Springfield, Ill., have recently put on the market a line of roller jaw chucks for straight shank drills from 1/16 to 1 1/32 in. diameter drills.

The chuck is designed on the roller chuck principle,



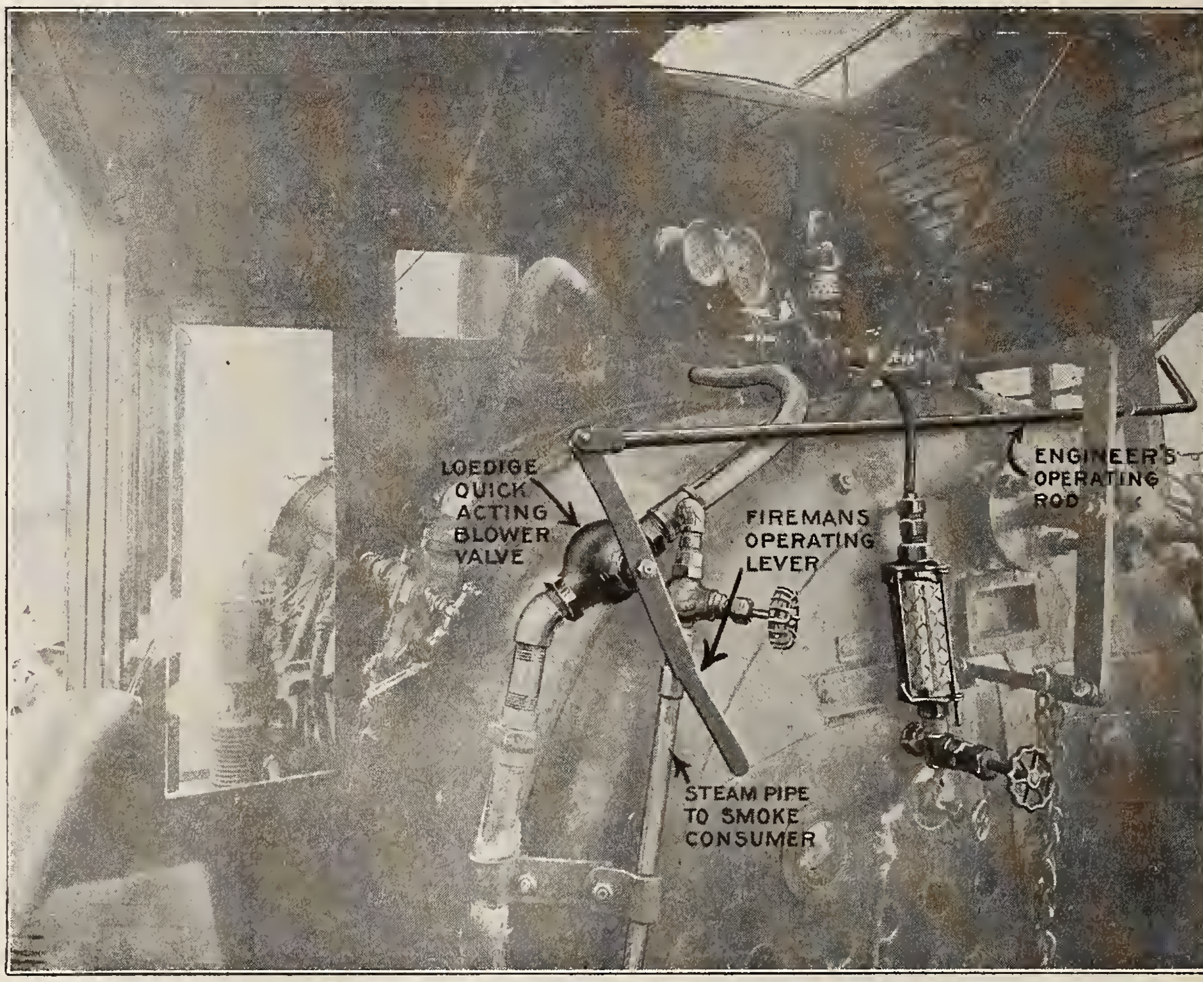
Weaver Automatic Roller Chuck

the body of the chuck acting as the outside cam and the hardened steel rolls bearing against this cam and against the shank of the drill.

A solid one-piece cage fitting inside the body is adjustable to bring the rolls to bear at different points on the cam for different sizes of drilling shanks.

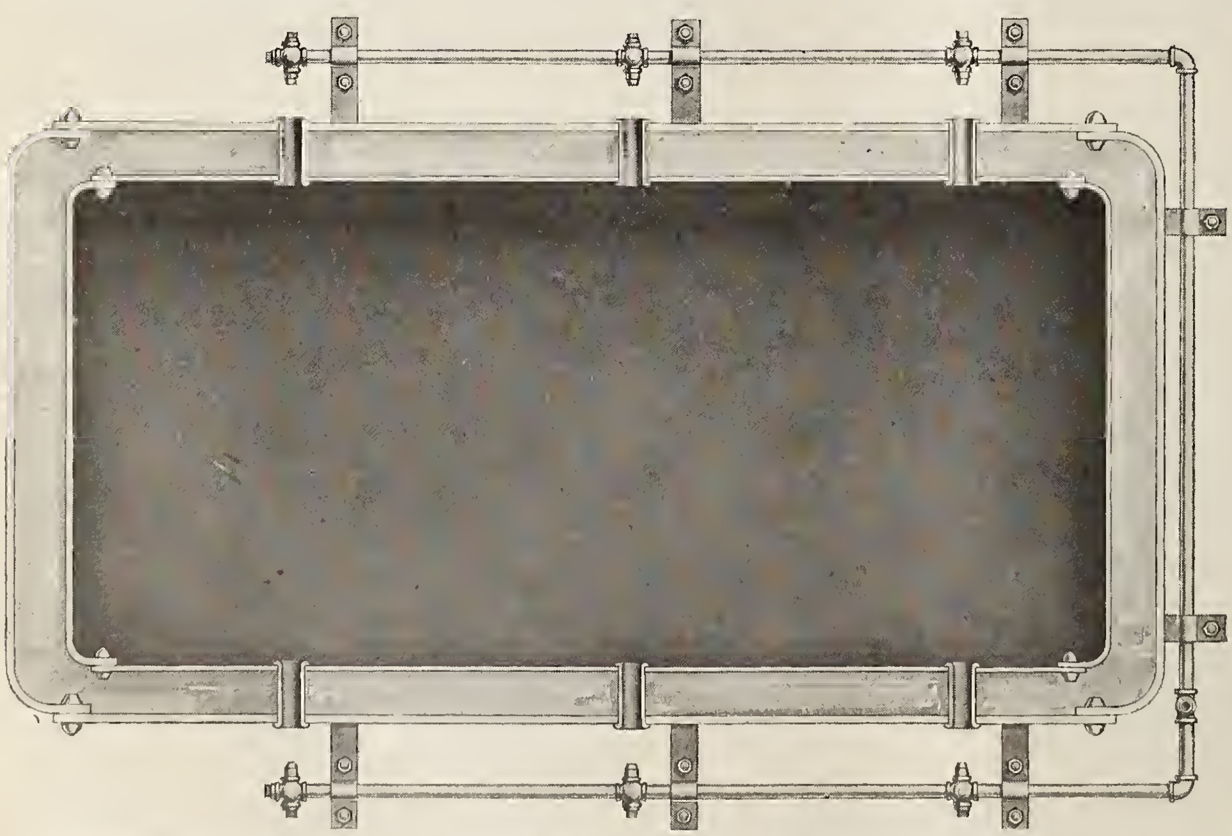
The steel rollers do not deform or scar the shank of the drill. The greater the pressure exerted on the drill the greater the grip of the chuck on the drill.

The Sargent Company, 1418 Fisher Building, Chicago, have recently made a number of improvements on the Loedige Quick-Acting Blower Valve that have made it of great value in eliminating black smoke on locomotives. A suggested position of attachment has been worked out, as well as a system of operating levers. The illustrations make the device and the method of installation and operation clear. The view inside a locomotive cab shows this valve connected in the steam line on the fireman's side, with a hand lever for the fireman and an operating rod running across to engineer's side. This setting of the valve is advised because from either position a simple and easy movement of the hand opens the valve instantly. This method saves time in comparison with valves requiring to be turned to the open position.



Blower Valve and Operating Mechanism in Cab

The second view shows the recommended practice of locating steam jets outside of the fire-box. the control of which is separated from the quick acting valve by an ordinary globe valve.



The Steam Jets Force Air Into the Fire Box and by the Instantaneous Blow of the Loedige Valve All Smoke Solids and Gases Are Consumed

The new Loedige valve is an improved and simpler construction of the Loedige valve which was tested at Altoona, Pa., on Pennsylvania Railroad locomotive testing equipment at the request of the General Managers' Association of Chicago and fully reported in the proceedings of the Railway Master Mechanics' Association. That report recommended the equipment of locomotives with the steam jets and shows the Loedige Quick Acting Blower Valve as the only valve which would meet the theoretical and practical requirements of "an easily operated—quick opening valve—capable of giving reasonable graduations of pressure in the blower line."

This valve operating even without the assistance of the steam jets at sides of the fire-box will generally control and prevent showing of black smoke and it is doing this on locomotives which previously had been equipped at the expense of several hundred dollars with special apparatus which reduced their fire-box capacity and did not satisfactorily prevent black smoke.

The Loedige valve was developed on the Chicago & North Western Railway and is standard equipment for the purpose on all their locomotives, which accounts for their position of "first' 'in the list of twenty-nine Chicago railroads in a recent report of the Department of Smoke Inspection of the city of Chicago, which gives their per cent. of density 6.17 against an average of all roads entering Chicago of 11.77, three of which run over 20. This report is especially interesting because there were twice as many test observations by smoke inspectors made on the Chicago & North Western as on any other railroad in Chicago during that time.

New Trade Literature

American Blower Company, Detroit, Mich., have issued a 44-page illustrated book on "The Commercial Value of Washed Air," in which are described by noted authorities the advantages to employer and employee of using washed and tempered air. The remainder of the book is given to a description of the construction and operation of the "Sirocco" purifying and ventilating system and the sizes and capacities of various types of installations.

American Shop Equipment Co., McCormick Bldg., Chicago, Ill., have issued an eight-page circular on oil burning rivet heading forges showing portable and stationery rivet forges suitable for steel car work, hydraulic rivet and general light forge work. Models are shown on trucks and other for permanent places.

Beaudry & Co., 141 Milk St., Boston, Mass., have recently published illustrated sheets describing two recently designed Beaudry Peerless power hammers, motor driven. The sheets include descriptions of the machines and specifications covering the sizes and capacities of the various types.

The Coale Muffler & Safety Valve Company, 325 East Oliver St., Baltimore, Md., have recently issued a 32-page illustrated catalogue describing the use and adjustment of the Coale improved muffler safety valve, which reduces the noise of escaping steam to a minimum. Safety and pop valves are described, specifications tabulated for valve springs, and instructions for installation. There is also described the Riggin full opening and closing blower and blow-off valve.

The Covington Machine Company, 14 Wall St., New York City, have issued a 12-page illustrated bulletin, No. 11, describing punches, shears, bending rolls and other fabricating tools for sheet metal and structural shapes.

The Dake Engine Company, Grand Haven, Mich., have issued a 48-page illustrated catalogue for 1915-1916, covering their line of air and steam motors for jib cranes and hoists, swinging gears, hoisting engines, derrick crabs, pneumatic chain and wire hoists, drilling hoists, boiler test pumps, steam feeds for saw-mill carriages, etc. In addition to illustrating this line of material, the catalogue gives piece-part names and numbers for replacements, and current price list.

The Flannery Bolt Co., Pittsburgh, Pa., have recently issued their 1916 calendar showing the construction and typical installations of Tate Flexible Stay Bolts. The calendar is printed with large clear figures, which will make it of value in the daily work of readers of Master Mechanic.

Ford Chain Block & Manufacturing Company, 139 West Oxford St., Philadelphia, Pa., have issued a 16-page illustrated catalogue describing the Ford "tri-block" chain hoist, as well as screw hoists and differential hoists from ½ to 20-ton capacity. A description of their loop hand chain guide is given; also a list of parts, sizes, hoist in feet, and prices.

Goldschmidt Thermit Company, 90 West St., New York City, have recently issued the second edition of their book on thermit mill and foundry practices. The book contains 76 pages and is well illustrated. It describes the theory and practice of thermit welding and the details of operation for a number of types of weld, illustrating the part to be repaired, the method of constructing the mould and the completed weld. Cost of welds is taken up, as well as descriptions of the necessary outfits for doing different classes of work.

Gerdes & Co., 30 Church St., New York City, have issued an illustrated mailing card describing the Gerdes hygienic method of direct forced draft ventilation, applicable to machine shops with or without balconies and to general building construction.

The Industrial Works, Bay City, Mich., have issued a 90-page illustrated book, No. 107, on their complete line of cranes, illustrating and describing portable and stationary cranes of many different types and capacities, designed for railroad and construction purposes, pile drivers, portable rail saws, transfer tables and various accessories. Cranes are shown operating by steam, electric and hand power. The completeness of the line illustrated and the frankness with which the capacities and provinces of the various types and sizes are stated is a valuable part of the book.

The Lincoln Electric Company, East 38th St. and Kelley Ave., Cleveland, Ohio, have issued a 24-page illustrated catalogue on electric arc welding, which devotes a number of pages to a concise and clear description of the processes of welding by blacksmith forge fire, acetylene torch, thermit and electric methods. Welding terms are defined and the balance of the book describes the Lincoln arc welder and shows a number of examples of welding methods.

The Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., have issued a 36-page illustrated catalogue, No. 50, describing the Newton rotary planing machines. The catalogue goes into the theory of continuous cut rotary planing and illustrates and describes the full line of machines equipped for this work. An insert shows various Newton slotters, saws, milling machines, boring machines, etc.

H. A. Rogers Company, 87 Walker St., New York City, have issued a 16-page illustrated catalogue describing Moncrieff's gauge glasses: Unific brand for high pressures up to 400 lbs. and Perth brand for lower pressures up to 200 lbs. The catalogue contains sizes and prices as well as data as to the life of gauge glasses.

The Universal Car Seal & Appliance Company, Lyon Block, Albany, N. Y., have issued two illustrated circulars describing respectively their Universal Gibraltar and Universal Simplex freight car door fasteners. The circulars give full size line drawings of the locks and explain their installation and operation.

The Western Wheeled Scraper Co., Aurora, Ill., have issued a 16-page illustrated bulletin on the Western automatic ore dump car, describing the Standard Western Dump Cars with the new ore dumping device, which tilts the bed of the car and raises the side with one movement. The construction and operation of the car is illustrated, as well as different types of service to which it can be put.

Westinghouse, Church, Kerr & Co., 37 Wall St., New York City, have issued a 12-page illustrated bulletin, No. 20, on the lay-out and equipment of the locomotive repair shops of the Chicago & Alton R. R. at Bloomington, Ill. The bulletin discusses the theory of building a shop around a predetermined machine lay-out, rather than attempting to advantageously lay out machines after the shop building has been completed.

Personal Items for Railroad Men

F. A. Phillips, recently appointed locomotive foreman of the Great Northern Ry. at Butte, Mont., succeeds there H. E. Stapt.

W. J. Yingling, recently appointed general foreman of the Norfolk & Western at Crewe, Va., succeeds there N. W. Norsworthy.

R. Lloyd, recently appointed locomotive foreman of the Great Northern Ry. at Great Falls, Mont., succeeds there F. A. Phillips.

Amnon I. Derr, recently appointed general manager of the Morgantown & Wheeling Ry. at Morgantown, W. Va., succeeds J. Ami.

H. S. Rosser, recently appointed general foreman of the Norfolk & Southern Ry. at Berkley, Va., succeeds there J. W. Stickley.

A. A. Adams, recently appointed locomotive foreman of the Great Northern Ry. at Willmar, Minn., succeeds there F. J. Kearney.

F. J. Kearney, recently appointed locomotive foreman of the Great Northern Ry. at Melrose, Minn., succeeds there W. B. Craswell.

O. W. Hitt, recently appointed general foreman of the Detroit, Toledo & Ironton R. R. at Napoleon, Ohio, succeeds there J. H. Suhl.

I. H. Drake, recently appointed master mechanic of the Atchison, Topeka & Santa Fe at Clovis, N. Mex., succeeds Hugo Schaefer.

L. J. Miller, recently appointed master mechanic of the Marshall & East Texas Ry. at Marshall, Tex., succeeds there F. N. Norman.

R. E. Kelly, recently appointed master mechanic of the Kansas City & Memphis Ry. at Rogers, Ark., succeeds there W. A. George.

R. E. Anderson has recently been appointed air-brake instructor of the Chesapeake & Ohio Ry., with headquarters at Richmond, Va.

R. M. Boldridge, recently appointed master mechanic of the Apalachicola Northern R. R. at Port St. Joe, Fla., succeeds there J. P. Dolan.

J. H. Suhl, recently appointed general foreman of the Detroit, Toledo & Ironton R. R. at Springfield, Ohio, succeeds there O. V. Morrison.

Clyde Medley, recently appointed car foreman of the Chicago, Milwaukee & St. Paul at Deer Lodge, Mont., succeeds there J. A. Campbell.

C. Grant, recently appointed master mechanic of the Nacogdoches & Southeastern R. R. at Nacogdoches, Tex., succeeds there W. V. Fountain.

Frank Sowerby, recently appointed general foreman of shops of the Chicago, Milwaukee & St. Paul at Deer Lodge, Mont., succeeds there S. S. Koehler.

R. L. Mason, for fourteen years manager of the railroad department of Hubbard & Company, has severed his connection with them, and entered the railroad supply business on his own account at 1501 Oliver Building, Pittsburgh, Pa.

J. W. Tenney, recently appointed road foreman of equipment of the Chicago, Rock Island & Pacific at Trenton, Mo., succeeds there M. J. McDonald.

F. J. Yonkers, recently appointed road foreman of equipment of the Chicago, Rock Island & Pacific at Good Land, Kan., succeeds there N. P. Cosgrave.

W. F. Brennan, recently appointed traveling storekeeper of the Chicago & Alton Ry., has served that road for the past three years as storehouse foreman at Bloomington, Ill.

W. D. Brown, recently appointed general manager of the Mineral Point & Northern Ry. at Mineral Point, Wis., has been serving that road in the capacity of assistant general manager.

J. L. Teemster, recently appointed storekeeper for the Kansas City Terminal Ry. at Kansas City, has resigned from his position as traveling storekeeper on the Chicago & Alton, to accept his new duties.

Richard Brooks, recently appointed assistant to the general manager of the Western Ry. of Havana and of the Havana Central R. R., with offices in the Central Station, Havana, Cuba, succeeds M. L. Masteller.

E. S. Barstow, recently appointed car foreman of the Spokane, Portland & Seattle Ry. at Vancouver, Wash., succeeding W. P. James, resigned, leaves the position of piece-work inspector on the Southern Pacific at Portland, Ore., to take up his new work.

Wesley Fuller, recently appointed road foreman of engines for the Lehigh & New England R. R. at Pen Argyl, Pa., entered the service of that road as engineman, and in 1912 was made traveling fireman and later assistant road foreman of engines. Mr. Fuller succeeds John McMullen, who has been made fuel inspector.

D. K. Auman, recently appointed master mechanic of the Dakota Division of the Great Northern Ry. at Grand Forks, N. D., has been in the service of that company for a number of years as engineer and traveling engineer on the Breckenridge Division. Mr. Auman succeeds E. English, who has been transferred to the Minot Division at Minot, N. D., as master mechanic.

J. A. Kerrigan, recently appointed general foreman of the locomotive department of the Nashville, Chattanooga & St. Louis at Nashville, Tenn., entered the service of that road in 1899 as machinist in the shops at Nashville, and in 1904 was appointed roundhouse foreman. Mr. W. G. Reyer, whom he succeeds, has resigned from the service of the company to take up personal business.

H. C. May, recently appointed Superintendent of Motive Power of the Lehigh Valley at South Bethlehem, Pa., entered the service of the Chesapeake & Ohio at Covington, Ky. Later he entered and graduated from Purdue University at LaFayette, Ind. After the completion of his college education he was made a Master Mechanic of the "Big Four" at Louisville. Mr. May later held the position of Superintendent of Motive Power with the Monon Route with headquarters at LaFayette, Ind. He will retire from this position to come to the Lehigh Valley, where he succeeds F. N. Hibbitts, resigned.

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ENERGY

(Its Relation To Moving Trains)

Energy is an element which pervades the universe—mobile, fluid, restless, resistless and eternal.

The Scientist, in attempting a definition, says Energy is the capacity for doing work.

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Energy flows—as a fluid—under pressure.

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As Air Brake Designers and Engineers we must give, continuously, the most careful consideration to the problems of Energy.

Westinghouse Air Brake Co.

PITTSBURGH, PA.

TRADE MARK

RAILWAY MASTER MECHANIC

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The Steel Boom and Prosperity

It has been pointed out, not without reason, that the fact that our steel mills are busy, does not necessarily represent the advance of general business throughout the country. It ought to be an index of prosperity, but just now we are passing through an exceptional period in the world's history, where the abnormal demands of the great war have, for the time, almost eaten into the heart of the steel-producing industry.

There is, however, no doubt that at this time the wheels of prosperity are beginning to turn, and business all over the United States has taken an upward trend. The point for construction engineers, mechanical engineers and supply men generally, is to recognize the fact that steel producers and metal workers in allied fields of endeavor are full of orders arising from the demands of war, and if the legitimate and increasing business of our railroads are to be adequately met, it behooves them to make arrangements to place orders as soon as possible, so that deliveries will not be delayed so as to stagnate actual work. Wherever work is decided upon, the time ahead is none too long before it may be urgently required, therefore it is the part of wisdom to prepare for future contingencies with as little delay as possible, and when the war does cease the transition will not be as abrupt as it otherwise would be.

Valuation of the Railroads

Since the work of placing values on the railroads of the United States was begun, those engaged in this stupendous task, which will, without doubt, be of no avail in the end, have partially examined or surveyed some 50,000 miles—one-fifth of all the lines now in operation. At this rate it will require four or five more years to complete the entire work. The surveys, up to date, do not include land valuations, which was one of the features of the Act of Congress which set this whole matter in operation.

Not to mention the great expense thrust upon the railroad companies to bring the valuation project to an end, it might be easily estimated that the government will incur an outlay of $15,000,000. And all this for what?

The valuation notion which originally sought to secure the worth of our railroad systems, in other words to learn their money value, may have had some meritorious object in view; but just how this information can be of service in establishing consistent and just rates, which possibly was the ultimate end, is not easily comprehended. It seems that, thus far, the valuations secured show under capitalization rather than an excess. Considering the monstrous cry that the railroads of the country have been grossly over-capitalized this showing has caused some surprise. Until the entire valuation scheme is brought to a finish there will be no results obtained that will be of material use. A matter extending over so many years leaves the field of valuation so uncertain that what might have been a true conclusion now, will be false, unjust and absolutely unreliable five years hence. The foundation of this vast public demand is therefore established upon speculative problems and uncertainty.

If behind this move, to determine railroad valuations, lies a desire on the part of the politicians to secure government ownership of these properties, the people may, with reason, rise up against it, for we have so many instances of other government owned railroads which have resulted in gross mismanagement and waste of money that the idea is little short of grotesque. In the end, leaving some of these possibilities out of consideration, it is safe to say that this expensive and complicated valuation enterprise will leave the railroad problem exactly where it stood before these enormous expenditures were incurred.

Boiler Feed Water

Scale on locomotive boiler flues has come to be taken for granted. Special machinery has been designed to rumble the flues and take off the scale, and this process has become as much a part of the routine of general repairs as cutting and welding the flues or renewing boxes.

Pitting of the flues and boiler shell, but more particularly of the water covered surface of the firebox is also being taken for granted—being considered inevitable.

Elsewhere in this issue an analysis is made of the reasons for the deposit of scale, and the formation of pits,—starting with boiler feed water as it leaves the clouds, and following it until it leaves the locomotive as exhaust steam. A locomotive boiler may be likened to a still in which by boiling off the pure water, the impurities which continuously enter dissolved in the feed water, are concentrated until their activity and capacity for damage become very much greater than would seem to be indicated by an analysis of the original feed water.

The characteristic analyses of a number of types of feed waters are given, with an explanation of what results in the boiler in each case, why such results are sure, and the methods used in determining the chemical reasons for the results.

A broader understanding of the boiler feed water problem will result from studying the actions and results of impurities from the standpoint of the chemist and the man familiar with the exigencies of railroad locomotive work.

Owner's Defects On Cars

The question of repairs to what are called owner's defects on freight cars has made some progress of late years, but is far from being finally settled yet. The progress to which we refer is that cars having owner's defects may be repaired with M. C. B. standard material, or, of course, with material proper to the particular design of car. This is some advance on the original idea that a car where the repairing company had no material on hand belonging to the car, it was forced to send for it.

In course of time the system now in vogue grew up. An army of inspectors booked defects on cars received, so that they could pass them home in the same condition. There was in fact a sort of tacit agreement not to make the rapairs unless compelled to do so, and to let owner's defects take care of themselves.

All this works well enough as far as the reduction of time and material on foreign cars is concerned. It is true that the handling company could make the repairs and charge the owners with the cost according to the rules, and not be out of pocket, but the argument against this is simple enough. It is in effect that the handling company does not want to put its men on work of that kind, even if paid for it. The company is in the position of a tradesman or shopkeeper who has all the work he can do with his staff, and so refuses new orders.

A railroad, unlike the tradesman, cannot refuse "new orders" in the shape of a car having owner's defects, because it must receive the car, but it does not make the repairs for its own reasons. If a car was offered in interchange for which the delivering company was responsible, it would give a defect card or make rapairs before delivery. Any argument which involved the idea that its men were busy enough on its own equipment, would then not hold at all and repairs would be made.

Here we have the making or not making of car repairs governed by two different ideas, and those who advocate passing cars with owner's defects, would probably hold that by this distinction, a company would not have to do as much work as it would if repairs to owner's defects were compulsory. This is quite true as far as it goes.

To offset this view, it may reasonably be said that the present system involves a very large clerical force and it takes up time to get the record where that is deemed necessary and to transscribe it, and it subsequently involves time in looking up the record and sometimes it involves correspondence.

The joint inspector is the final arbitrator in all such cases, and this official has most justly been the recipient of genuine appreciation. It is to his good judgment and ability that the whole system works as it does, and he is not responsible for the money value or the want of it, which may inhere in the system. In a recent address Mr. W. S. Laycock said in speaking of the average car inspector, that he should bear no grudge; a man cannot inspect cars with a grievance, whether against a foreman, the operating department, or about his remuneration.

The question of compulsory or optional repairs to cars having owner's defects is likely to call for readjustment perhaps in the near future. We all know what the system is now. Making these repairs a part of the duty of the handling company would tend to reduce clerical work. It would make records less important than they are now, and might promote the use of the hammer and the wrench rather than the note book and the pencil.

These are advantages which would become more apparent after the compulsory repair system had been in vogue some time, but there is an advantage which would operate at once and would be of direct value in the maintenance of cars. Owner's defects on cars kept in service do not mend themselves, and though the present system may facilitate the movement of cars, the defects tend to grow worse, and when they reach a certain stage may help a defect to grow into one for which the handling company is responsible. Some roads pass owner's defects without record, believing that repairs may be made wherever found, but other roads make records so that in case owner's defects at last involve their own responsibility they will have something to show for their contention that part only of a serious defect belongs to them. There is no real way to test the effectiveness of the compulsory repair theory except to subject it to the service test of actual everyday railway work. It is likely that it would be satisfactory, and seems to be worth a trial.

Results of a Year in Pennsylvania

The investigator of accidents for the State Public Service Commission of Pennsylvania shows, by a recent report, that during the year which ended June 30, 1915, 60 per cent. of all the fatalities occurring on the railroads in Pennsylvania were due to trespassing on railroad property. Nine hundred and ninety-nine persons were killed on the steam railroads in that time—609 of them trespassers, and there were 105 more who lost their lives at grade-crossings.

Of the vast number of passengers carried by the railroads in that year, only two passengers were killed in train accidents, and it turned out after investigation that in these instances there was neither negligence on the part of the railroad company nor its employes. While the total number of accidents of all sorts for the year showed a considerable increase, fewer trainmen and passengers were injured than during the previous year. This reflects great credit on the part of the railroads, indicating efficiency and close attention to the matter of safety. If people will trespass, however, they should assume all the responsibility and not go beyond themselves or ask for redress when their heedlessness results in misfortune.

The June Conventions

The usual preparations for the June conventions are being carried on with unusual enthusiasm, warranted by the belief that the pendulum is commencing to swing toward better times.

The Master Car Builders' Association, which meets this year June 14-16, is giving consideration to a number of subjects that should result in valuable data and recommendations.

The American Railway Master Mechanics' Association meeting, June 19-21, has a number of distinctly new subjects to consider, among which, the design, maintenance, and operation of electric rolling stock, Mr. C. H. Turner, committee chairman, will be watched with unusual interest on account of the increasing importance of this subject in the future of steam road development. The equalization of long locomotives, Mr. S. G. Thompson, committee chairman, is a matter the importance of which has been growing with the lengths of our more powerful engines.

The Railway Supply Manufacturers' Association reports that indications for the largest and best attended convention are founded on twice the applications for space at this time that were recorded at this time last year. The first space allotment, which will take place at 10 A. M., February 18, in the office of the association, 2136 Oliver Building, Pittsburgh, Pa., will undoubtedly dispose of the most attractive locations, and as applications for space will be considered in the order of their receipt, manufacturers who contemplate exhibiting in June will do well to be represented at this meeting.

The convention will be held at Young's Million-Dollar Pier, under the same arrangements as last year. The decorative features of the pier will be entirely new, although the color scene of green and white will be preserved. The arrangement of Aquarium Court is materially different and greatly improved over last year, and the aisleways will be under roof. The Annex will be improved by enclosing the greater part of the building with glass sash and by using new matting on all aisles. In Machinery Hall there will be no dividing railings and the floors will be especially cleaned and oiled.

The mechanical departments of railroads look forward each year to the June conventions as the big step in advance of the railroad year. The interest shown by railroad men and supply men in contributing to the value of the convention, returns to them many fold in the profitable results of the co-operative efforts of all.

New Railway Equipment for Mexican Trade

One of the greatest obstacles to the reopening of the business in Mexico, says a government commerce report, is the shortage of railway equipment. The railways are greatly in need of more locomotives and a very large number of freight and passenger cars. It is believed that when a new supply of locomotives and freight cars is obtained, the railways will then operate a sufficient number of trains to meet the growing demands resulting from improved conditions.

Many American and foreign mining men have returned to Mexico in the hope of opening up and operating their properties, but some of them believe that it will be impossible for them to operate until the railways are more adequately supplied with cars, so that they will be able to move the products of the mines to the smelting plants or to the ore markets. They state that as soon as they can obtain cars for their ore, most of the mines in this part of the Republic will reopen, which will cause the smelters to resume, and will furnish employment to thousands of laborers. The smelting plants cannot reopen until they receive a proper amount of ore, and the various industrial plants, which depend upon the mining interests for much of their business, will await activity among the mines and smelters.

It is understood that arrangements are being made to furnish a sufficient number of locomotives and cars to supply these demands, and it is believed that this will result in considerable improvement in all lines of business, and will give employment to a very large number of men.

While conditions in the agricultural districts are not as good as they were in normal times, the crops have yielded a considerable amount since the period of last summer's famine. Americans in this part of the country were never treated with greater consideration than they are to-day. General good feeling prevails. Our machine toolmakers and railroad equipment supply firms have here a good opportunity to do a good deal of very profitable business, and the opportunity thus afforded should not be allowed to slip away, but promptly utilized, and to the full.

A complete revision and detailed classification of the names of importers and merchants in Central America and West Indies made by the American consular officers in co-operation with the Bureau of Foreign and Domestic Commerce, has been published as a section of a new edition of the World Trade Directory. The lists have been brought up to date and are presented in uniform style, with a finding index. A new feature is the listing, so far as the information could be obtained, of the American and other foreign agents of Central American and West Indian importing firms, and of the names of the parent firms of branch houses located in various Central American and West Indian cities.

Mikados for the Missouri, Oklahoma & Gulf Railway

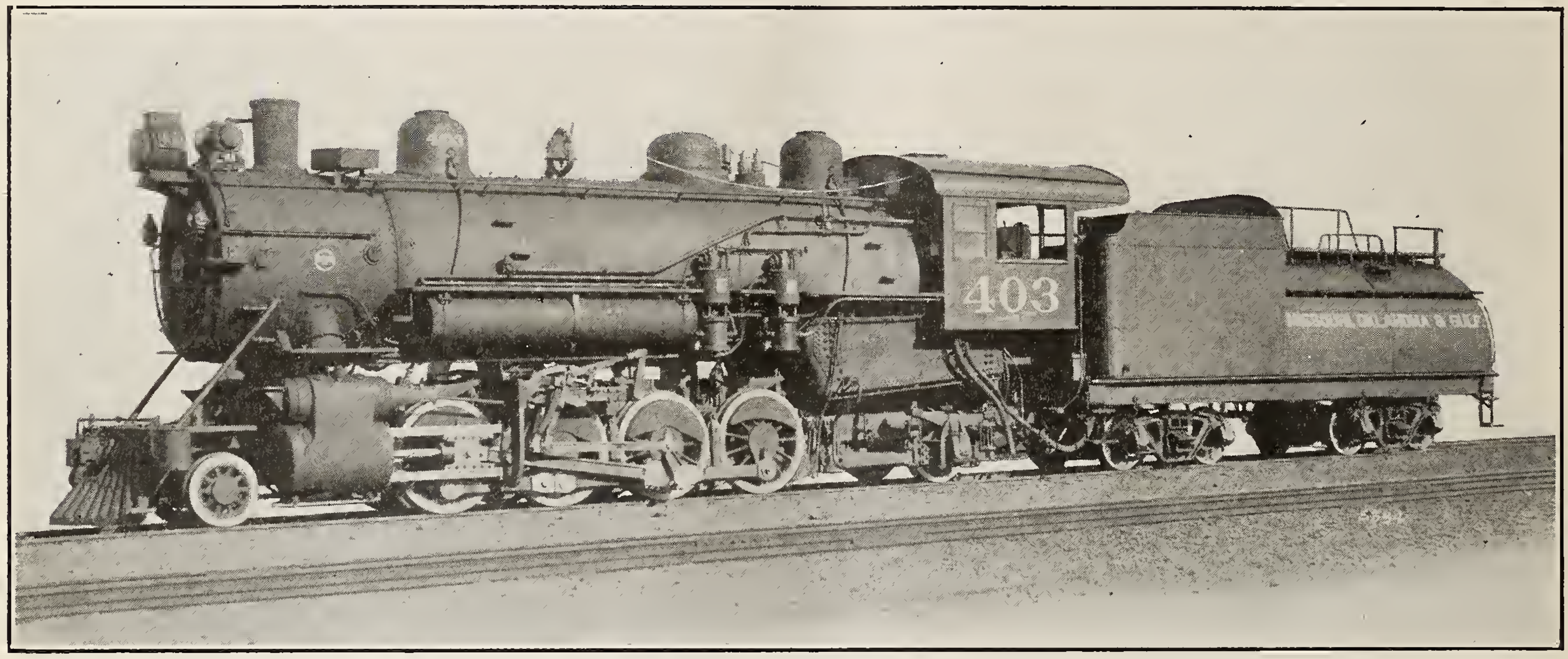
Baldwin 2-8-2 Locomotives With High Ratio of Tractive Force to Heating Surface. With Rushton Drifting Throttle and Southern Valve Motion

The Baldwin Locomotive Works has recently built four locomotives of the Mikado or 2-8-2 type for the Missouri, Oklahoma & Gulf Railway. These engines are of modern dimensions, as compared with the largest locomotives of their type; but considering the weight limitations imposed, a very satisfactory design has been produced. It is interesting, in this connection to compare the leading dimensions of these engines with those of a class of consolidation type of locomotives, twenty of which were built by The Baldwin Locomotive Works for this road during the years 1909-1912. This comparison is as follows:

Type	Cylinders	Drivers	Steam pressure	Grate area	Water heating surface	Super-heating surface	Weight on drivers	Weight total engine	Tractive force
2-8-0	20″ x 26″	52″	180	32.8	2,416	—	147,850	163,200	30,600
2-8-0	23″ x 28″	52″	180	57.2	3,778	838	176,600	230,900	43,400

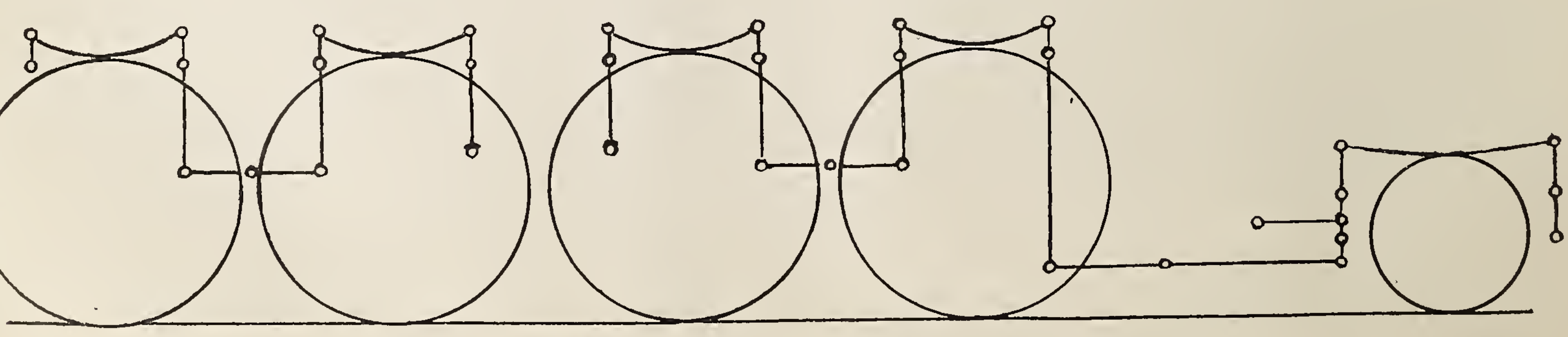
The consolidation type of locomotives use saturated steam, and develop 12.6 lbs. tractive force for each square foot of total heating surface. The mikado or 2-8-2 type of engines use superheated steam, and assuming that each square foot of superheating surface is equivalent to $1\frac{1}{2}$ square feet of water evaporating surface, the total equivalent heating surface becomes 5,035 sq. ft. This is approximately the amount of heating surface that the boiler would contain, if saturated steam were used; and one square foot would then be provided for every 8.65 lbs. tractive force. That is, in proportion to the tractive force developed, the steaming capacity of the mikado type, gauged by the heating surface, is approximately 45 per cent greater than that of the consolidation. This high relative steaming capacity is a great advantage in heavy service, as it reduces to a minimum the chances of steam failures.

For an increase in locomotive weight of 42 per cent, the mikado type shows an increase in heating surface, using the equivalent value, given here, of 108 per cent as compared with the consolidation engine.



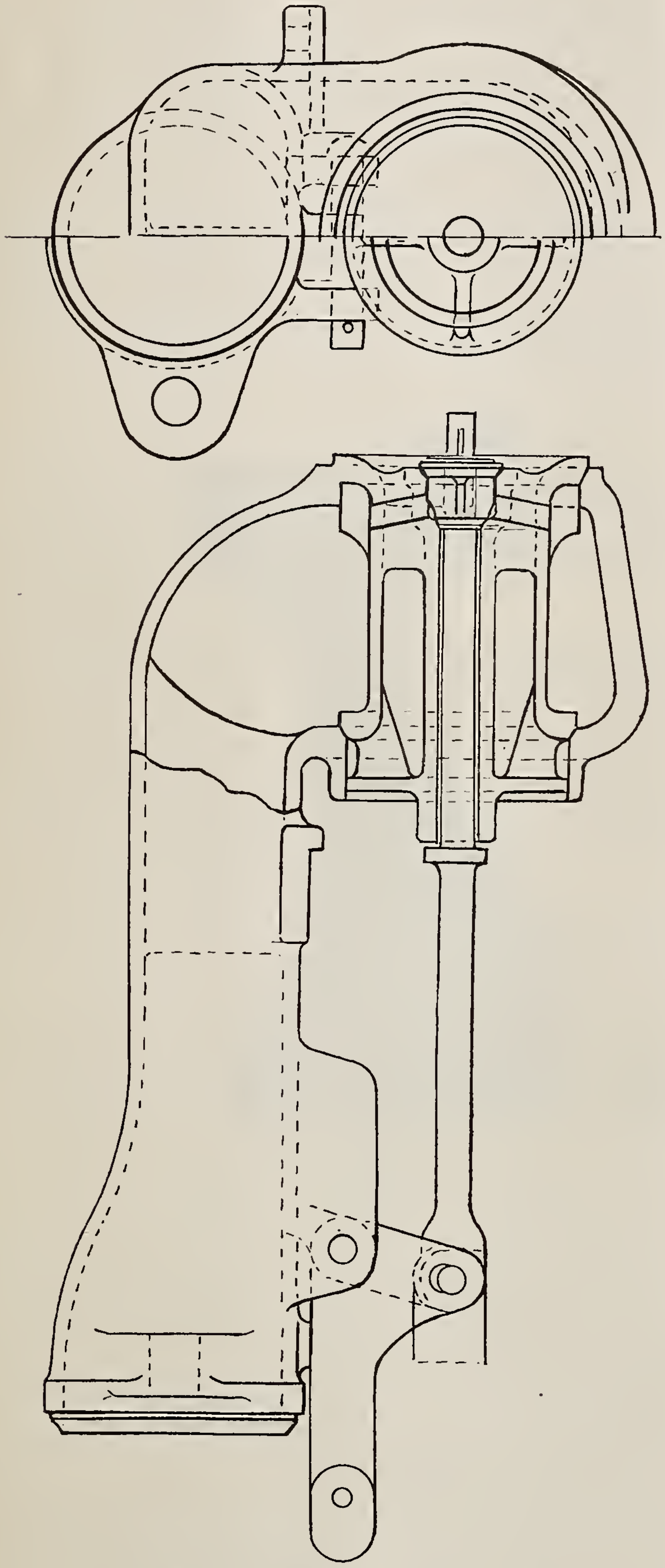
Locomotive of the 2-8-2 Type for the Missouri, Oklahoma & Gulf Railway
James Carr, Mast. Mech. Baldwin Loco. Works, Builders

The boiler of the mikado type, shown in our illustration, has a straight top, and is built with longitudinal seams having a strength equal to 90 per cent of the solid plate. The furnace equipment includes a brick arch and a power-operated fire-door. The front end of the firebox crown sheet is supported by two rows of Baldwin expansion stays. In this design, the nut on the upper end of the radial bolt is seated in a die-forged stirrup, which is screwed into the outside shell. After the nut has been screwed up, to give the desired tension, it is set into the bolt with a punch. This stay is strong and simple in construction, while it provides the necessary flexibility and uses ordinary stay bolt taps in the boiler shell.



System of Equalization Used on Baldwin 2-82 Locomotive

The throttle valve is of the improved Rushton type, with auxiliary drifting valve. The steam distribution is controlled by piston valves 11 ins. in diameter. The Southern valve motion is applied, and the gears are controlled by the Ragonnet power reverse mechanism. This device is operated by compressed air, and relieves



Rushton Drifting Throttle Valve

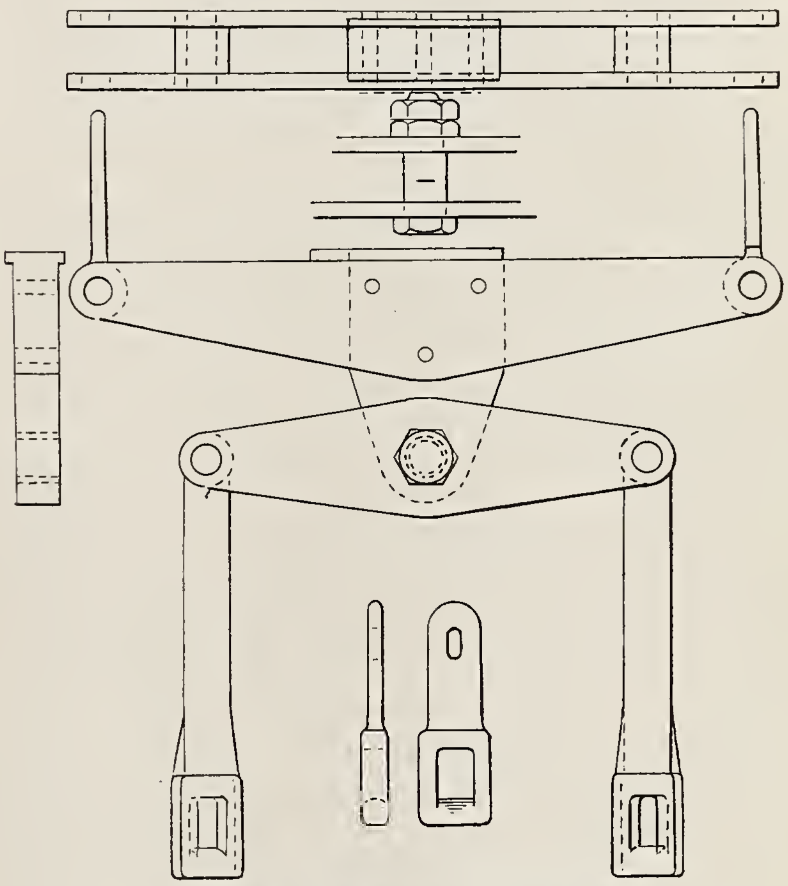
the engineman of considerable labor in handling the locomotive.

The rear truck is of the Hodges type, and is equalized with the third and fourth pairs of driving wheels. Back of the fourth pair, the locomotive is cross equalized by two transverse beams which are connected by a central vertical link. This construction tends to prevent any transverse rocking action from being communicated from the driving-springs to the rear truck springs, or vice-versa.

These locomotives have electric head-light equipment. Train numbers can be displayed in a suitable frame mounted on the smoke-box, and these numbers are illuminated at night.

The tender frame is composed of 12-in. channels, and the tank is semi-cylindrical in cross-section. A coal pusher is provided so that the fuel can be mechanically moved within easy reach of the fireman. The tender trucks have cast steel side frames and triple elliptic springs.

The following table contains the leading dimensions of these locomotives: Gauge, 4 ft. 8½ ins.; cylinders, 23 ins. x 28 ins.; valves, piston, 11 ins. diam. Boiler—type, straight; diameter, 82 ins.; thickness of sheets, ¾ in.; working pressure, 180 lbs.; fuel, soft coal; stay-



Cross Equalizer and Hangers

ing, radial. Fire Box—Material, steel; length, 114 3/16 ins.; width, 72¼ ins.; depth, front, 81½ ins.; depth, back, 67½ ins.; thickness of sheets, sides, 5/16 in.; thickness of sheets, back, 5/16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.. Water Space—Front, 5 ins.; sides, 4 ins.; back, 4 ins. Tubes—Diameter, 5⅜ ins. x 2 ins.; material, steel; thickness, 5⅜ ins., No. 9 W. G., 2 ins.; No. 12 W. G.,; number, 5⅜ ins., 38, 2 ins. 265; length 18 ft. 6 ins. Heating Surface—Fire box, 208 sq. ft.; tubes, 3,540 sq. ft.; firebrick tubes, 30 sq. ft.; total, 3,778 sq. ft.; superheater, 838 sq. ft.; grate area, 57.2 sq. ft. Driving Wheels—Diameter, outside, 52 ins.; diameter, center, 46 ins.; journals, main, 10 ins. x 12 ins.; journals, others, 9½ ins. x 12 ins. Engine Truck Wheels—Diameter, front, 30 ins.; journals, 5 ins. x 10 ins.; diameter, back, 36 ins.; journals, 7½ ins. x 10 ins. Wheel Base—Driving, 14 ft. 3 ins.; rigid, 14 ft. 3 ins.; total engine, 32 ft. 4 ins.; total engine and tender, 65 ft. 7½ ins. Weight—On driving wheels, 176,600 lbs.; on truck, front, 20,200 lbs.; on truck, back, 34,100 lbs.; total engine, 230,900 lbs.; total engine and tender, 385,000 lbs. Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel, 13 tons; service, freight.

The Chemistry of the Chilled Iron Car Wheel

First of a Series of Analyses of Conditions of Manufacture and Service Resulting in Failures Classified in Code of Interchange

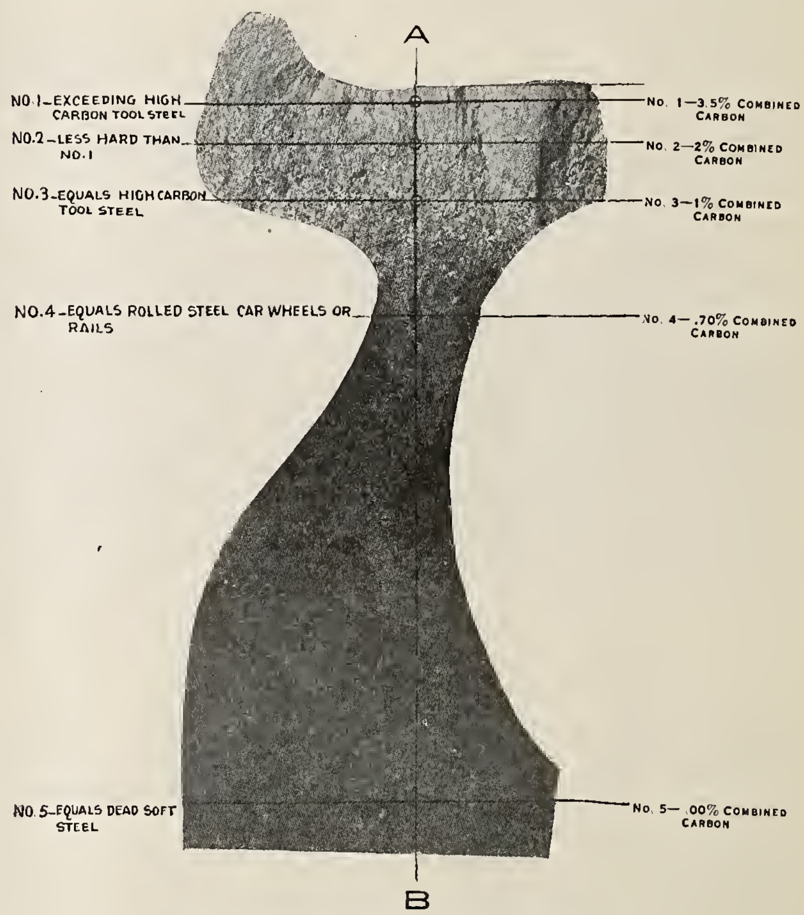
Not long ago at a meeting of the Richmond Railroad Club, Mr. F. K. Vial, chief engineer of the Griffin Wheel Company, presented a paper on "The Chilled Iron Wheel," which is perhaps the most scientific, and most fully detailed presentation of the whole chilled iron car wheel question which has ever been brought to the attention of railroad men. In presenting a digest of this valuable contribution to the literature of the subject, we have not reproduced the phraseology used in the paper, but have endeavored to give the significance of the researches and the results of the close study of the subject that Mr. Vial has brought out. We have, however, made, where possible, some observations and offered explanations which may assist our readers in the realization of the difficulties which have been surmounted in the task of exhaustively analyzing the chilled iron wheel.

The paper opens with the statement that about eight million tons of iron are required to make the twenty-five million car wheels used in railway traffic. Iron in some form is the only suitable metal for the manufacture of car wheels, but the requirements which railroad service presents are so various that was it not for the wonderful properties which lie domant in this metal, and brought out by scientific treatment, the use of chilled iron for this purpose would not only be dangerous, but actually impossible. Pure iron is too soft and ductile and of so low a tensile strength as to be entirely unfit for modern railroad car wheel use. The combination of iron and carbon, however, affords a means of successfully meeting the various requirements of service in such a way as to make it practically an ideal substance to use in car wheels.

Its tread is sufficiently hard to withstand the very heavy wear it is exposed to, while carrying concentrated loads at high speeds, yet it is the least destructive in its action on the rail. It enables a brake shoe to be used, having a high co-efficient of friction, which gives great retardation, and reduces brake shoe wear to a minimum. Added to all this, the hub of the wheel is required to firmly grip the axle when pressed on the wheel-seat, with the requisite tonnage. These requirements, which call for a hard tread, and a soft hub, might well discourage the manufacturer, if the secret by which it may all be accomplished, had not been revealed to him. A careful chemical analysis of the composition of the iron and carbon makes plain the reason for the desirable action of the metal in forming the wheel.

In the paper Mr. Vial exhibits a section of a chilled iron car wheel from hub to tread, and also speaks of a similar section of a steel wheel. The chemical analysis of each section of wheel shows the metal in both cases to be an alloy of iron and carbon, containing what are here regarded as impurities, viz: silicon, manganese, phosphorous and sulphur. Both are therefore in the same group, but the chilled iron wheel contains 3.50 per cent of carbon and the steel 0.70 per cent. Putting this in ordinary figures, it appears, if one dollar be the total value of chilled iron, there would be 3.50 cents worth of carbon; while in the steel the carbon would be represented by .07 cents.

The distribution of the carbon varies in the chilled iron wheel so that by the use of a chill mould, tread and hub are made to differ. The metal when in the molten state holds the carbon in solution. The comparatively sudden cooling of the mass, in the neighborhood of the chill, "sets" the chemically combined carbon and iron in the form of carbide of iron, Fe_3C. This alloy is very hard, exceeding that of high carbon tool steel. In the zone forming the tread, the carbon is all combined with the iron, and is distinctly a pronounced, stable, alloy. The atomic weight of iron is 56 and that of carbon is 12, so that the three atoms of iron required to take up one of carbon, makes the molecular weight of the compound 180, of which fourteen parts by weight are iron, and one is carbon. This compound is called cementite, and of this the tread of the wheel is formed. Cementite is white in color and is exceedingly hard.



Section of Chilled Iron Wheel

The beauty of the process seen in the behavior of this alloy is revealed by the analysis of the metal taken at a point about ⅞ of an inch below the tread surface, No. 2. A sample at this point shows 2 per cent of combined carbon or cementite, mixed with 1.5 per cent of graphite. This is a form of carbon made up of flat, hexagonal crystals, and is practically the same material as the "lead" of our pencils. Here the total amount of carbon is the same as that at the tread where no graphite existed, but at ⅞ of an inch below the surface, at point No. 2 in our illustration, the carbon appears as cementite and graphite, and uncombined or pure soft iron called ferrite. The presence of the cementite in lesser quantity, and in close and intimate relation to the uncombined iron or ferrite and the graphite, gives the wheel hardness, but in a less degree than at the chilled surface of the tread.

The hardness of the tread exceeds that of high carbon tool steel, while the composition of the metal at this point, that is, ⅞ of an inch below the tread surface, approximates so closely to high carbon tool steel as to be practically equivalent. In this case if it was possible to remove the graphite, so as to leave the cementite and the ferrite, as they stand together, constituting 98½ per cent of the total metal, and submit this material to a metalographist, he would report that it is identical in composition with high carbon tool steel and that he could not distinguish it from steels made by the cementation or the crucible process. This zone is one of high carbon tool steel, through which is distributed 1.5 per cent of graphite. A similar conception might be that of a fragrant smoking mixture, through which bran had been distributed, and compressed into a solid cake. The whole corresponding to the composition of this metal zone of the wheel. If it was possible now to remove the bran from the cake, the close relation of the Virginia tobacco and the Latakia would restore the fragrant mixture, and would be like the high carbon tool steel containing the cementite and the ferrite.

Another sample of metal taken from a point 1½ ins. below the tread surface, No. 3, would consist of about the same quantity of iron as before, but with 1 per cent of combined carbon (cementite) and 2½ per cent of graphite, and of course, some ferrite, would also be present. If the graphite could be removed as we have supposed in the previous case, our metalographist would be compelled to affirm that the sample was in every way equal to the composition of the highest carbon steel rail, or was from a piece of steel made by any of the processes known in steel manufacture.

Further down, a sample at point No. 4, would show little change in the character of the metal, the difference being that there would be more graphite and less combined carbon (cementite). Here the combined carbon would be about 0.70 or 0.80 per cent, and if the graphite was removed and the remaining material analyzed by the expert as before, he would undoubtedly report it as equal to the steel commonly used in rolled steel wheels, ordinary rails, etc.

The last sample, taken at point No. 5, and therefore drawn from the hub, would probably contain 96½ per cent of iron and 3½ per cent of graphite, there being in this region no combined carbon (cementite). If analyzed as the previous samples have been supposed to have been analyzed, that is with the graphite removed, the expert would identify the sample as equal to dead soft steel, being without combined carbon. The material, as examined by the expert, minus the graphite, would be ferrite pure and simple. The composition of the hub is therefore such, that when bored out to the proper size and forced on the wheel-seat with the pressure required, is found to grip the axle so firmly as to make a safe and permanent fit.

Considering these tests of the samples taken from various portions of the wheel, it is evident that the composition of the different zones is made up of from 96½ to 100 per cent of the total metal in the wheel and that what remains varies from 0 to 3½ per cent of graphite. With the graphite taken out, a specimen of most exquisitely graded steel exists, shading up by imperceptible degrees, through all the various forms of wrought iron, structural and medium steels to high carbon tool steel. The graded hardness of this ideal specimen has no equal in the steel industry. It responds to the most exacting and varied requirements, beginning, as it does, with the hardest known composition for wearing surface, backed by metal equal to the strongest grade of steel, and shading down to an easily machined and tightly holding metal, at the hub.

From this it is easy to see that from the chemical, physical and metalurgical standpoints, the chilled cast iron car wheel far outranks anything so far produced, which is thoroughly homogeneous throughout. The graded hardness of the chilled iron railroad wheel is precisely what an experienced maker would choose, so far as science goes today, if he was to use a chart showing the physical properties of the iron-carbon group, or indeed, the properties of the entire range of known metals, and selected, with free choice, the properties best suited for each part of the railroad car wheel. The gradation of structure suited to function, is one of the most beautiful and most perfect that has been found by means of any experiments in the whole realm of metalurgical research.

Does Not Like the "No-Kicker"

Editor Railway Master Mechanic.

Sir: In the November number of your valuable magazine I find an article by Mr. William Shriver, on the "Dynamiter" and what it eliminates. The account reads as if the device was going to kick itself into a prominent place in the air brake world, but it does not go half far enough, I mean the "No-Kicker." It should eliminate leaky brake cylinders, long and short piston travel and all possibility of train line leaks. These trifles are neglected as a matter of course, if the "No-Kicker" can overcome these every-day conditions, it will automatically eliminate the necessity for its own use and the result of undesired quick action.

Who ever heard of a train buckling, surging and giving all manner of shocks when the brake power was equal on each car? Did not Mr. Westinghouse invent the quick action tripple valve so as to set the brake on each car quickly enough to prevent the slack from running in or out. Has not this tripple valve been improved by adding the quick service port? If the brake power is equal on each car, will it be possible to throw the flagman from one end of the caboose to the other?

We have enough neglect in the up-keep of the brakes, as it is, without adding anything more. If anything is to be added to the brake equipment, some kind of an alarm or red danger signal will do. It should be so arranged that it will flutter before the eyes of the air brake inspector or whoever is responsible for train line leaks or unequal piston travel or leaky brake cylinders. More people should read Mr. W. V. Turner's "Thunder" on air brakes. He puts the responsibility for shocks where it belongs. Until the time of Mr. Turner's investigations, the cause of all shocks was shifted to the engineer or to the "Dynamiter." I am not itching to get into print and will sign as a reader of your valuable magazine.

Ft. Worth, Tex.

A READER.

The G. T. P. steamships operating in the North Pacific Coast waters have covered over eighty thousand miles during the season of 1915. This is considered one of the most remarkable records in the coastwise trade. Running between Prince Rupert and Seattle, the steamship "Prince Rupert," between June 8 and November 4, steamed 40,717 miles, almost twice the distance round the world. Her sister ship the "Prince George" covered 40,840 miles. The average distance run per day by these vessels was 395.86 miles, and the average speed per hour 16.49 knots. In order to keep their schedules, these steamships often steam over 18 knots, reeling off better than 400 miles in a day. The service is being maintained between the transcontinental trains of the company at Prince Rupert and the cities of Victoria, Vancouver and Seattle throughout the winter.

The Line of Draft

A Discussion of Draft Gear Capacity and Travel, with Reference to Slack and Shock in Trains

Some very instructive remarks were made by Mr. H. C. Priebe at a recent meeting of the Car Foremen's Association of Chicago. In dealing with the buffing shocks he said, among other things, that the M. C. B. committee stated that the intensity of end force is assumed to be equivalent to 250,000 lbs. static, which may be concentrated on the center line of draft gear or distributed between the draft gear and end sill. The point of contact between horn of coupler and striking plate is assumed to be 2 ins. above top of coupler shank. For a shank 5 ins. deep the distance from center line of draft gear to assumed point of contact of coupler horn is 4½ ins. The proportion of end force acting on striking plate is assumed to be 250,000 lbs., less the resistance of the draft gear when the horn of coupler touches the striking plate. Hence, when the coupler shank is 5 ins. deep and horn of coupler is allowed to touch the striking plate before draft gear is solid, the end force of 250,000 lbs. is effective on a line located a certain distance above the center line of draft gear. This is the first time, to my knowledge, that any mechanical body has ever conceded that the center line of end force is above the center line of coupler. This is as it should be, as there is no draft gear that I know of that is of sufficient capacity to entirely absorb this end force.

Go out and see what we find in every-day service. Take a level yard, where the switching is usually done by a switching crew of three men. Do you find any of them setting brakes to diminish impact with other cars? Do they switch cars at less than four miles per hour, or an ordinary walk? How long would a switchman remain in service that could not "hit the ball"? Go to the hump yard, and, while conditions there are improved because they aim to keep sufficient men there to ride all cuts of cars that go over the hump, every once in a while a cut will get away and the result is disastrous. On the road a smash is entirely due to the slack in the train.

The strongest argument against the spring gears is a supposed recoil, but recoil we must have or we have no draft gear. If the recoil were as great as some people think it is, disaster would follow. No one hesitates to place sufficient springs in the trucks of cars to properly carry the load. The movement of standard truck springs has a range amply sufficient to furnish the resilience required to properly carry the load on a good roadbed, and if we would furnish the same resilience in the capacity of the draft gear, with approximately the same travel, we could then come nearer to eliminating our road trouble, and by placing a reliable car inspector in classification yards to report all damage done to cars by rough handling, then and not until then may we hope to attain 100 per cent efficiency.

What seems strange is that many people overlook the fact that in train service there are always two draft gears between two cars, and every time the travel of the draft gear is increased one inch the movement between two cars is increased four inches, at the same time doubling the slack, which is causing more trouble than all of the other causes combined.

To illustrate this more forcibly, take a modern friction draft gear, many of which have a travel of 3¼ ins. These are placed in a car with the horn of the coupler 3¼ ins. from the striking casting. This allows the coupler to move in 3¼ ins. and out 3¼ ins. from the normal position, allowing each coupler to move 6½ ins., and as there are two couplers between two cars, there is 13 ins. of actual movement, without considering clearance between knuckles, which will average another inch, making a total of 14 ins. between each two cars in a solid steel train.

A train of 100 cars has 116 ft. 8 ins. of movement between cars, of which there is 62 ft. 6 ins. of slack and 54 ft. 2 ins. of resistance when new. After a year of service the gears have lost another inch of resistance from friction wearing surfaces and there is but 37 ft. 2 ins. of resistance and 79 ft. 2 ins. of slack, and so on until we have nothing but slack. The result is the increasing cost of freight car repairs. The fact of the matter is we are trying to absorb momentum with the draft gear, that should be controlled by the brakes.

My experience has been that whenever an engine failed to start a train with resilience enough to equal one revolution of the drivers, she was unable to take the train to destination.

It is not a question today of having sufficient draw-bar travel to start freight trains, but it is a question of having an engineer who can start a train without breaking it in two, due to excessive draw-bar travel. The resistance should be increased and the draw-bar travel should be reduced to produce results without depending on the engineer's judgment as to how much slack he can take with safety.

Good results were obtained when the resistance in the end of the cars exceeded the carrying capacity of the cars. Today the trouble is that the capacity of the car exceeds the capacity of the draft gear. To prove this observe in a yard how about 90 per cent of the draft gears can be and are stretched out dead by a locomotive having a tractive effort of less than 70,000 lbs.

As an example, take a train, about dusk, and at a speed of about 12 miles an hour. Suddenly a red light was seen a few car lengths ahead. The engine was abruptly stopped and there came a most severe shock. The red light disappeared and green came in view. It had all been caused by a man with a red and green lamp, hearing the train, turned to look and inadvertently displayed the red light. The shock damaged two cars so badly they had to be chained up to bring them in.

Some people call this shock recoil of draft gear, but this is not the case. It was the slack in the train, for, as the head end of the train had stopped and the rear end was still running, the force of that moving rear end tonnage is what caused the shock.

The steel center sills in a car brought to the notice of the arbitration committee had a cross sectional area of 17.9, or nearly 18 sq. ins., and otherwise were within the recommended ratio of stress. Had this been a wooden center sill car it would have broken the combination. The steel sills had a greater strength than two 5x9 ins. wooden sills, and when more than two wooden sills are broken it denotes unfair usage. But it is different with steel underframes, as ruled by the arbitration committee in this case.

On the other hand, had the above steel center sill construction been built in combination with two 5x9 ins. wooden center sills, it would have had a strength equal to that required for all steel tank cars, or 30 sq. ins. The mere saying of 30 sq. ins. between bolsters does not cover it. It should be continuous for the full length of the underframe, and it should be based on the same fundamental principles used by the present recommended underframes for new cars other than tank cars.

Moving Picture Car to Promote Safety on the N. Y. C. Lines

Car Designed to Show Employees the Dangers of Careless Practices in Shop and Other Work as Part of Safety Campaign

The Interstate Commerce Commission's Report, No. 56, for the months of April, May and June, 1915, has just been distributed. It contains a very close analysis of the collisions, derailments and other accidents resulting in injury to persons, equipment or roadbed arising from the operation of railways used in interstate commerce. In this report the term "industrial accidents," covers accidents not connected with train operation but occurring to railway employes, other than trainmen, on railway premises. This includes all those engines. It is 1,297 on duty, and 72 off duty. Coupling or uncoupling cars claimed a total of 425 injured. All these were on duty, and the operation referred to in the report does not include injuries with reference to air or steam hose. It is coupling accidents fair and square. Other accidents on or around trains was the cause of injury to 358 persons on duty, and to 36 persons not on duty. The bursting of, or defects in, locomotive boilers or boiler attachments caused the death of 2 persons and injury to 84.

"Movie" Car for Display of Safety Educational Pictures on the New York Central Lines

accidents which take place in railroad shops, roundhouses, repair tracks and other similar places.

The totals for this, the second quarter of the year just passed are 2,058 passengers, employes and others killed. At this rate the annual total would be 8,248, but in any case the number for this quarter, viz., 2,058 killed would be over 22 a day for 90 days. The number of persons injured in this quarter was 38,336. These are heavy totals for three months, but when the analyses is pushed further, and where the totals of killed and injured among railroad employes, are set down, the mellancholy import of the result obtained is definitely revealed.

In the three months under review, a total of 355 employes were killed, and this amounts to nearly one man a day. Of the killed all were on duty at the time of their death, except 26. The heaviest casualty group is that where 83 were killed by being struck or run over by engines or cars outside yard limits, 62 lost their lives from the same cause inside yards, and 54 met their doom by falling from engines or cars. Those not on duty who were killed from these causes were comparatively light, being respectively 9, 8 and 3.

When we come to employes injured, the total mounts up to 7,982, and of these 180 employes were not on duty when injured. The total divided by the number of days in the three months, viz.: 90 days gives an average of over 88 injured persons each day. In this case the greatest number of injuries occurred while doing work about trains. This totaled 3,720, all being on duty, and does not include this kind of work in shops, engine houses or switches. The next heaviest figure represents those injured in getting on or off cars or

From the figures given in the report, sad as they undoubtedly are, it is nevertheless justifiable to believe that accidents in shops and round-houses are, by comparison, infrequent, though they do take place. It is therefore fair to conclude that safety appliances and safety methods are making some progress, and for this the mechanical department has a right to feel good cause for satisfaction, while they nerve themselves to greater activity in the interests of economy not only of dollars but in the higher value of human life and limb.

Some of our larger railways have taken up this work

Display of Picture Inside of "Movie" Car

of safe operation seriously and in earnest. In our August, 1915, issue of "Railway Engineering and Maintenance of Way," we had occasion to mention the activity of the New York Central lines in their work of reducing the trespass evil. The trespassers are not exclusively tramps and hoboes, the great majority are employes of manufacturing concerns. These men walk on the track in preference to the highway. The N. Y. C. campaign was one of education directed to factories, schools and to the local magistrates who try cases of trespass.

In another field of safety work the New York Central has pressed the moving picture film into its service.

Workmen Looses an Eye by Neglecting to Wear Goggles Provided by the Railway

A picture entitled "The House That Jack Built" has been produced by this railway, and the story was written and the scenes devised by Mr. Marcus A. Dow, the general safety agent of the road. He has taken great pains to employ competent and clever people in the production of this picture. Mr. C. E. Davenport merits commendation for the manner in which the scenes are staged. Twenty-five actors and actresses were employed. Of the principals, the work of Mr. A. Thomas as Jack, and Miss Iva Shepard as his wife, are excel-

Injury to Foot Owing to Nails in Board Carelessly Left on Shop Floor

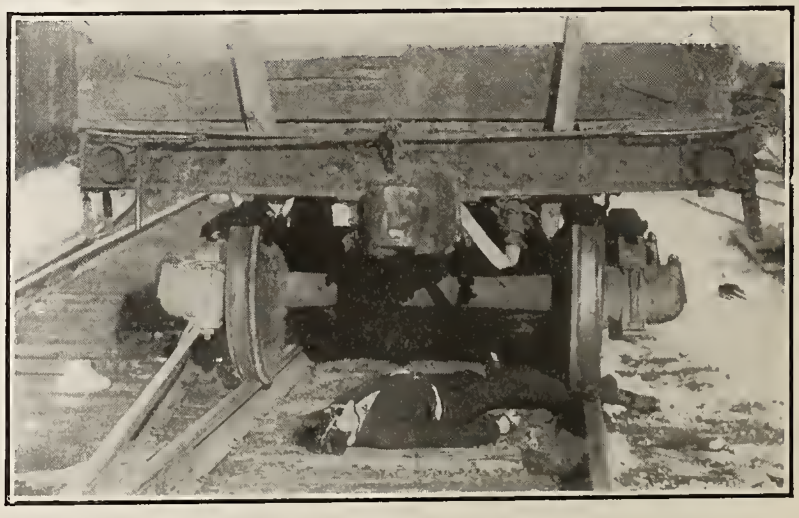
lent, as is also that of Mr. George Henry, who portrayed the conductor and was a booster for "Safety First."

The New York Central lines will show this film to the employes of the road and their families in a specially fitted "Movie" car, which will travel over the system, stopping at all yards and shops for daily exhibitions. Employes will be required to take the time to "see the show," with the view of teaching them the lessons in safety so impressively brought forth in this interesting and instructive series of scenes.

The title of the story is taken from the Mother Goose rhyme of that name, and in the unfolding of the scenes the lines of the old familiar verse are cleverly intertwined with the scenes. Jack Foster, a brakeman, who is a fine type of man in character and appearance, and has saved his money, is building a new house. Husband and wife are delighted over the prospect of moving into their new place. Jack, although a fine fellow, is seen to have one fault, that of carelessness while engaged in his railroad work. He is taken to task by the conductor, who is his close friend. His wife overhears the conductor tell Jack that sorrow will eventually cross the threshold of his home if he does not give up taking chances. The wife, haunted by visions of his carelessness, sees in her mind's eye a train collision due to her husband's neglect in failing to go back with his flag a sufficient distance to protect his train, which is stalled. One of the most realistic collisions ever seen in the "movies" is presented in a faithful reproduction of that awful form of accident. "Happiness was the malt that lay in the house that Jack built." Carelessness is shown to have been "the rat that was eating happiness, the malt, that lay in the house that Jack built."

Thoughtless Workman Struck by Moving Car

Among the scenes at a typical safety rally, one sees the result of carelessly leaving nails sticking up in a plank in a railroad repair shop passageway where a person might step on them; a shopman is seen to lose an eye because he refused to wear the safety goggles provided for his protection; a carpenter loses a finger while working at a buzz saw with the guard removed from the saw; a brakeman is knocked off the roof of a box car when a coupling is made, while standing carelessly too near the end; a brakeman who went between moving cars fell and his arm was run over in plain view of the audience; an employe stand-



Man Stunned, Helpless, Leg Cut Off by Wheel

ing between the rails and attempting to get on the fo board of an engine, falls under the engine and is kill

The psychological aspect of many of the acciden which take place was shown by a man quarreling a breakfast with his wife. He goes to the shop haunted by the memory of angry gestures and harsh words. With his mind thus absorbed he becomes practically oblivious of his surroundings. As he walks across the tracks, his body is there, but his mind is far away, and he is not

Result of Carelessness—"Flagging from the Back of the Caboose"

in full control of his faculties. He is struck down by a moving car and crippled for life.

We have looked at the hard figures of the commission report, and we have seen an honest attempt to mitigate the suffering and death of employes by a great railway. The kindly and sympathietic spirit which has grown up around us is here intelligently directed to secure a lasting good. It may be that later on other pictures forcing the dread result of careless or irresponsible action will be brought out, so that he who runs may read. The good work now to be done may render this unnecessary, but if need be the safety crusade, in able hands, may startle the thoughtless by a forceful vision of the grim reaper and the army who fall beneath his ruthless scythe, or they may yet be shown the figure of Atropos, who with relentless shears cuts the thread of strong and vigorous life; and in a moment we see only a windswept hillside and its thickly clustered graves.

The Baltimore & Ohio's Safety Campaign

Showing How a Few Ideas Well Put Bring Good Results

"Safety first" and "efficiency" are trite watchwords, but, once adopted for excellent reasons, there is no likelihood of their becoming out of date. They instill carefulness and are good mottoes to follow at all times. The benefits thus far accomplished by frequent repetition are indeed many, and will be lasting.

The Baltimore & Ohio are going right on vigorously, and have set an example in this direction which is most commendable. Under the supervision of W. S. Hoover, the B. & O. superintendent of police at Cincinnati, the company is sending hand bills broadcast among schools and homes, headed "Nevers," which originated with E. L. Tinker, of Leslie's. In small towns, and in neighborhoods bordering a railroad, in large cities, the iron horse and moving trains have furnished a novelty for children that never wears out. Called thither by the interest always to be obtained there, the average child will risk life and limb in its hunt for excitement and amusement. The railroad seems to be a never-failing source of pleasure and an attraction even to those of larger growth.

The "Nevers" run as follows:

Never cross the tracks by night or day without stopping to listen and look each way; never walk along the railroad ties—you can't always trust your ears and eyes; never hop a freight, for nothing quite heals the wound received under the grinding wheels; never, on a hot or sunny day, sit beneath a box car to rest or play.

Never crawl under a car of freight, when the crossing's blocked—play safe and wait; never play games around the tracks at the station—there are much safer places to seek recreation.

Never leave on the rail any spikes or bars, because in this way you may wreck the cars; never a railroad bridge should you cross, a train may come and result in your loss; never pick up coal 'round the railroad yard, a train may catch you off your guard.

The present campaign is resulting in much good. The list of accidents and the death rate, too, have been substantially curtailed. Mr. Hoover invites suggestions to aid him in his campaign not only from employes but the public as well. Fences have been put up, in places, to prevent trespassing. Crossings are being more carefully protected, and all kinds of efforts are being made to prevent accidents everywhere on the line.

There is no virtue in pain, suffering, sacrifice or unhappiness for its own sake. This illusion of asceticism is vanishing from the human mind. Sacrifice on the part of the individual is valuable and valid only when it results in higher present or future happiness for the individual or some one else. There is no virtue in pain, physical or mental, except as a step to a greater good for ourselves or others.—W. W. Atkinson.

Proceedings of the Traveling Engineers' Ass'n

Resume of the Important Subject Considered in the 1915 Proceedings

The report of the annual proceedings for the year 1915 of the Traveling Engineers' Association, has just come from the press. This organization has been steadily growing in importance since its inception in 1893. The total membership on August 1, 1915, was 1,063, and at that date the treasurer reported a balance in the bank with all debts paid. The growth and influence of this association has been remarkable. It started with only a few members, gathered together in Dr. Sinclair's office, and to-day its members come from the Atlantic and Pacific coasts, the Gulf of Mexico and from the railways of Canada. The president in 1914-1915 was Mr. J. C. Petty of the Nashville, Chattanooga & St. Louis. The secretary is Mr. W. O. Thompson, whose address is New York Central car shops, East Buffalo, N. Y. Mr. Thompson also holds office this year.

Passing over the opening exercises, we come to the paper "The Effect of Properly Designed Valve Gear on Locomotive Fuel Economy and Operation." The paper was presented by Mr. W. E. Preston of the Southern Railway. It occupies thirty-seven pages and is a most thorough explanation and scientific presentment of the whole subject, taking up as it does, not only the various valve gears in use, but dealing with tractive force, horsepower, the amount of coal used on an engine and the general principles of computing, and the calculations applied.

The paper on "Difficulties Accompanying Prevention of Dense Black Smoke and Its Relation to Cost of Fuel and Locomotive Repairs," was read by Mr. C. C. Shaw of the International & Great Northern. The paper was not a long one, and included mention of coal burning engines and locomotives where oil was used. One of the points brought out in the discussion was that where the officers of the road were dead against black smoke it had a very good effect on the men all the way down and did a good deal to stop the production of heavy, dense black smoke.

A paper read by Mr. L. R. Pyle of the Soo Line, on "Recommended Practice for the Employment and Training of New Men for Firemen." The new man, he believed, should be well grounded in the reason for doing the work as he will be asked to do it. A representative of the company should have a chance to start him right and not leave him to the mercy of some engine crew to get his ideas. A plan of instruction was outlined which any road interested in the subject could easily try. Moving pictures, it was suggested, might be used as a means of instruction.

A paper on "Scientific Train Loading and Tonnage Rating" was read by Mr. A. G. Kinyon of the Seaboard Air Line. The paper dealt with the best method by which to obtain maximum tonnage haul for an engine over an entire division, taking into consideration the grades at different points on the division. In this paper draw bar pull of locomotives was taken up, speed factors for saturated and superheated engines were given, internal and external train resistance and the determination of train weights were gone into very thoroughly. The car factor method of tonnage adjustment, weather ratings, with examples and instructions, also the kind and capacity of cars were carefully set forth.

Mr. J. E. Ingling of the Erie Railroad presented the paper on the "Advantages of Superheaters, Brick Arches and Other Modern Appliances on Large Locomotives, Especially Those of the Mallet Type." Among the modern appliances were mentioned the superheater, the pyrometer, the drifting valve, the brick arch, the mechanical stoker, the grates, the coal passer on tender, the automatic fire door, power reverse gear and the flange oiler. Speaking of drifting valves, the committee believed that some means should be provided to admit a sufficient amount of steam to cylinders and valve chambers on suprheater engines and on those having large cylinders. While there have been several types of drifting valves tried, the committee says in the report "there has not been one developed which will meet the requirements mentioned, that is a drifting valve which will open automatically when the throttle is closed and engine drifting, and automatically close when the engine stops, regardless of the position of the reverse lever. Unless a drifting valve will close automatically when the locomotive stops, it is not a safe device." Taking up the subject of brick arches the report stated that "we apply arches now to get more power, without increasing fuel consumption, where formerly we used them to reduce the fuel consumption, for the same power output."

A paper followed, "How Can Road Foremen of Engines Improve the Handling of the Air Brakes on Our Modern Trains?" This paper was read by Mr. C. M. Kidd of the Norfolk & Western. It clearly pointed out the need of instruction constantly given by the road foreman of engines to the enginemen, in the course of his travels. He himself should have a thorough knowledge of the subject so that he could handle and explain brake action under all circumstances.

The officers for 1915-1916, elected at this convention were Messrs. J. R. Scott, president; B. J. Feeny, first vice-president; H. F. Hanson, second vice-president; W. L. Robinson, third vice-president; G. A. Kell, fourth vice-president; A. G. Kinyon, fifth vice-president; David Meadows, treasurer, and W. O. Thompson, secretary. The topics for the 1916 convention to be held at Chicago next September is as follows: (1) What effect does the mechanical placing of fuel in fire-boxes and lubricating of locomotives have on the cost of operation? (2) The advantages of the use of superheaters, brick arches and other modern appliances on large engines, especially those of the Mallet type. (3) Difficulties accompanying the prevention of dense black smoke and its relation to cost of fuel and locomotive repairs. (4) Recommended practice and make-up and handling of modern freight trains on both level and steep grades to avoid damage to draft rigging and lading. (5) Assignment of power from the standpoint of efficient service and economy in fuel and maintenance.

Some interesting figures were placed before the association by Mr. F. W. Brazier of the New York Central Lines. The locomotives in the United States number 63,378; passenger cars, 62,674; freight and company service equipment, 2,474,013; employes, in the United States, 1,800,000. The standard passenger engine of twenty years ago cost about $13,000 and weighed 116 tons. To-day the Pacific type, 4-6-2, costs about $25,000 and weighs 215 tons. Passenger cars were wooden vehicles; to-day they are steel.

To correct deficiencies, remedy defective faculties, overcome peculiarities, and bring the mind into symmetry and poise, so that it will express its maximum of power, will form a large part of the education of the future.—O. S. Marden.

Analysis of Effects of Impure Boiler Feed Water

By W. A. CONVERSE

Extracts of Paper Presented to the Railway Club of Pittsburgh, in Which the Reasons for Scale Formation and Corrosion are Discussed

It is believed that water as it leaves the clouds is in a practically pure condition, and that the first opportunities for its contamination arise immediately following the beginning of its descent to the surface of the earth. In falling through the atmosphere, either as rain or otherwise, it takes up certain substances. Naturally these substances taken up are dependent upon the substances contained in the atmosphere through which it falls, which in turn are to a large extent due to the industrial conditions existing upon the surface of the earth. But there is one substance always present in the air, and that is carbon dioxide (CO_2) or carbonic acid gas. Men interested in the production of power from the combustion of coal realize that CO_2 is the constituent of flue gases or stack gases upon which can be based an opinion of the accuracy or the perfection of the combustion going on in furnaces. In a district where bituminous coal is the chief fuel, and where this fuel is largely impregnated with sulphur, which is the case generally with the middle states bituminous coal, the sulphur, in the process of combustion is also converted into another gas. This sulphur gas naturally impregnates the atmosphere and is dissolved by water falling through the air, and eventually converted into sulphuric acid which is of such a character that when in even a weak solution in water it will dissolve metallic iron very rapidly. There is also present in the atmosphere, at all times, another class of substances commonly known as the ammonia class, but not present in sufficient quantity to give the characteristic odor. The atmosphere carries some of this in practically all neighborhoods at all times, consequently more or less of this class of substances becomes a part of the impurities contained in natural waters.

Assuming now that the water has passed down through the atmosphere and has reached the immediate surface of the earth, it has taken up some carbon dioxide (CO_2), some ammonia, undoubtedly some sulphur gases, and probably some oxygen (since the air is made up, to the extent of twenty per cent of this gas)—all of these gases being in solution in the water itself.

What happens at the immediate surface of the earth? That depends upon the litter or refuse which covers the surface of the earth upon which the water falls. If the surface is strewn with decaying or rotting vegetable matter, such as timber, leaves, twigs, etc., it takes up more carbon dioxide (CO_2) because the process of rotting of timber, for instance, is nothing more nor less than a slow process of combustion, identical in character in every chemical respect with that which is going on underneath boilers. If the water falls upon a surface strewn with animal matter such as the stockyards district in Chicago, it takes up more ammonia at this point. Then, again, animal fats like tallow and lard are made up in part of fatty acids, and these fatty acids are rather soluble in water, and are readily taken up in moderate quantities by water coming in contact with them, and are extremely destructive to metallic surfaces. These are only a few of the substances that are commonly taken up just at the surface of the earth.

If this water is followed down through the channels of the earth another class of substances is taken up. The bulk of the substances taken up previous to this were gaseous in form. Some solid matter is, however, usually taken up at the surface of the earth, but it usually consists of organic substances, which will not be discussed in detail at this time.

Water is the greatest solvent known; that is, water will dissolve some of more substances and more of some substances than any other liquid known. There is practically nothing that is absolutely insoluble in water. This can not be said of any other substance that might be considered as a solvent. The solvent action of water is further influenced by the substances which it has taken up through its travels down through the strata of atmosphere, at the immediate surface of the earth, and while traveling down through the earth. For example, consider carbonate of lime (ordinary lime stone). If distilled water were passed down through a layer of limestone, it would not take up or dissolve a qauntity exceeding 3½ grains per gallon. But upon analysis of water samples from time to time quantities as high as 53½ grains are found. This means that 50 grains of the carbonate of lime in solution in this gallon of water is there simply because of the presence of carbon dioxide (CO_2) which had been previously taken up from the atmosphere or from the immediate surface of the earth, due to the decay of vegetable matter or otherwise, since 50 grains of carbonate of lime in such a water is held in solution by the carbon dioxide gas present. And this particular gas being very readily eliminated from water with a rise in temperature, the carbonate of lime must go out of solution when the water is heated. Water even at 140 deg. Fahr. will give up a considerable portion of this carbon dioxide (CO_2), and if maintained at 212 deg. Fahr. for a sufficient length of time will give up all its free and loosely combined carbonic acid gas, which would result in throwing out of solution these 50 grains of carbonate of lime, leaving in solution the 3½ grains only.

Following the travel of the water through the underlying strata of the earth, it takes up many other and different substances, mostly solid and mineral in character. If the water in traveling down through the earth comes in contact first with a deposit of carbonate of lime commonly known as limestone, it will take up or dissolve a quantity of carbonate of lime above 3½ grains per gallon depending upon the amount of carbon dioxide it has previously accumulated in passing through the air and over the immediate surface of the earth, and the length of time the water remains in contact with the limestone. If in traveling through the earth it comes in contact with a deposit of sulphate of lime, or what we know in its natural state as gypsum, we would naturally expect that the sulphate of lime or gypsum would be the predominating substance in the water. That is true in a sense. It is not necessarily true, however, because of this fact; if the water had previously come in contact with a deposit of carbonate of soda (soda ash) it would not dissolve or take into solution any appreciable amount of sulphate of lime. On the other hand, if it had come in contact with a deposit of salt (chloride of soda) before passing through the deposit of surphate of lime (gypsum), it would take up a very much larger amount of sulphate of lime than otherwise would be the case. The amount of the different solid substances a water will dissolve is to a considerable extent influenced by the kinds and quantities of other substances previously taken up and present in the water.

This chart shows all the substances which are found in practically all water, those containing other substances being by far the exception:

Chart No. 1.

Total Dissolved Solids	Incrusting or Scale forming solids	Silica Carbonate of Iron Alumina Carbonate of Lime Sulphate of Lime Carbonate of Magnesia Sulphate of Magnesia In presence with excess of Carbonate of Lime
	Non-Incrusting or Corrosive or Foaming Solids	Sulphate of Soda Chloride of Soda (Salt) Carbonate of Soda Chloride of Lime Chloride of Magnesia

Silica is nothing more nor less than ordinary, white sea sand, so to speak. Over 99 per cent of white sand is silica. Passing down to carbonate of lime, school crayon is the most common or ordinary form of this substance. Another common form of this substance is ordinary whiting.

Sulphate of lime is well known as plaster of paris. In its native condition it is known as gypsum. Sulphate of magnesia is an interesting salt from more view points than one. It is commonly known as Epsom salts.

In the second group, sulphate of soda, chloride of soda, carbonate of soda, chloride of lime, etc., is found chloride of soda (common table salt). Common salt is absolutely essential in the scheme of human economy. To chemists it is one of the very best examples of what can be done in the way of changing the chemical and physical properties of substances by chemical reaction. Chloride of soda or common salt is made up of two substances, one of them metallic sodium, which is vicious from every angle, and chlorine, which is even more obnoxious. Metallic sodium is so active that it decomposes water and ignites the hydrogen that is liberated, and gives off a report similar to an explosion. Placed on the skin it would in a very few seconds bore down through the skin and finally go clear to the bone. It is extremely poisonous when taken internally; in fact, it is so objectionable that the chemist himself uses extreme caution in handling it. The other substance, chlorine, is a gas and is more obnoxious, more objectionable and more poisonous than metallic sodium. These two poisonous substances will unite chemically in certian proportions, and produce a substance that is not only harmless, but absolutely essential to the welfare of the human family. Such possibilities are true in connection with the salts common to boiler feed waters.

The next substance, sulphate of soda, is simply a combination of metallic sodium and sulphuric acid.

The substances on the chart are divided into two classes; incrusting or scale-forming solids, and non-incrusting or corrosive and foaming solids. All those substances shown under the first classification can and do enter into scale formation, these substances being the silica, carbonates of lime and magnesia, sulphate of lime, and sulphate of magnesia in the presence of an excess of carbonate of lime. Those coming under the second classification, due to their extreme solubility, cannot and do not enter into scale formation; namely, sulphate of soda (Glaubers salts), chloride of soda (common salt), and carbonate of soda (soda ash). On the other hand, however, when present in water in relatively large quantities, they do give rise to foaming, corrosion, and many other types of troubles. The chloride of lime is rather inactive, and the chloride of magnesia will be considered later.

The most rational way of explaining the causes of some of the more common ill effects of boiler feed waters would be to consider the analyses of waters from several different localities, representing different types, which have been used in practice a sufficient length of time to show the effects of those waters when nothing whatever was used to counteract or change their ill effects, and to mention the theories that have been advanced to account for them, and the investigations that have been made to confirm or refute them.

Analysis No. 1.

Silica	.502	Grains Per Gallon
Oxides of iron and alumina	.093	" " "
Carbonate of lime (chalk)	.234	" " "
Sulphate of lime (gypsum)	None	" " "
Carbonate of magnesia	.407	" " "
Chloride of soda (common salt)	3.600	" " "
Sulphate of soda (Glauber's salts)	8.214	" " "
Carbonate of soda (soda ash)	22.789	" " "
Undetermined matter	.180	" " "
Total	36.019	" " "

The substances named on the charts are so arranged that those shown below the horizontal line never enter into scale formation, and those above do enter into scale formation, when present in sufficient quantity or relatively large proportions. Those below give rise to troubles of their own kind, more particularly foaming, corrosion, etc. The selected waters are rather heavily impregnated with substances, for the reason that it is easier to interpret quantities in whole numbers than in decimals.

This water will foam, as experience has shown. Why does it foam? The larger portion of the non-scale-forming solids consists of carbonate of soda (soda ash). Carbonate of soda is nothing more nor less than soda ash. Statements are made to the effect that a water devoid of suspended matter will not foam. This water does foam, and as far as the suspended matter is concerned it contains none. Neither does it contain a sufficient amount of any substance that, when submitted to the conditions extant in the interior of a steam boiler, would give rise to any appreciable amount of suspended matter during an ordinary run between wash outs. There is a total of 73 grains of the soda salts. They are soluble to the extent of several hundred grains per gallon, consequently they soon reach a point where they induce foaming, due to the fact that they change or increase the surface tension of the water in the boiler itself. A little matter of 22.78 grains of carbonate of soda does not appear to be much. But consider a stationary boiler developing 500 horsepower continuously for 24 hours a day; it would evaporate about 45.000 gallons of water. The 22.78 grains per gallon is equivalent to 3.25 pounds per thousand gallons, therefore we would have 146¼ pounds of carbonate of soda in the boiler at the end of 24 hours. Imagine the boiler operating fourteen days or two weeks; and there would be 2,047½ pounds in a boiler containing about 3,500 gallons of water. The result is a very concentrated solution remaining in the boiler, which would foam without question, and it did so from the second day following washout, at which time there was in the boiler not to exceed 130 pounds of the carbonate of soda.

Then another very deleterious condition arose here, namely, the distintegration and softening of gaskets, which in turn resulted in a leaky condition. Any chemist knows that the gaskets upon the market today are largely made up either of asbestos or asbestos composition, or rubber or rubber composition. Asbestos is a mineral product; chemists know that it is soluble to a considerable extent in a strong alkaline solution, that is, a solution of some of the soda salts. Asbestos as it exists in gaskets is in a very fine, fibrous condition, consequently when this strong alkaline solution comes in contact with it, the alkali naturally dissolves these fibres and causes a breaking down or change in the properties of the gasket itself, resulting in trouble.

As for the gaskets of the rubber type, any ordinary rubber placed in a strong boiling solution of carbonate of soda, or caustic soda, and allowed to remain there for 48 hours, will change very materially in character. It loses its elasticity, it swells to several times its original size in diameter, and it becomes of the appearance of cold glue or gelatin.

Analysis No. 2.

Silica	1,576	Grains Per Gallon
Oxides of iron and alumina	.280	" " "
Carbonate of lime (chalk)	Trace	" " "
Sulphate of lime (gypsum)	44.989	" " "
Carbonate of magnesia	11.339	" " "
Sulphate of soda	2.404	" " "
Chloride of soda (common salt)	4.590	" " "
Undetermined matter	.096	" " "
Total	65.274	" " "

About 58 grains out of 65 are made up of scale forming salts, and about 45 out of the 58 are sulphate of lime. Naturally this water would be expected to give rise to the formation of a large amount of scale, and it did. The scale was made up of sulphate of lime to a very large extent. The peculiar trouble in this case was serious corrosion underneath the scale. It is not uncommon for some to assume that if the surface of a boiler is covered over with scale, corrosion would be practically impossible. In statonary practice it is a common expression that 1-32 in. of scale over the interior of a boiler is to be preferred to taking chances with corrosion. This position must of necessity be considered erroneous. Upon a thorough investigation it was found that corrosion actually did take place and to a very serious extent, and this condition gave rise to greater anxiety than the scale formation itself.

In arriving at some rational explanation as to what actuallly did take place, a careful analysis of a portion of the scale lying next to the metal, which was apparently originally a part of the surface of the metal, shows that there was an action going on which compared identically with the action of sulphuric acid upon iron. Sulphate of iron was found on analysis of the substance taken off of both the surface of the tube and the side of the scale which was originally in contact with the tube. The water itself was not acid, contained no free sulphuric acid, and consequently the corrosion must be the result of a liberated product. The theory advanced was that the sulphate of lime constituting the greater part of the scale lying in direct contact with the metal reached a temperature, when the scale had become of sufficient thickness, which caused a decomposition of the sulphate of lime, liberating sulphuric acid. This sulphuric acid in turn attacked the metallic iron, giving rise to corrosion. The sulphate of iron formed as a result of the corrosion, being an extremely unstable salt, that is, one that does not stay together very readily, breaks down in the presence of temperature and moisture, and again liberates sulphuric acid, leaving behind the iron in the form of iron oxide. The sulphuric acid again acts upon the metallic iron, producing more sulphate of iron, which is in turn converted into oxide of iron.

It may be asked why the sulphuric acid leaves the oxide of iron to go to the metallic iron. In chemistry it is more true that every individual substance has an affinity, than it is in the human family. Metallic iron has a greater affinity for sulphuric acid than does oxide of iron, consequently a new portion of sulphate of of iron is formed. This is what chemists call a cyclic or continuous action. The acid liberated from the scale, acting on the metallic iron, decomposing, acting again and again on the iron, and resulting in corrosion.

How was this theory proved to be correct? To bring about decomposition it was necessary to have temperature, because sulphate of lime does not decompose below a certain temperature. With the use of mechanical devices the scale formation in this boiler in which the experiment was carried on was turbined down to one-half its original thickness, and it was found that as long as the scale was kept down to one-half the thickness which it ordinarily formed in a given length of time, no corrosion underneath the scale formation took place. The evidence showed that the cause of the trouble was first a liberation of sulphuric acid, in turn due to the high temperature at the point of contact of the scale with the surface of the metal, which primarily was due to the thickness of the scale. Therefore with the prevention of scale formation to a great extent, the temperature at the point of contact was reduced below the point necessary for the decomposition of the sulphate of lime, the liberation of sulphuric acid, and consequently the corrosion in this case was obviated. The correctness of the foregoing conclusions were confirmed in practice.

Analysis No. 3

Silica	.595	Grains Per Gallon
Oxides of iron and alumina	1.116	" " "
Carbonate of lime (chalk)	8.783	" " "
Carbonate of magnesia	4.569	" " "
Sulphate of soda	1,836	" " "
Chloride of soda (common salt)	3.040	" " "
Undetermined matter	.088	" " "
Total	19.027	" " "

This water illustrates the correctness of the statement that foaming can be due to suspended matter. Foaming is not always attributable to suspended matter, as there are numerous cases to show that feed waters containing other substances, do foam without question. This water contains 19 grains of solid matter, of which all but about 5 grains would be classed as scale forming substances. As a matter of fact this water does not under many conditions give rise to more than a small amount of scale formation. The carbonates of lime and magnesia when precipitated from a water of this type go out of solution in a very finely divided, oozy, or what might be termed a gelatinous condition, in which form they are not to a very great extent retained in a heater, but pass therefrom to the boiler in the form of suspended matter, where, due to their light gravity, they travel very readily with the circulating water. The small particles of these incrusting substances soon begin to generate steam from their own surfaces, which results in the body of water in the boiler assuming the condition of a seething mass, which finally results in a foaming condition. In other waters containing these same substances in virtually the same quantities, and also containing even a moderate amount of sulphate of lime, foaming is not usually experienced, owing, no doubt, to the fact that the sulphate of lime when thrown out of solution is much heavier than the carbonate of lime, and readily settles upon the interior surfaces of the boiler, and in so doing carries with it mechanically a considerable part of the precipitated carbonates, the mixture readily attaching itself to the surface of the boiler in the form of incrustation.

An experiment was carried on for the purpose of determining whether or not the foaming experienced in this case was correctly attributable to the precipitated carbonates, as follows: the feed water was treated in such a manner as to remove about one-half of the carbonates of lime and magnesia shown by analysis No. 3, and then pumped into the boiler, and it was found that it was possible to operate the boilers over a period of sixty days, with no trouble in the form of foaming. Further experiment developed the fact that the same results could be obtained by changing the carbonates into other substances by chemical reactions, and at a much lower cost.

There is another condition that arises from the use of waters of this kind. Since the carbonate of lime is thrown out of solution in a very finely-divided and light condition, and gives rise to trouble in the form of foaming and priming, we may correctly assume that the steam space in these boilers is full of these floating particles, in which condition they would naturally carry over with the steam. It is commonplace in districts where waters of this kind are used to have complaints to the effect that it becomes necessary to open up the cylinders of the engines every so often, in order to remove more or less of a black, putty-like substance. Analysis of many samples has shown that this so-called putty-like substance was nothing but a mixture of cylinder oil and carbonates of lime and magnesia, principally the former. The oil itself carries none of these substances, consequently there is no other possible way of its coming into the cylinders except that it be carried over mechanically with the steam. Even though there is no foaming or priming, the finely divided carbonates of lime and magnesia carry over and are constantly rubbed together with the cylinder or valve oil, and produce this putty. This trouble has been overcome by changing the nature of the precipitated substances by chemical reaction.

Analysis No. 4

Silica	28.382	Grains Per Gallon
Oxides of iron and alumina	3.760	" " "
Carbonate of lime (chalk)	.398	" " "
Sulphate of lime (gypsum)	1.879	" " "
Carbonate of magnesia	.372	" " "
Sulphate of soda	Trace	" " "
Chloride of soda (common salt)	.850	" " "
Undetermined matter	.216	" " "
Total soluble mineral solids	35.857	" " "
Suspended matter	113.413	" " "

This analysis is a curiosity. A record of over 150,000 analyses covering that many different waters discloses only one of this kind. Silica is ordinary sea sand. The total amount of solids in this water in solution is 35.8, of which 28 grains is silica. It is hard to realize that 28 grains per gallon, or four pounds per thousand gallons, of ordinary sea sand would go into solution. But in this case it is in solution. The part that silica plays in the enamels on bath tubs indicates the tenacity with which it adheres to metallic surfaces. In the case of the bath tub it is put on under high temperature, but silica for that purpose is an entirely different form. This silica is a gelatinous form, the fusing point of which is very much below that of the silica in the form used in enamels, and as a matter of fact the boiler in which this was used was coated with an enamel just like the enamel on the bath tub, except that it was brown in color, due to the iron oxide it contained.

This analysis suggests another point that it is well to mention here. A chemist meeting people and discussing the analysis of water every day, frequently hears the question asked, "Why not filter it?" even though the water in question was perfectly clear and therefore contained no suspended matter. You will notice that while this water carries but 35.8 grains of matter in solution, it carries 113 grains in suspension. All of the 113 grains were removed by filtration before proceeding with the analysis or determination of the kinds and quantities of substances contained in solution. This confirms the statement that the 28 grains of silica was actually in solution. It is impossible to remove from a water by any method of filtration, anything that is contained in solution, except that you treat the water with chemicals beforehand and convert some or all of these substances into an insoluble form, in which form they go out of solution and then constitute suspended matter. It is impossible to remove from water by filtration without chemical treatment anything that you cannot see with the naked eye, barring bacteria which may be removed by some of the so-called bacterial filters, but they are not supposed to be considered in connection with waters for technical purposes.

Analysis No. 5

Silica	.525	Grains Per Gallon
Oxides of iron and alumina	.093	" " "
Carbonate of lime (chalk)	.222	" " "
Sulphate of lime (gypsum)	5.273	" " "
Carbonate of magnesia	5.388	" " "
Chloride of magnesia	5.151	" " "
Sulphate of soda	Trace	" " "
Chloride of soda (common salt)	8.790	" " "
Undetermined matter	.065	" " "
Total soluble mineral solids	25.507	" " "

Analysis No. 6

Silica	1.168	Grains Per Gallon
Oxides of iron and alumina	.105	" " "
Carbonate of lime (chalk)	5.559	" " "
Sulphate of lime (gypsum)	3.786	" " "
Carbonate of magnesia	3.021	" " "
Chloride of magnesia	2.731	" " "
Sulphate of soda	Trace	" " "
Chloride of soda (common salt)	5.723	" " "
Undetermined matter	.115	" " "
Total soluble mineral solids	22.238	" " "

These two analyses (Nos. 5 and 6) are of interest for the reason that they confirm the contention that the ill effects of a water are not exclusively attributable to the quantities or kinds of substances contained, but usually more particularly to the relative amounts of these substances contained. The water as per analysis No. 5 naturally gave rise to scale formation in considerable quantities, but the most objectionable feature was that of corrosion. This water was and is now being used in locomotive service, and it is a well-known fact that the flue sheets corrode so rapidly that it is seldom possible to operate a machine more than six months without replacing them. The most serious corrosion in this case took place principally above the water line. Why? The water carries a trifle over 5 grains of chloride of magnesia and virtually one-fourth grain of carbonate of lime. Chloride of magnesia under a temperature of even 250 deg. Fahr. decomposes and liberates hydrochloric or muriatic acid. Muriatic acid is volatile and carried with the steam when in even very dilute solution readily attacks iron. All these facts strongly confirm the conclusion that the corrision which took place could correctly be traced back to the chloride of magnesia in the feed water.

It was found upon further careful investigation that steam and moisture taken out of the boiler at a point well above the water line had a decided acid reaction, and that acid was positively proved to be muriatic, and consequently a product of the decomposition of chloride of magnesia, which constitutes further evidence of the correctness of this theory.

Referring to analysis No. 6, another water that carries chloride of magnesia, but gave rise to no corrosion, it is a well-known fact that when carbonate of lime is present in water to a sufficient extent, with the chloride of magnesia, it will combine with the muriatic acid liberated, and neutralize it, producing chloride of lime, and in this way prevent the corrosion by the muriatic acid, which would otherwise take place.

The water as per analysis No. 5, contained a little over five grains of chloride of magnesia and only approximately one-fourth grain of carbonate of lime, while in the case of the water as per analysis No. 6, there were five grains of carbonate of lime and but two and three-fourths grains of chloride of magnesia. In the former case the ill effects of the acid were not offset by another substance contained in the water, while in the latter they were. The action of water in a steam boiler is not always dependent upon the total amount of substances contained, nor the kind contained, but frequently upon the relative amounts of the different substances present.

Analysis No. 7

Silica	.310	Grains Per Gallon
Oxides of iron and alumina	.081	" " "
Carbonate of lime (chalk)	None	" " "
Sulphate of lime (gypsum)	.380	" " "
Carbonate of magnesia	Trace	" " "
Chloride of magnesia	.258	" " "
Sulphate of soda	.261	" " "
Chloride of soda (common salt)	.533	" " "
Undetermined matter	.046	" " "
Total	1.869	" " "

Here is a water that has been passed on by chemists many times, and pronounced an ideal water for boiler purposes. It contains but 1.8 grains of total solid matter. A nipple taken from the cold water side of a feed water system in a stationary plant, which had been in service less than six months, shows excessive corrosion in the form of pitting, several pits perforating the specimen completely. As a matter of fact, for a number of years it was found necessary in practice to replace the cold water portion of this system once in every six or seven months; and with all this going on in this part of the system, no corrosion took place in the boiler. Since nothing was passing through this portion of the system, but the cold water, and keeping in mind that water under many conditions will dissolve more or less of all metals such as gold, silver, lead and iron, and under most conditions will dissolve more iron than of other metals, the first step in the investigation is to assume that the corrosion could be correctly attributed, at least to a considerable extent, to the water itself.

With this in view, an investigation was carried on as follows: four samples of water were taken from the following points: the original source of supply, the inlet to the pipe system, the outlet of the system, and the pet cock at the bottom of the water column. Very careful determinations of the quantity of iron in solution were made and it was found that the amount of iron contained in the sample from the inlet corresponded with that contained in the samples from the orginal source, but in the sample from the outlet, two and one-half times as much iron was found. These figures represent the amount of iron actually in solution, and do not include any which might have been in suspension, therefore show conclusively that the water did actually dissolve or take up iron in passing through the pipe system. The amount of iron in solution in the sample from the boiler proves that in passing through the pipe in question, the water had taken up as much iron as it could hold in solution, or in other words was saturated, and it could not dissolve any more after leaving the point in the pipe system at which it had become saturated, consequently could not and did not exert a corrosive action in the boilers.

If this is a solvent action, why did it not take place uniformly over the entire surface, rather than in the form of pitting? If we take a piece of boiler plate and bring it to a high state of polish, and put it under a high power microscope there is evidence that the composition of iron or steel is not continuous or uniform. A chemist's report covering a sample of iron or steel does not state the amount of iron contained, but rather the content of carbon, silicon, manganese, sulphur, phosphorus, etc. Each of these substances, as they exist in the metal of the sheets or tubes, are chemically combined with a certain amount of the pure metallic iron or other metals, forming new substances characteristic of themselves, which are very different from the pure or uncombined iron itself. The balance of the metal is made up of uncombined iron, commonly known as ferrite. Since, then, the sheets or tubes are not of continuous or uniform composition, and knowing that practically no two different substances are soluble to the same extent, it is safe to assume that the compounds of iron which were the most soluble in the water in contact with their surface would first of all dissolve to the greatest extent, which would result in the corrosion showing in the form of pitting rather than taking place to a uniform extent over the entire surface.

There have been three principal theories governing the corrosion of iron and steel advanced during the past several years which have, of necessity, a direct and important bearing upon what takes place in steam boilers. These are generally referred to as the electrolytic or galvanic, the carbonic acid, and the peroxide theories. The electrolytic theory has virtually displaced the other two, and some discussion of it will make the cause of corrosion more comprehensible.

Science holds that every substance in existence is either electro-negative or electro-positive to every other substance. It is not uncommon in boiler practice to have present a noticeable galvanic current, which, if this theory is correct, must result in corrosion. There are three essentials to a galvanic cell: an electro-positive substance or pole, an electro-negative substance or pole, and an electrolyte or carrier. As shown heretofore when referring to the non-continuity of iron or steel there are even in a small area of sheet or flue, the necessary different substances to act as the two poles, and the presence of a layer of water over the surface will act as the carrier. There are the necessary elements of corrosion. If the water carries more or less common salt, or some other substances, the current-carrying capacity of the water is enhanced and the tendency to corrosion relatively increased.

Sight must not be lost of the fact that with a properly equipped locomotive the boilers are directly connected with brass fittings, copper ferrules and at times other metallic accessories, to say nothing of the difference in the character of many flues, or the flues and shell, or both, all of which tend to promote corrosion in some form or other. The wrought-iron or steel flues or tubes in a boiler, may be as good as it is possible to produce, but sufficiently different in their composition or continuity, or both, to bring about a possible condition leading up to electrolysis.

Since as previously stated there are three essentials to an electrolytic action, it stands to reason that if one of these can be eliminated the trouble would be overcome. It is not possible to prevent two substances acting in the capacity of the two poles of a battery, under favorable conditions, but it is possible to so change the water being used as a feed supply as to destroy its ability to act as an electrolyte, and thereby prevent corrosion.

No attempt has been made in describing these typical cases to prescribe remedies. It would be necessary to submit samples of water before a remedy could be recommended. There is no one substance or preparation known that can be correctly classed as a specific, or that can cure all kinds of troubles, even when confined to a very limited territory.

It is not rationally assumed that waters from the different sources, even in a small district, are at all the same in character, and an endeavor to furnish a satisfactory remedy on such an assumption would be similar to your family physician prescribing for a member of your family without seeing the patient.

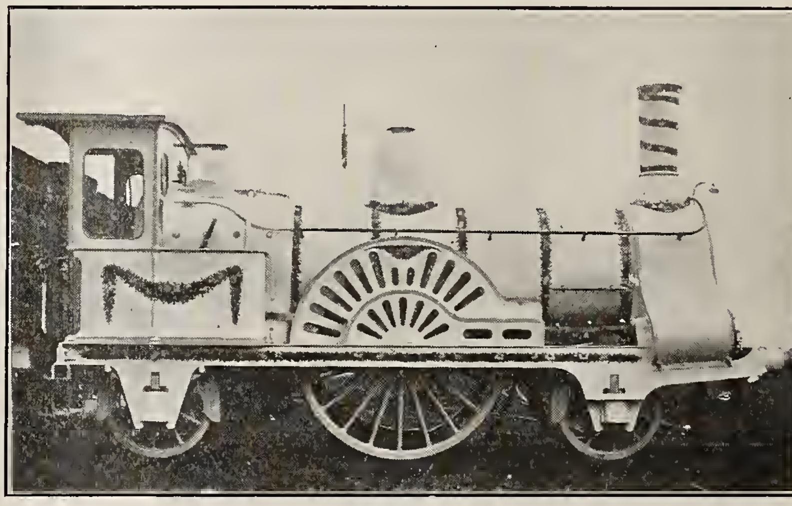
It is impossible to annihilate matter, consequently all of the solid matter carried into the boiler must remain there, either in solution or suspension (in the form of mud), or in the form of scale proper, until the time of washout and cleaning. It is not possible by treatment of the water to entirely prevent all accumulation so far as the so-called soluble salts are concerned, but it is possible with the use of a proper treatment, to ward off at least to a very large extent all troubles due thereto. If a certain amount of solid matter is contained in the water in a boiler, and any amount of other soluble solid matter is added to it there will be contained in the boiler a quantity corresponding to the sum of all, in one form or another.

Remedy for the ill effects of boiler feed water lies along the line of analyzing a specific water, and adding, in the light of that analysis, chemicals which will neutralize the ill effects of chemicals in the feed water. This neutralizing action must be so planned that its products shall be harmless and easily removed from the boiler.

Engine Decorated Fifty-Three Years Ago

When the late King Edward VII was married to the Princess Alexandra of Denmark on March 10, 1863, there was the utmost rejoicing throughout the United Kingdom. The Great Eastern Railway supplied a "single" to draw the royal train that took the happy couple on their honeymoon. This engine was built by Messrs. Fairbairn & Co. to designs by the late Robert Sinclair, M. I. C. E. The decoration of the engine and tender were unique, and were so elaborate that the railway was compelled to bring a man from France to do the work, as their own painters were not equal to the task. The engine was painted a light cream color, and the wreaths and festoons of flowers were in their natural hues.

The engine which is shown in our illustration was a light machine as compared with those used on our rail-



Decorated Engine of 1850

ways to-day. It weighed, with its tender, 51 tons, or, as we would now say, engine and tender weighed 114,240 lbs. The English ton is 2,240 lbs., which accounts for the weight being more than 51 of our tons. The cylinders were 16 x 24 inches, and the diameter of the "single" driver was 7 ft. 1 in. At a speed of sixty miles an hour the driving wheels would turn 237 times in a minute.

Some of the English engines of this class, which were called "singles" on account of the one pair of driving wheels, had an arrangement by which when running down grade the drivers could be lifted vertically, just clear of the rails, and the engine then drifted or coasted on the small front and rear wheels. This removed friction and the consequent wear of parts. It also did away with the lubrication usually necessitated by the turning of the driving wheels, as the main rods, valves, pistons, and their rods remained stationary. The plan, although it appeared feasible, did not make much headway in the mechanical world. The "singles" have been gradually replaced by more powerful engines as the weight of traffic increased. The boiler pressure was 120 lbs. to the square inch, and this gave the engine a tractive effort of 6,480 lbs. This is the amount of weight which this engine, moving along the track, could pull up out of a well.

We can easily see that this locomotive could not vertically lift one of even the light coaches of those days, but an engine is only required to exert its pull upon cars which have their weight borne by the track, and the whole of the locomotive force is occupied in simply overcoming the resistance to rolling the train along the road. The little bright colored engine looks quaint and odd to us to-day, but it serves to mark the progress made, for it is 53 years ago since it made the honeymoon trip for a king.

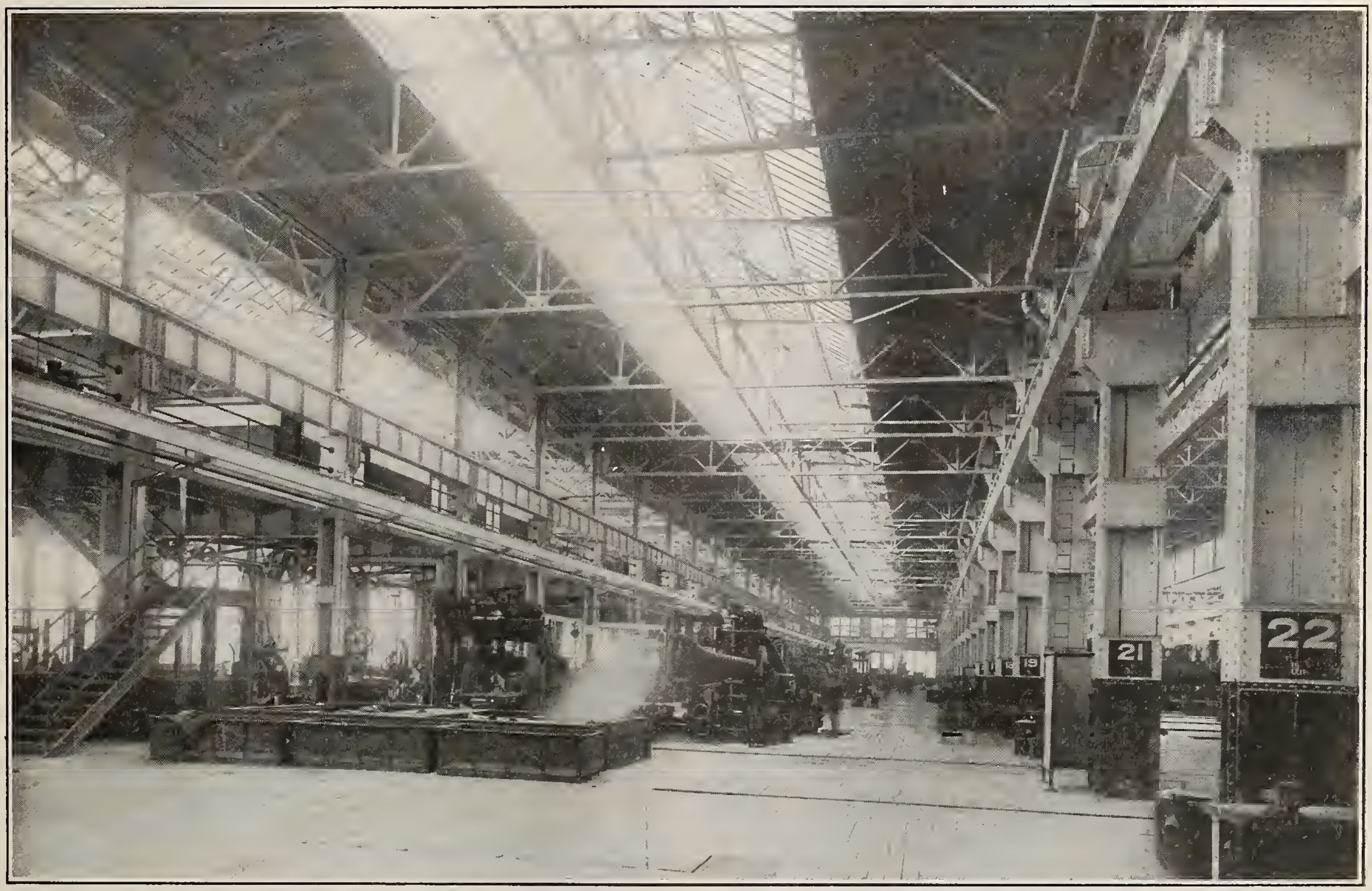
The National Transcontinental Railway Shops

The Construction and Equipment of the Locomotive, Machine, Boiler, Tank and Smith Shops, at Winnepeg, Man.

Considering the Transcona shops in general, they are well built, the steel work is good. The shops are bright with natural light, and the open lattice girders of the roof trusses below the skylight do not cast any shadows on the floor. The drainage from the roofs is carried down waste pipes inside the buildings and discharge into the sewer. The inside position of the waste pipe prevents freezing in winter. The skylights are ample. The shops are situated at the town of Transcona, about 5 miles east of Winnipeg, Man.

The grouping of the buildings is so arranged that those necessary for locomotive repair work are as near together as practicable, and those in which car and coach repair work is carried on stand together. The central midway, served by a ten-ton electric crane, with 62-ft. span, unites all the shops as far as the conveyance of material is concerned, while the space below the crane is tranversed by industrial tracks for the movement of material by hand.

The placing of the shops with one end of each on the midway has the advantage of permitting the extension of the shops at their other ends, and it has also allowed the buildings to be placed so that the space between the sides of the shops has been reduced to a minimum. This is an advantage at Winnipeg where the winter is severe as it reduces the distance to be traveled in handling material between shops and brings the length of the midway to a minimum. The girders carrying the midway crane are supported on steel columns close against the shop walls, so that the crane handles material close up to the door of each. Between the shops the girders are carried on triangular steel bents, the inner faces of which are vertical so as to provide an unbroken lifting and carrying space for the crane.



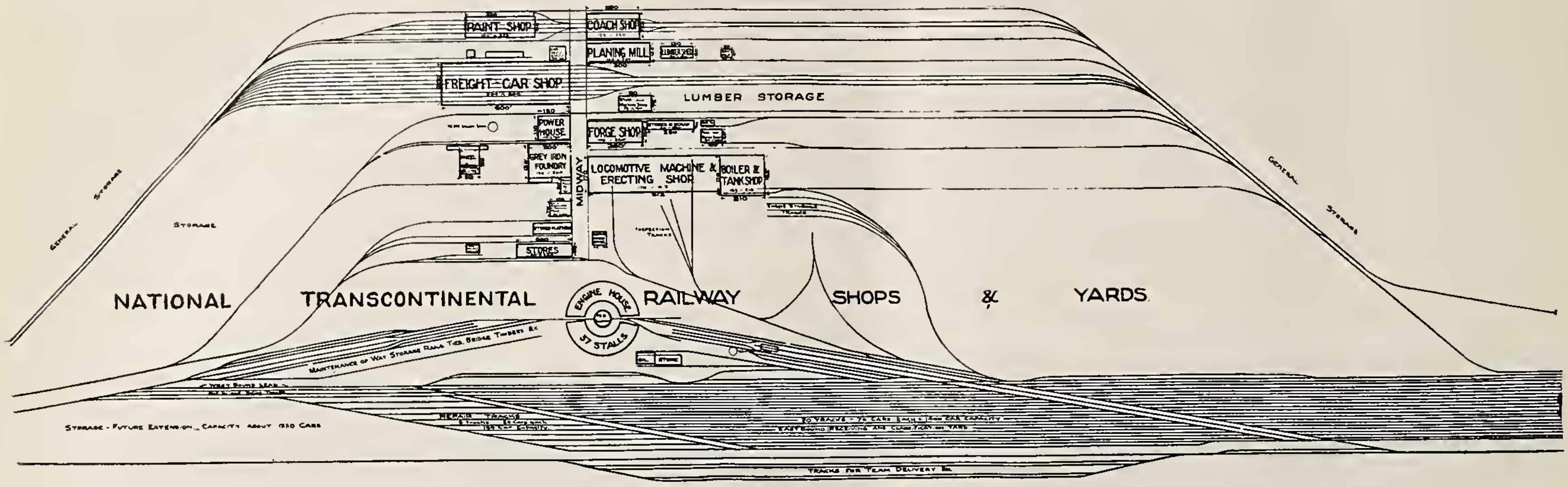
View of Machine Shop, National Transcontinental Railway, Winnipeg, Man.

The layout of the plant is such that the roundhouse is the building farthest south, and is at the end of the midway. The motive power offices are close to the roundhouse, and are opposite the stores building. The midway runs north and south and the locomotive shops occupy the southerly half of the property. On each side of the midway the car and coach shops are north of an entrance track passing the high level water tank. This and a track north of the coach shop afford two methods of access to the midway for material and other supplies.

The powerhouse is in the center of the whole group of buildings and was placed there so that electric transmission and other losses may be as small as possible. The foundry and the smithy being used by the locomotive and car departments, are placed on each side of the midway. North of the locomotive shop and south of the car shops. They thus occupy the intervening space between them. Material can therefore be readily moved north or south from them according to destination.

The artificial lighting of the shops is by mercury vapor lamps which in the shops are placed above the cranes. This form of light does not give heavy or sharp shadows and there is no shadow cast by the lamp itself, as is the case with arc lights. The cranes are made with open lattice girders so that light passes through the members and the shadows from the parts do not reach the ground. There are electric light receptacles on each of the posts so that lamps at the end of protected wires may be carried about and temporarily placed to suit the convenience of workmen.

electric cranes in the plant) there is an arrangement which automatically prevents the load being hauled up into the drum. When the lower or lifting hook pulley reaches a predetermined point as it is being wound up, it throws out a limit switch on the "lifting" circuit, and this cuts off the current. The fall of a solenoid core results, and as this is attached to the arm



General Layout of Shops and Yard at Transcona, Man.

Steam, water, compressed air and drinking water are conveyed in pipes throughout the shops. Various colors are used so that each line and its contents, may be readily identified. The pipes in the midway are placed in a tunnel large enough to permit a workman to reach any of them. The same distinctive color is used in all the shops. The connections for each shop are taken from the main line pipes in the midway and are laid in tile conduits packed with asbestos sponge. This material does not deteriorate and forms an insulating medium which keeps in heat of steam and hot water and prevents the absorption of heat by the cold water

View of Midway N. T. R., Winnipeg, Man.

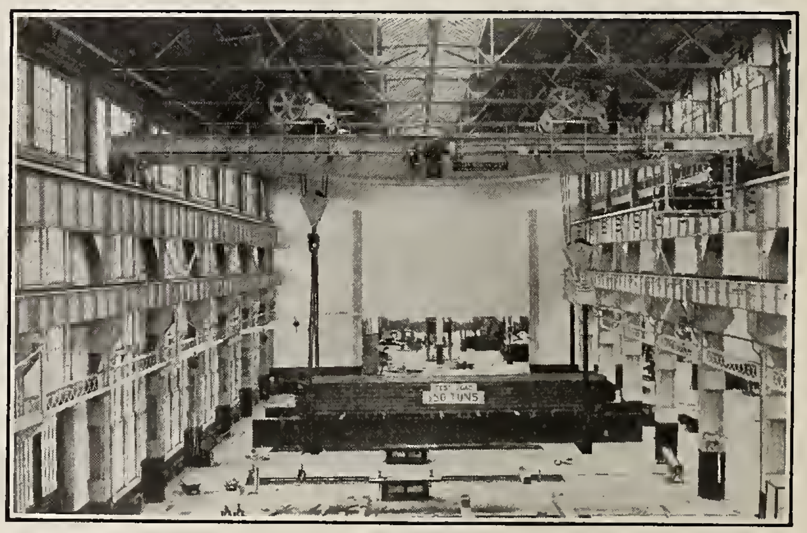
pipes. Oil for fuel is conveyed to the furnaces in the forge, locomotive and boiler shops, and is driven by the pressure of air supplied to the storage tanks. The yards and buildings are protected against fire by a water system having hydrants, hose and nozzles attached. Fire hydrants for the yard (in which there is always some cars and more or less burnable material) are placed at convenient points and are housed so as to be available at any season of the year.

The Locomotive Shop

The locomotive department contains the erecting shop and the machine shop. These two are in one building, 612 ft. by 170 ft. There are three bays or longitudinal areas in this shop. The first is 70 ft. wide and in this the locomotive pits are placed. This shop is served by two electric cranes. The upper one is a large 120-ton Morgan crane, the girders of which are solid plates, and this is the only crane in the plant so constructed. The lower crane is a quick-moving Booth crane of ten-ton capacity. Each crane is operated by an A. C. motor of special design, and on each (and in fact on all the

of a lever, it draws up a powerful band brake. There is also a mechanical brake. The load therefore cannot be "overwound" and the intentional release of the brake is necessary before the load can be lowered. The various switches and contacts are covered so that the operator is protected from accidental contact with them.

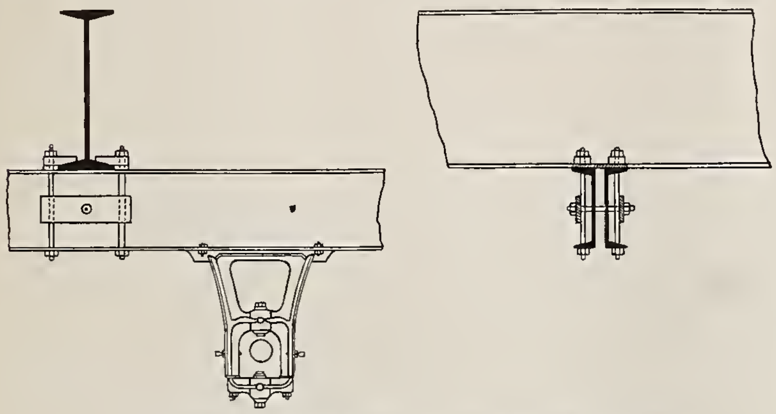
There are twenty-five pits in the erecting shop, two being on the entrance tracks, one of which is kept open for the entrance and departure of locomotives so that the shop may be said to have twenty-four working pits. The position of the pits is at right angles to the length of the shop. This arrangement requires that an engine, when being placed or removed, must be lifted by the 120-ton crane, high enough to pass over the other locomotives already on the pits. This method has the advantage of doing away with a transfer table outside the shop and so avoiding the first cost of the table and eliminating the operating charge which must neces-



Runways for Heavy and Light Cranes, N. T. R. Shops, Winnipeg, Man.

sarily be high where the cold is severe and the snowfall, if not heavy, is sufficiently dry to drift readily. Facility in placing a locomotive is secured by the fact that one crane does all the work. There being no other operator, no misunderstanding between crane men can occur.

The locomotive headed toward the wall has its front end opposite a window and near a jib crane, one crane being placed on each alternate wall post. The jib crane enables workmen to lift smokestacks, steam chest covers, smokebox doors and fronts and to handle superheater pipes, etc., without calling upon the ten-ton travelling crane. This arrangement enables the 10-ton crane to be kept constantly at the work for which it was intended, viz.: that of carrying material, without having its use confined for a time on what may be called the "local" work of erectors. The presence of the jib cranes thus adds to the efficient service of the ten-ton travelling crane. When the wheels



Countershaft Hanger, Transcona Shops

are taken out they are rolled clear of the locomotive and are picked up by the 10-ton crane and brought to the wheel department, which is centrally located. This location of the wheel department only causes one-half the shop length to be travelled by wheels belonging to engines furthest off, and the whole method of wheel handling does away with wheel rolling and handling to be done by men.

The pits are supplied each with a pair of pitjacks which rest on the rails. The steel frames containing the jacks can be moved along the rails as required. These frames and jacks do away with blocking which would otherwise have to be used and this helps to keep the shop clear of encumbering material.

The space between each pit contains a workbench, with a wooden top, to which the vises are attached and the space underneath is used as a locker for tools. This locker has four panels composed of wire netting. When the tools are locked up under the bench they cannot be stolen, but the wire panels enable a foreman to see if the interior is tidy and if it is free from oily waste, overalls, or other material. The receptacle may also be inspected by the night watchman and in the event of fire the hose can be applied and water reach the interior of the locker through the wire netting.

Machine Shops.

This shop is equipped with machines of the latest design. The old time lathe and slotter have, for many operations, been replaced by machines designed to perform certain kinds of work at higher speed and with greater facility, in handling material.

There are machines for general use in the various departments such as those for pistons, motion and crosshead work, for tool, bolt, rod, brass, boiler tank and repairs, etc. The machines have been placed so that the general movement of parts from one machine to another, or from one department to another shall be such as to reduce handling to the lowest terms and prevent as far as possible the legitimate movement of material being followed by any counter movement whatever.

A uniform method of setting the machines has been adopted which insures rigidity. The great majority of machines stand on reinforced concrete foundations extending to a depth of about 11 ft. The machines are held by bolts bedded in the concrete. The foundation is built up to within half an inch of the 3-in. plank floor of the shop. Each machine has been levelled on its foundation and placed so that the machine pulleys are exactly in line with the main shaft or countershaft pulleys as the case may be. After the machine has been set and bolted down, grouting was run in round the base of the machine flush with the floor, and slightly sloping up to the base of the machine. This slight slope is provided for the removal of water due to any condensation or moisture, so that the base of the machine would be kept dry as possible, and the machine being bedded in grouting, would stand solidly in its position without any tendency to work loose on the bolts. Grouting with the same slight slope was put in round the shop columns, so that there would be no tendency for an accumulation of water or moisture to rust or eat into the base of the columns.

The main line shafting for one set of group-driven machines is in perfect alignment with that of the next set. The object being in case of emergency to enable one group to be driven by the group motor of the other. If No. 1 motor breaks down, one length of shafting can be taken down, a coupling applied and the section of shaft replaced and the two halves of the coupling united.

The hangers for the shop shafting, either main or countershaft, are bolted to channel steel turned on edge with webs on the inside. These channels are clamped up to the steel I-beams of the gallery or roof. Small cast iron pieces with flat tops, rest on the bevel surface of the I-beam flanges. The bolts when tightened up hold the small channels in place close against the I-beams. The clamping bolts themselves are prevented from any slip or movement by being held together with a plate and bolts. The arrangement is shown in the accompanying illustration. The lining pieces and plates with the exception of the cast iron

Steel Car Shop, N. T. R., Winnipeg, Man.

packing pieces, have been picked up from scrap about the shop. These hanger carriers are easily removed and are capable of use anywhere about the shop.

The Tank Shop

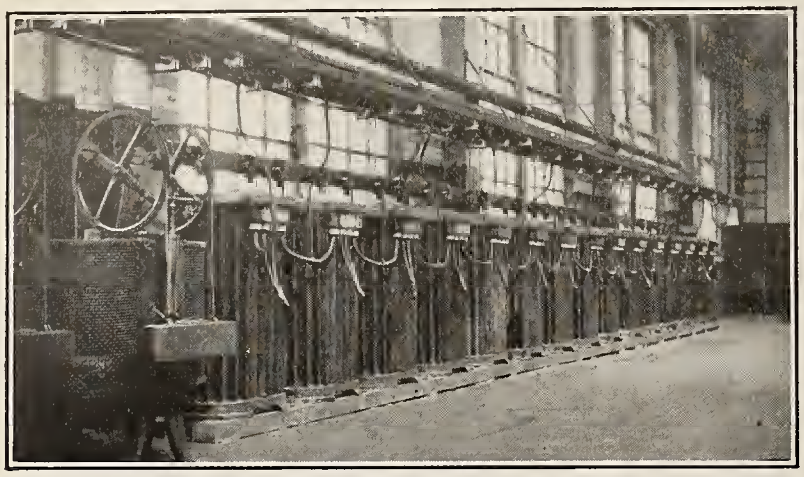
The tank shop is equipped with eight tracks and one entrance track. This shop is at the extreme east end of the building and the boiler shop is next to it. These two shops are in an area walled off from the machine and erecting shop. The rivetting tower is, however, in the extreme south corner of the machine shop.

The arrangement for operating the 20-ton electric crane for the rivetting tower is satisfactory. The crane control for raising, lowering and traversing is placed on the rivetting platform, so that the movements of the crane are governed by a man on a level with the work, and who is within speaking distane of those handling the boiler and who can see what is going on without the necessity of depending on signals. The chance of misunderstanding is thus eliminated and work can be more expeditiously done.

In the tank shop the axle lathe is placed in a pit, which is properly drained. The level of the centers of this machine are at approximately the same height above the floor as an axle with wheels. The wheels can be rolled into the lathe without their having to be lifted.

Machines in the Shop

The majority of the machines are either Canadian or English manufacture, and are very good examples of their class. Those which have come from the United States have been selected on account of their good qualities and a conscientious effort has been made to secure the best possible equipment.



Interior of Power House. Bank of Transformers. N. T. R., Winnipeg Man.

At all the larger radial drills pits have been provided so that articles of odd shape that would not lie on the machine table can be lowered into the pit and the radial drill swung over it and work done.

Quint of Hartford, Conn., has supplied a modern turret drill, and Bertram of Dundas, Ont., a 36-in. boring mill with turret head. The turret heads of these machines enable them to perform a number of similar operations quickly and easily without the necessity of removing the tool at each change.

One of the most modern machines is a heavy radial drill made by Asquith (English). The floor plate of the machine is set flush with the floor of the shop, so that a cylinder or other heavy casting can be easily placed upon it. A gutter has been cut round the foundation, leading to a pocket in the concrete, so that the lubricant may flow into the pocket for use again. The pillar of this machine is exceedingly solid and carries a heavy arm composed of two members. On the under side of the arms, the drill-head is placed so that the drill itself has what is called a "central thrust." The weight of the arm is balanced by a bracket, cast integral with it, extending out from the other side of the large cylindrical pillar. This bracket carries the motor for driving.

Another machine of very substantial make is the Morton draw-cut cylinder planer and borer. This machine cuts on what would be the return stroke of an ordinary shaper. This gives a powerful and natural cut. The machine not only planes all the flat surfaces of a locomotive cylinder, but it bores out the cylinder, bores out the piston valve chamber, mills out the steam and exhaust ports for a slide valve and drills all the holes in a cylinder and saddle casting if necessary. It is a motor driven machine, the motor being mounted on the machine.

The Bullard 60-in. boring mill can bore out coach, tender or driving tires, or do any similar work up to the limit of 60 inches diameter. It is a solid and powerful machine. The mechanism below the floor, by which the lost motion in the table can be taken out, is placed in a concrete pit, into which a trap door in the floor opens. All the adjusting and driving mechanism is below the surface and is therefore protected from damage and is in a pit which enables a man to inspect and adjust the otherwise hidden parts. In many shops this inspection or adjustment cannot be made without excavating the earth in order to let a man get at the parts. The table of this machine is about 18 ins. above the floor level, and work can be handled on and off it with ease.

A Norton draw-out shaper in the wheel department is capable of doing work on driving axle boxes, brasses, shoes and wedges and truck boxes. Brass and box can be handled on the same machine.

The Bullard 36-inch boring mill with plain and turret head can handle driving boxes and brasses with the greatest facility, and in certain operations the fact that the turret head is there helps to reduce the time taken to do the work.

The Ryerson flue rattler is sunk below the floor and is in a concrete pit containing water, where a series of revolving endless chains roll the flues over and over one another below the water. Heavy notched strikers hanging on chains assist in removing the scale. A circular pocket has been put in the concrete pit drain, and in this pocket a bucket just fits. When the water is drained off the pit it flows into this pocket fills it and passes on. The pulverized scale sinks to the bottom and is caught in the bucket. The bucket can be lifted out by the overhead crane and the silt so collected may be disposed of as desired.

The shops can be supplied with air independent of each other or they may all draw air from the complete system. Fuel oil is supplied to the boiler and forge shops by air pressure exerted on the surface of oil in the tanks in the oil storage house.

The Boiler and Tank Shop

This shop is 180 ft. long and has four bays which run at right angles to the direction of the locomotive pits. A wide space near the locomotive shop has been provided for the erection of boilers and for general boiler work. The flue department in the locomotive shop is on the other side of the dividing wall and this brings boiler and flue work in the vicinity of each other. A 20-ton electric travelling crane serves the boiler shop.

The Forge Shop

The smithy is in a separate building north of the locomotive shop. It is 260 by 100 ft. and the roof truss being a single one, leaves the floor space free from columns. This is an advantage in handling the heavy work which has to be done here. This shop, like the locomotive shop, is grouped into departments as far as possible. For example, the spring department occupies one corner of the building and is equipped so as to handle the spring work for both the locomotives and cars.

There are 26 double Buffalo forges along one side of the shop and they are set back to back and are inclined at such an angle to the wall that they afford facility for placing and removing material. The fires which are employed on lighter work face the wall along side of which runs a narrow gauge industrial track leading out of the shop at both ends. The fires used on heavier work have the inside position and those handling hammer work are served by hand cranes. The hammers, of which there are eight in all, range from 200 lbs. to 5,000 lbs. At each of these hammers there are pits, one on each side, covered by trap doors. The pits give easy access to the anvils and foundations, so that anvils may be levelled or otherwise adjusted from time to time. This feature lessens the cost and trouble of maintenance, as in case repairs or adjustments have to be made the shop floor is not encumbered and time lost making a special excavation.

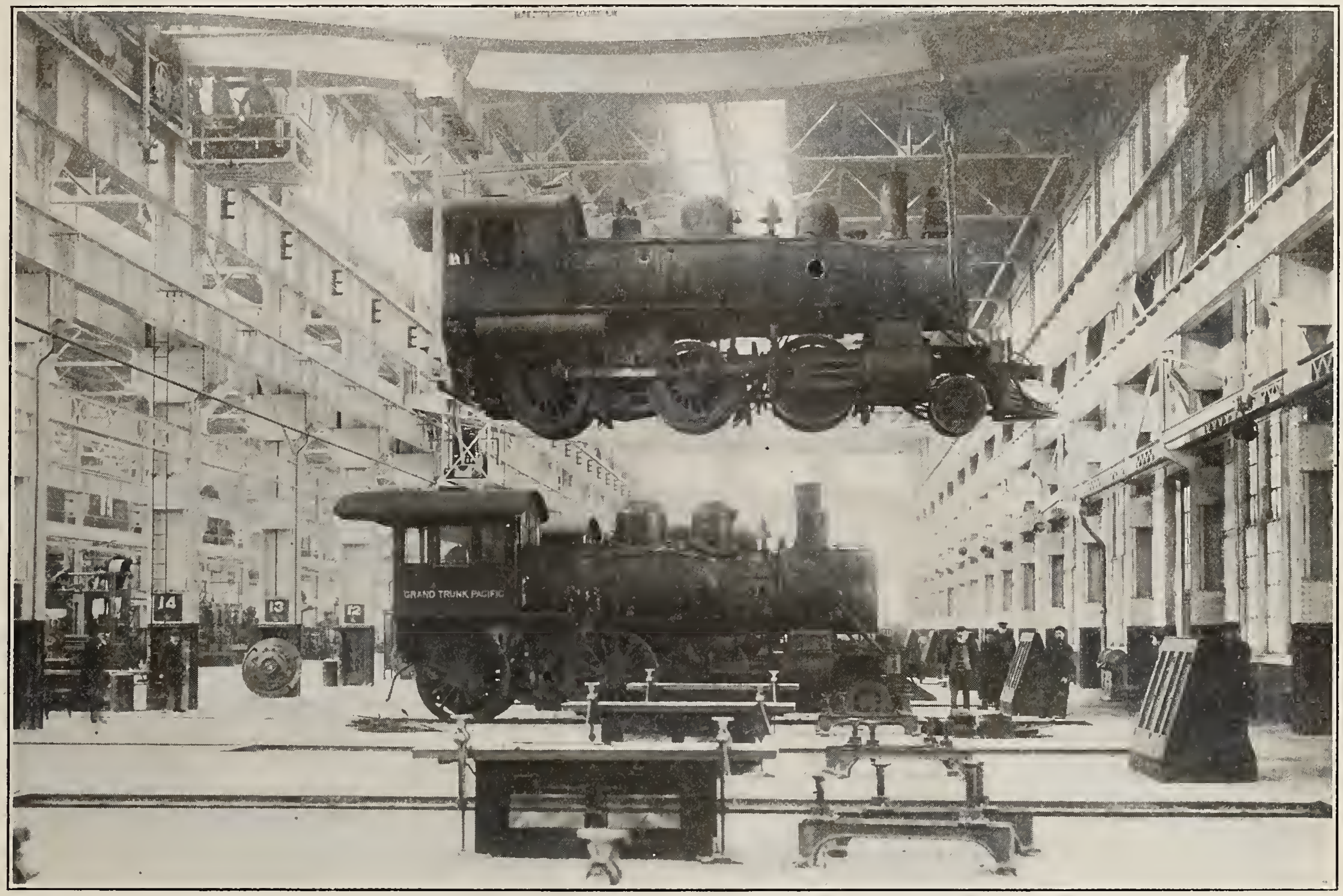
Among the machines in this shop there is a cutting off and centering machine. Axles forged in this shop may be placed in this machine and cut to length and a roughing cut run over them. They are then ready for shipment to outside stations where they will be finished when used. This reduces the handling of such material to a minimum.

The Grey Iron Foundry

This shop is directly opposite the locomotive shop. The main foundry has a bay 70 ft. wide which is spanned with a 15-ton electric crane, which has a 5-ton auxiliary hoist attached. There are one-ton jib cranes placed in suitable brackets on the posts in addition to the overhead equipment, and these can be moved from one pillar bracket to another by the overhead crane, as occasion demands.

The cupolas, of which there are two, 72 and 84 ins. in diameter, respectively, 50 ft. high, are placed in a room 30 by 40 ft. The cupola room also contains a very completely furnished charging floor and below it are placed the blowers, along with the scale for weighing charges. A two-ton pneumatic hoist with safety clutches carries material to the charging floor.

The grey iron cleaning room is served by a 5-ton electric traveling crane and there are also four rumblers, electrically driven. An exhaust system from the rumblers conveys the dust and sand into a box below the surface of the ground outside the building. This box is provided with baffle plates, having openings alternately top and bottom, like swash plates in a tender. The dust-laden air passing through the box is compelled to move up and down in reaching the discharge aperture and the dust and sand falls to the bottom of the box between each partition. The partitions, or baffle plates, can be drawn out vertically and the box easily cleaned.



General View of Erecting Shop, National Transcontinental Railway, Winnipeg, Man.

The brass moulding shop, which forms a department of this shop, is placed at the south side. It is 30 by 80 ft. and is enclosed by an expanded metal partition between the shop posts. This protects the contents of the shop and at the same time does not obstruct the light. The shop is served by a one-ton hand-operated traveling crane. There are four brass furnaces, each 26 ins. in diameter by 36 ins. deep. placed in one corner. The equipment consists of a shipper's bench, a sprue cutter, band-saw, emery grinder, and a dry and wet tumbler.

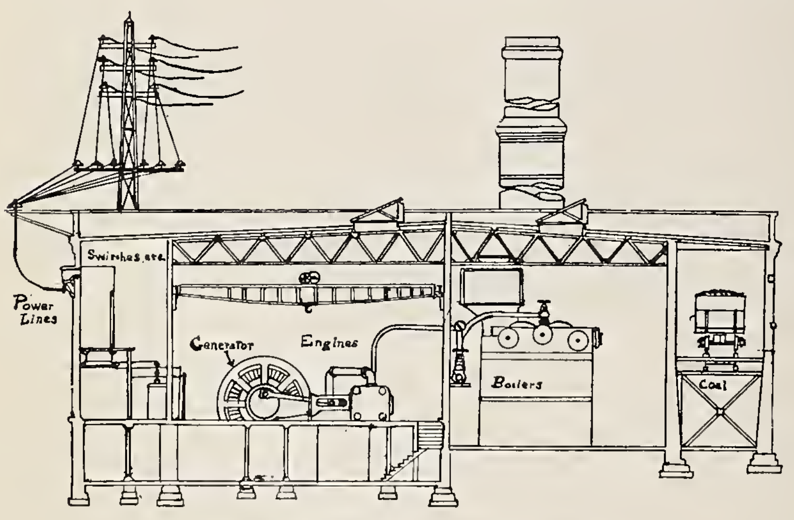
The Transcona plant, in general, may be considered as an example of a well equipped shop in which the arrangement of the machines has been carefully thought out, and in which provision for the future has been made. The shop is capable of handling work according to modern methods and its operation has given every satisfaction. Mr. W. J. Press, the mechanical engineer of the Government Commission, was in charge of the layout and equipment of the shops.

A Study of the Principles of Electricity

By REGINALD GORDON

Fundamental Principles as They Apply to Power for Electric Locomotives

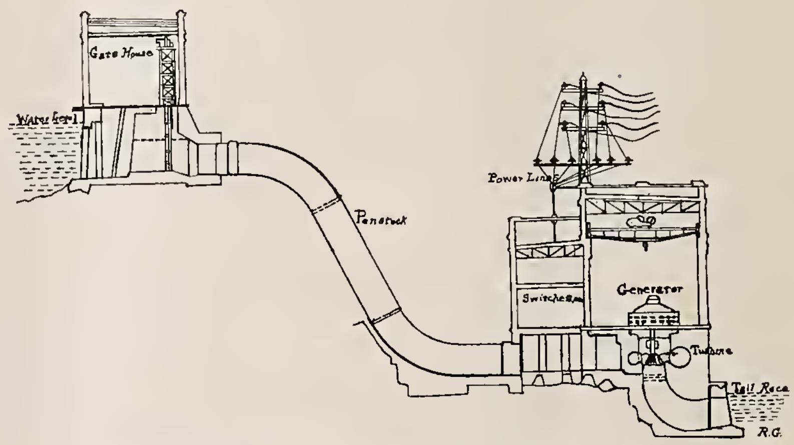
The rapid increase in the use of electricity as a motive power and for many other purposes by railroads makes it necessary for both officers and employes to familiarize themselves not only with the actual operation of the various devices in use, but also to learn the nature of the force with which they must work, its possibilities and the means used for its control. Not many years ago the only electrical devices railroad employes were called upon to care for were those of the telegraph system. The introduction of electric lighting for passenger cars, and of electric motors for driving shop machinery and for operating turn-tables, coaling stations, signals, etc., now requires the services of skilled electricians, who must know how to inspect and care for many things heretofore unfamiliar to the average railroad man. With the introduction of electric locomotives of from 1,500 to 4,000 horsepower, and trains of multiple-unit motor cars aggregating more than 1,200 horsepower, enginemen who have been accustomed to running steam locomotives find not only a new kind of motor to deal with, but one whose forces act somewhat differently from those with which they are familiar. It is more than ever important, therefore, to study the fundamental principles of electricity. Experience on roads where electric locomotives and motor cars have been introduced is that the steam locomotive runners have not much difficulty in learning the operation and control of this new form of motive power, but many of these men are anxious to know more about the nature of electricity, inquiring not only what it does, but why it does it. It is not possible to give anyone a



Power House Steam Driven

clear idea of just what electricity is. We are unable to think of electricity as a separate thing, or entity; we know it only by its effects. Many theories have been advanced to explain its nature. Some of these have been discarded because they did not explain all the observed effects. Others have been retained because, while they do not satisfy every case observed and noted, they yet answer fairly well until some other explanation can be found. It is not the purpose here to deal with theories of electricity, but rather to give elementary explanations and reasons for the action of devices that come under the care of railroad employes. We deal with electricity always associated with material substances, and realize its effects chiefly through the changes that take place in substances through which it passes, or in the space surrounding the wires of a circuit through which it is conducted.

There are certain clearly defined effects of electricity. Sometimes one of these alone is manifested; at other times it is in combination with others. Four of these, and the four to which our attention is most commonly directed, are: 1, Electro-magnetism; 2, Heat; 3, Light; and 4, Chemical action. Electro-magnetism is the principle or basis of action of all dynamos, motors, transformers, etc. The heating effect of electricity is primarily the manner in which we produce electric light; and while all electric lights are produced by the heating effect of electricity passing through some kind of matter, yet some devices give very little heat with their light, and others a wasteful amount. The men in charge



Power House Operated by Water Power

of telegraph, telephone and signal circuits, and passenger car lighting, have to deal to a certain extent also with the chemical effects of electricity, because they often must use a source of power, a battery of some kind, either primary or secondary.

It must be clearly understood that to produce energy in the form that is called electricity, work of some kind must be expended. Just as it is impossible to get something out of nothing, so the only way to produce electrical energy for the purpose of driving locomotives or cars or machine tools in the shop, or even to move the armature of a telegraph relay, is to do work on the system by driving a generating machine or dynamo by means of a steam engine, or slowly to burn up or oxidize certain materials in the battery, as is done in the case of the operation of signal motors and telegraph instruments, car lights, etc.

In the illustrations the general arrangment of two typical central stations for the generation of electric power are shown. In one of these the combustion of coal on the grates generates steam in the boiler. The steam drives the engine as shown, and this engine in turn drives the generator or dynamo, the output of which is electric energy.

In the second illustration there is represented a water wheel which drives a dynamo by the energy received from a mass of water falling from a high level to a lower one. In both these cases the ouput of the station is electricity, the equivalent either of the amount of coal burned on the grates and the quantity of water turned into steam, or of the amount of water which falls per minute from the level in the reservoir back of the dam to that of the tail race. The consumption of steam in the engine, or of water by the wheel, is a measure of the energy put into the system. The output, or total of electric power produced by the generator is the equivalent of this, but is not quite equal to it in amount.

Freight Car Construction, Maintenance and Abuse

Fundamentals and Standardization of Construction Discussed. Causes and Cost of Maintenance Considered, Including Operating Abuses and Owners' Defects

All the departments of a railroad are more or less affected by the condition of freight cars. This being so the construction of the car is important because its success in service and maintenance is dependent on how it is made. Railroads expend much money each year for new equipment of different designs. If the cars fail to be satisfactory on the road they fall short of what was intended. It is desirable to use as light cars as possible consistent with efficiency.

Here we may say while giving a resume of Mr. C. J. Wymer's paper, read at a recent meeting of the Car Foremen's Association of Chicago, that this is a subject of the utmost importance. Mr. Wymer is general car foreman of the Belt Line Railway at Chicago and as such he speaks with authority. We may say, however, that the elimination of useless dead weight is a source of silent but constant gain, because the hauling of dead weight not required by the traffic goes on from day to day and from year to year, and eventually piles up an amount on the debit side of the ledger which is in the aggregate a serious loss, though it may never appear in figures. Mr. Wymer goes on to point out, quite justly, that the opposite of this is a great economy, deserving careful consideration, and there is also a danger in employing its use to the extent that it ceases to be an economy only so far as the initial cost is concerned, and proves a burden of expense in maintenance by reason of accidents, delays, loss and damage to freight, etc., which more than offsets the advantage gained.

Of the two evils the latter is more readily recognized, as it is prominently brought into view by failures, while the other is distributed over a long life and is discovered only by minute and technical investigation. A reasonable factor of safety should be included in the design in excess of technical requirements to provide a resistance necessary to equalize, in a measure, the results of unjust service due to the human element, which nevertheless exists.

A proper assemblage of parts is also a feature to be kept in mind when designing new cars in order to obtain strength where the greatest resistance is required and yet not to exceed what is necessary where resistance is not so important a factor, as simplicity of renewal when repairs are necessary. Some cars are apparently designed with the thought that each is a permanent structure and that the parts will endure throughout the life of the car without attention, or perhaps, the builder has failed to give any thought to future maintenance. If the structure would endure without repairs, it would be an ideal condition, but failures due to deterioration and accident comes into the life of all cars, and when simplicity of assemblage, without sacrifice of efficiency, has not been given due consideration; unnecessary expense is added to the maintenance. The use of commercial sizes and shapes is another point to keep in mind when designing new cars, as their use lowers the cost of repairs, as well as reduces detention of cars.

These are some of the undesirable features to be avoided, and some which should be favored. The thought, therefore arises, how can the problem best be solved? The remedy lies in standardizing designs and construction, as rapidly as is consistent, with means of enforcing this idea. Standardizing means the elimination of arbitrary opinion and action from which most of our trouble comes. Standardization insures thorough investigation of the subject by the best talent. This prevents certain things being followed to an extreme to the detriment of another, resulting in practically assuring a harmonious combination of all the desirable features, bringing the most efficient and desirable equipment. Standardization reduces purchases by restricting them to actual requirements and so eliminates much dead stock. The speaker believed that standardization would insure improvement in construction, as it would tend to choke off many ideas of questionable merit. It would make for the industrial survival of the fittest.

Coming to maintenance, it was pointed out that cars cannot be maintained in perfect condition, and any attempt to do this would entail a loss of material and labor, and a withdrawal of cars from service where they earn money. There is a degree of efficiency necessary to keep a car reasonably safe for handling and for the protection of the freight it carries. This efficiency must be such as to prolong its life at a minimum cost. Many cars are not up to this condition and should be withdrawn from service. Every effect has its cause, and one applicable to this state of affairs is poor design. This results in a car becoming disabled long before fair usage would bring it to that state. Another cause is inadequate facilities to meet requirements in districts where large numbers of cars are required and the demand forces unfit cars into the service. Overtaxed facilities and lack of labor-saving methods prevent many cars from being properly and fully repaired, and the period of service performed is only of short duration, and they return again for repairs in worse condition than before. If suitable attention had been given in the first place the cost in the end would have been less and the service performed would have been greater. It is not infrequent to see new end sills and draft timbers applied to worn out draft sills and numerous other repairs made in a similar manner which can only mean that the same performance must soon be repeated. Greater uniformity in construction would insure a larger output at less cost as suitable material would be more readily available and workmen becoming familiar with similar construction could perform the work with greater dispatch.

Periodically reducing and reorganizing forces tends very much to prevent economical repairs. Each time a shop is organized for extensive repairs it means the introduction of a large number of new men. These take time to become efficient, and the money thus expended would keep a well organized and efficient force permanently employed, and these would produce a larger amount of work. If of necessity the forces are to be larger at certain times than others, the best result to be obtained, for money, can be had by doing so at seasons of the year when weather conditions are most favorable, as there is a considerable percentage of loss in labor performed when there is no protection from the elements during the winter season.

It is also good business to exert energy in repairing cars and getting them in serviceable condition when they are idle, having them in condition to earn when required, instead of having them idle or in service in a crippled condition. Good serviceable cars mean so much in reducing other expenses that there seems to be no reason why they should not be maintained in an efficient condition. A load placed in a defective car often means delayed movement, added expense in transporting, claims for damage, and possibly dissatisfied patrons. An accident resulting from a bad car means damage and destruction to good cars, delay to the entire traffic of the railroad, added expense to the maintenance of equipment and the maintenance of way accounts for frequently serious track damage results, in addition to damaged equipment.

Greater uniformity and efficiency in construction, proper maintenance of equipment at all times, and adequate facilities for the same, means economical maintenance of equipment, tracks, reduction of claims, reduced operating expenses, fewer blasts of the wrecking whistle, increased average miles per car, more efficient service and a better satisfied investor and public would most certainly result.

There is that feature of the M. C. B. Rules making a distinction between owners and delivering line defects. There is a vast army of men employed by the railroads whose principal duty it is to make records as a means of protection against so-called delivering line defects, and they attach greater importance to a few sheathing slightly raked, that may not affect the service of the car, than they do to a worn wheel or to numerous other defects, endangering the safety of the equipment, commodity or human life. We are constantly educating them, that it is almost a crime to overlook a defect involving a defect card which often has a value of less than a dollar. A business-like view of the situation would be to cease spending two dollars in an effort to save one. Do away with the delivering line defects, inspect for safety of operation and commodity only, educate these men along the lines of endeavor which have a real value and give up illusions. A vast amount of this labor expense could be in purchasing material and repairing defects which are a menace to safety instead of finding and making a record of a lot of slight defects and giving them the attention of more important ones. Such a reduction of expense would continue down to the offices and result in saving a large labor and stationery expense there.

In reply to those who advance the argument that penalties are necessary against the handling line to promote the proper care of equipment, it was pointed out that there is no relation between penalty and performance. The employes misusing a car have no knowledge of these penalties and take no notice of the ownership as indicated by the initials on a car. They will damage a car owned by the railroad employing them as readily as they will one owned by a foreign line. They could hardly make this distinction if they desired, on account of the mixed assortment of cars they handle.

Mr. Wymer expressed his belief that railroads are spending more money annually on labor and stationery in protecting themselves against these defects than it would cost to make the repairs, and the repairs have still to be made or they are allowed to continue. There would be less delay to equipment at interchange points. It might be in order for the association to appoint a competent committee to make a careful investigation of this subject and find out approximately what we are gaining or losing from present methods. It is not our intention to use a foreign car without justly compensating the owner, but it is our desire that it can be handled more economically by the railroads on a rental basis than by a combination of rental and rules.

In regard to the misuse or abuse of cars there are several. One being the continuance in service of a car when its physical condition makes it a fit subject for repairs. We very often have cars subjected to abuse in switching, by cornering, side wiping and impact. Much could be avoided by the exercise of ordinary care. There are many cases where the destruction of a car is not due to the element of time, but to disregard of the proper protection of property.

Another abuse is the loading of first-class, 100 per cent cars, with hides, coal, oil and other rough freight. This reduces them to a condition unfit for grain, food products and other commodities that require cleanliness and protection from the elements. Cars are abused by railroads and shippers by a disregard of the loading rules, which experience has found essential and has approved. Car ends are often damaged in ordinary handling because the proper methods of loading have been ignored, and it happens in many instances that further damage results by unloading the freight when the car has become unserviceable. A careful study of this whole question by those in a position to regulate the abuses would greatly improve the average condition of freight equipment on our highways of commerce, and a resulting feeling of satisfaction in the mind of the public would be brought about.

Women in Charge of Cars

One of the London dailies, speaking of war conditions in England, says: "Because of the shortage of men, the Glasgow Corporation is giving women a trial as tramway-car drivers. Six women are to be trained and placed in charge of cars in a quiet locality. The first three days are to be spent in learning the mechanism of the car, followed by two days' work on the 'school car.' The next three days will be devoted to further instruction in the mechanism, and then a practical test will be made in ordinary street driving. The women will then take their places alone as drivers for 30 days. This final test passed, they will be recognized as fully competent drivers."

Example of Great Efficiency

The vast mileage of the Pennsylvania Railroad system serves practically half the population of the United States. During two years, ending with December 31 last, there were carried over these lines 361,572,114 passengers. Involved in this transportation problem in those twenty-four months were 2,400,000 passenger trains performing their service on schedules which called for practically the same number of freight trains, as well.

This overwhelming number of people were carried without a single one being killed in a train accident.

In the five years—1908, 1910, 1913, 1914 and 1915—on the lines east of Pittsburgh, the Pennsylvania ran 4,000,000 passenger trains and carried 520,000,000 passengers without one being killed in a train accident. These are great showings. This achievement is an example of great efficiency, and when General Manager Long congratulated the faithful army who were engaged in these operations, by sending out felicitous New Year greetings, he did exactly the right thing. It will encourage the men to keep on lines of efficiency all the time.

Laboratory Test of Baldwin 2-8-0 for Illinois Central

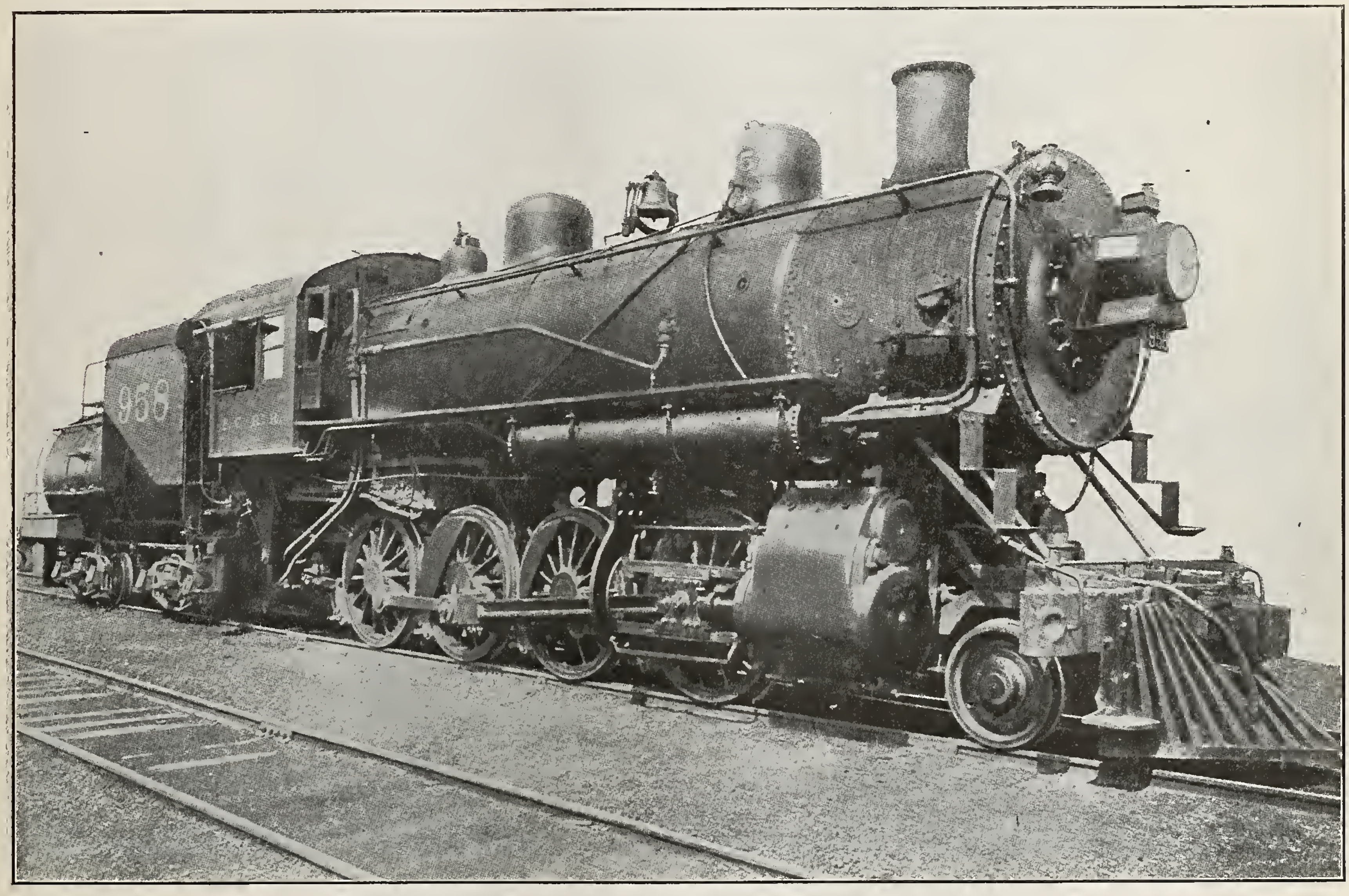
Tests Made After General Overhauling, and Comparisons Made With Result of Bringing Each Working Part to Maximum Efficiency

The Illinois Central Railroad recently submitted a consolidation engine to test at the engineering experiment station of the University of Illinois. The object of the tests was stated to be for the purpose of determining the general performance of the locomotive and the performance of its boiler and engines, first, as it was received after three and a third years of service, and, second, after some repairs had been made. In this condition the engine was reported to be in excellent shape.

The locomotive tested was built by the Baldwin Locomotive Works in 1909. It weighs 223,000 lbs. and has 22 x 30 ins. simple cylinders, using saturated steam. Its principal dimensions are given below.

Total weight, in working order	223,000 lbs.
Weight on drivers	200,900 lbs.
Cylinders, diameter and stroke	22x30 ins.
Diameter of drivers	63 ins.
Firebox width	66 ins.
Grate area	49.55 sq. ft.
Heating surface, tubes (fire side)	3,094 sq. ft.
Heating surface, total	3,283 sq. ft.
Boiler pressure	200 lbs.

When it was received at the laboratory the locomotive had run 107,800 miles. Immediately preceding the tests the locomotive had been in service only five weeks after receiving general repairs, and was in good condition when it arrived at the laboratory. It was completely tested in this condition and the results of the first are designated as Series 1. The results of this series disclosed a performance not quite so good as had been anticipated, and in the endeavor to do whatever was possible to improve the performance the valves were reset and eccentric straps shimmed; cylinders and valve chambers were rebored; new pistons and piston rings, new valve bull-rings and packing rings were applied; the rod packing was renewed; the exhaust nozzle-tip changed from $5\frac{1}{4}$ ins. to $5\frac{7}{8}$ ins.; and a small leak in one of the steam pipe joints was stopped. Certain incidental repairs having no effect on performance were made at the same time. Following this work the locomotive was run the equivalent of about 1,200 miles in wearing down the cylinders and packing before making the tests of Series 2.



Illinois Central "Consolidation" No. 958, Ready for Labora ory Test

The principal ratios of this engine, No. 958 on the I. C. R. R., are as follows:

$$\frac{\text{Weight on drivers}}{\text{Tractive effort}} = \frac{200{,}900}{39{,}180} = 5.12$$

$$\frac{\text{Weight on drivers}}{\text{Tractive effort}} = \frac{200{,}900}{40{,}470} = 4.96$$

$$\frac{\text{Total weight}}{\text{Tractive effort}} = \frac{223{,}000}{39{,}180} = 5.69$$

$$\frac{\text{Total weight}}{\text{Tractive effort}} = \frac{223{,}000}{40{,}470} = 5.51$$

$$\frac{\text{Tractive effort} \times \text{diameter of drivers}}{\text{Total heating surface}} = \frac{39{,}180 \times 63}{3{,}283} = 751.8$$

$$\frac{\text{Tractive effort} \times \text{diameter of drivers}}{\text{Total heating surface}} = \frac{40{,}470 \times 61}{3{,}283} = 751.8$$

$$\frac{\text{Firebox heating surface}}{\text{Total heating surface}} = \frac{168}{3{,}283} = .0513$$

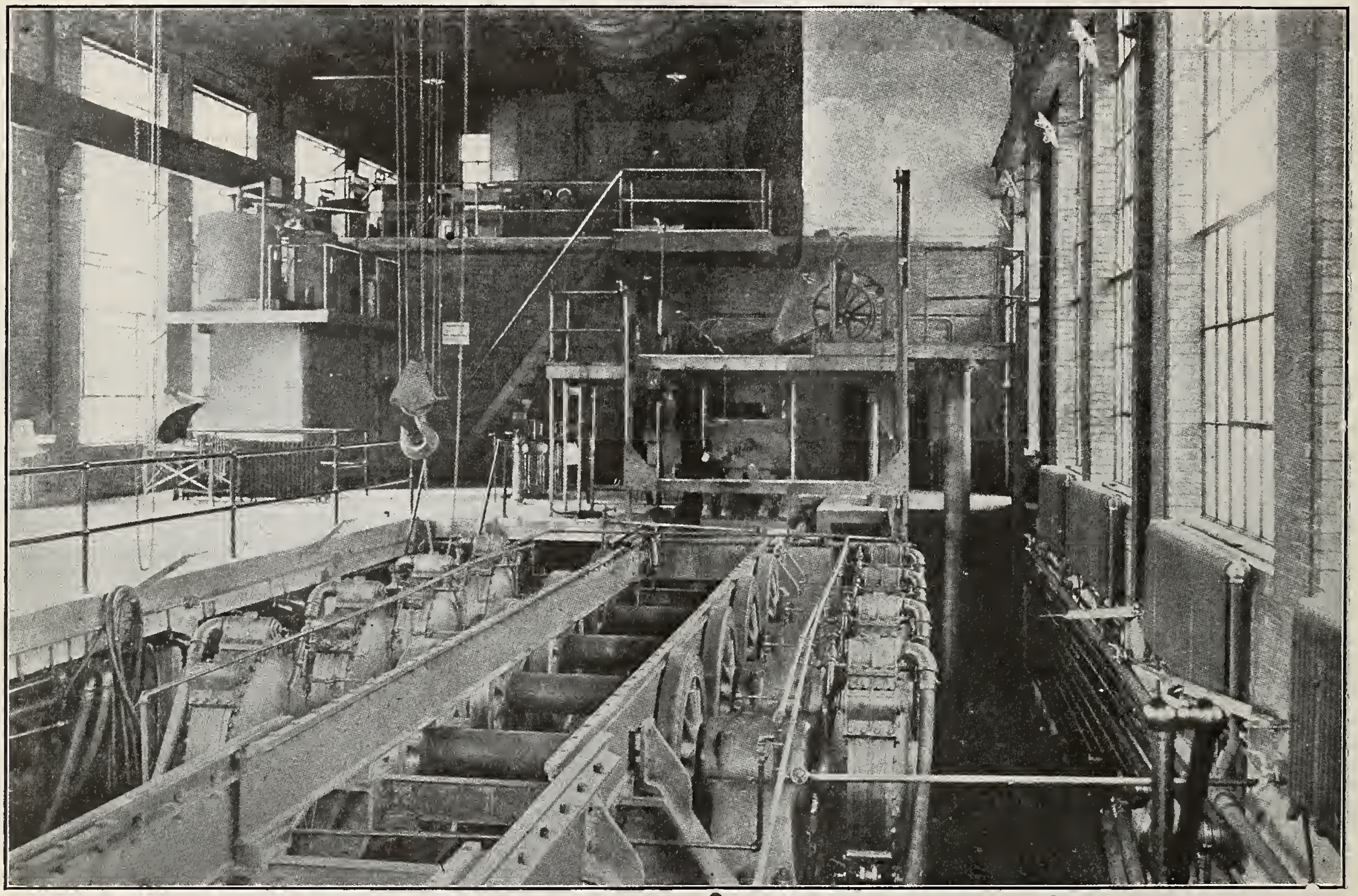
$$\frac{\text{Weight on drivers}}{\text{Total heating surface}} = \frac{200{,}900}{3{,}283} = 61.19$$

$$\frac{\text{Total heating surface}}{\text{Total weight}} = \frac{3{,}283}{223{,}000} = 67.92$$

smoke box in front of the diaphragm was equal to 12.8 ins. of water.

During the test, as stated in the university bulletin, the heating surface was forced to its greatest capacity, the total equivalent evaporation per hour was 57,954 lbs. This is equal to 17.65 lbs. per foot of heating surface per hour. This rate of evaporation is altogether unusual in service and has been exceeded only rarely under test conditions. The best results were obtained in test designated as No. 2024, during which the equivalent evaporation per pound of dry coal was 10.07 lbs. Some doubt, however, is expressed about the validity of this result, which exceeds the next highest evaporation per pound of coal (8.96 lbs.) by 12.4 per cent.

These results were all obtained when using run-of-mine coal from Mission Field Mine, Vermilion County, Illinois, which varied in heating value from 11,835 to 12,848 B. T. U. per pound of dry coal.



Engineering Experiment Station of the University of Illinois

$$\frac{\text{Heating surface}}{\text{Grate area}} = \frac{3{,}283}{49.55} = 66.26$$

$$\frac{\text{Tube surface}}{\text{Firebox heating surface}} = \frac{3{,}094}{168} = 18.41$$

$$\frac{\text{Total heating surface}}{\text{Cylinder volume}} = \frac{3{,}283}{13.199} = 248.8$$

In testing this engine two trials were made, but the statements given apply to Series 1 and 2 combined. The maximum amount of dry coal fired per hour was 11,127 lbs., or 224½ lbs. per square foot of grate area per hour. This is in excess of usual practice. The maximum quantity of cinders thrown from the stack was 27.4 per cent. of the dry coal fired. This occurred under conditions which rarely prevail in service, the draft in the

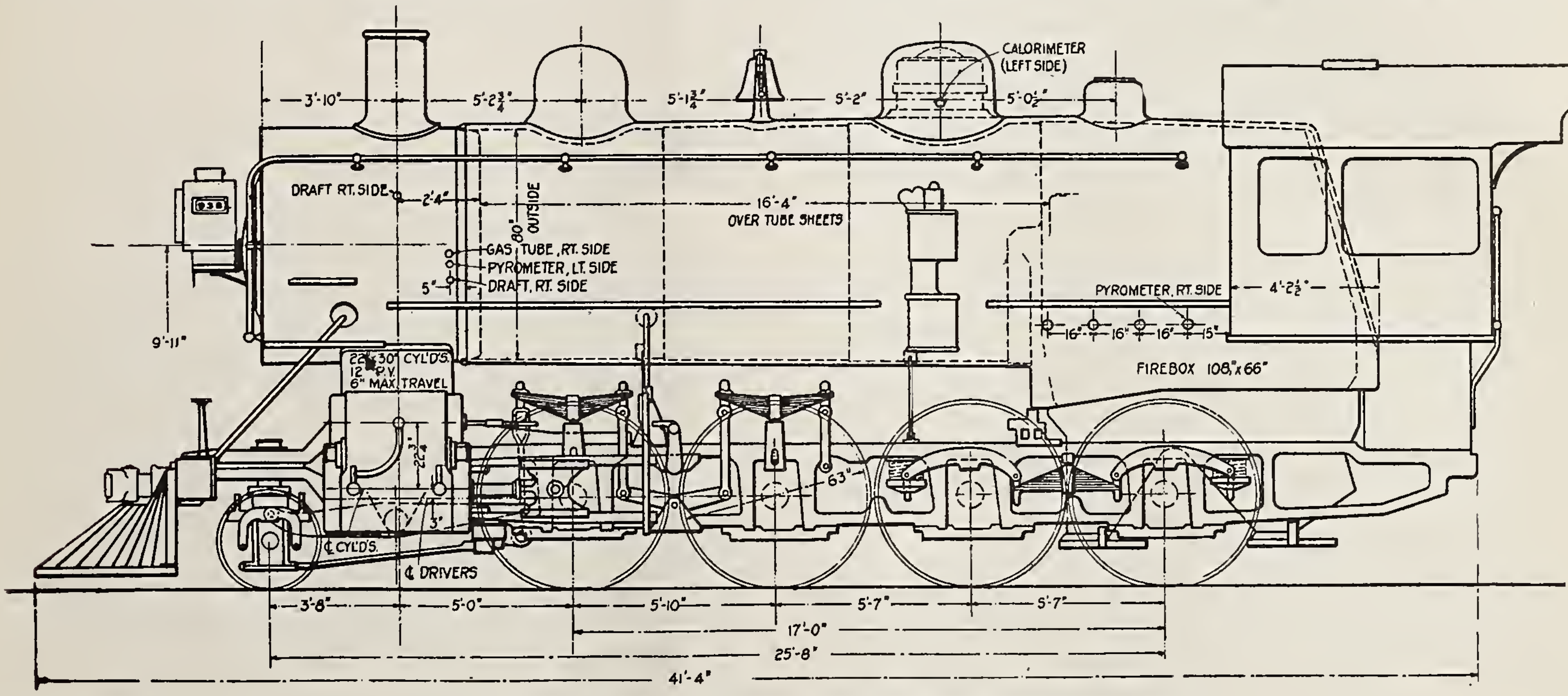
The maximum indicated horse power developed during the tests was 1,654, which occurred in test designated as No. 2093, with a cut-off of 48.6 per cent. and a speed of 30.4 miles per hour. This is the greatest power which has been developed during laboratory tests with a locomotive of this type. The maximum draw-bar horse power was 1,431. The maximum tractive effort developed, 29,240 lbs., is only 75 per cent. of the rated maximum and is not significant because of the fact that, as in all laboratory tests, it was not feasible to work the locomotive at the lowest speeds and the greatest cut-offs.

Just here it may be said that according to the calculated tractive effort which is intended for starting speed, and using the Master Mechanics' formula, this engine would have developed a draw-bar pull, neglecting internal resistance, of 39,180 lbs. The figure given in the test was probably determined by dynamometer tracings, which automatically eliminates the friction of the machine itself from the record, and in any case the engine was run much above the starting speed. The loss of tractive effort which takes place as speed increases is due to the earlier cut-offs for higher speeds and a consequent decrease of the mean effective pressure in the cylinders.

The Master Mechanics' formula assumes the mean effective pressure in the cylinders to be 85 per cent. of the boiler pressure, and here it amounts to 170 lbs. The 85 per cent. rule, while fair as a matter of comparison where all engines are treated alike in this formula, is nevertheless considered by many authorities to be too low as a pressure factor in the equation. This usually

During the tests the locomotive was fired by C. Welker, a skilled fireman, detailed for this purpose by the Illinois Central Railroad and taken from their regular force. Previous to his engagement at the laboratory he had had four and one-half years' experience as fireman on that road and upon the completion of the tests he returned to regular service. During some of the tests he was assisted by one of three other firemen who were also detailed at various times from the Illinois Central force. None of these men had had less than one year's experience. Mr. Welker in these tests was in charge of the other men and was responsible for the character of the work.

The writers of the bulletin are careful to inform their readers that in attempting to draw from the re-



General Plan of Illinois Central Railroad 2-8-0, No. 958

accepted figure is no doubt accurate enough for the older types of locomotives. Recent tests, however, have tended to show that its value ought to be increased, as the latest types of locomotives have been more carefully or, one may say, even more scientifically designed than formerly, in which more efficient valve gears have been used, larger valves and more direct steam and exhaust parts have been employed. Steam and exhaust passages are less obstructed, so that the all-round effect has been to improve the steam distribution and so obtain a greater mean effective pressure, from the boiler pressures now in vogue.

In the university tests and the test program the locomotive was worked throughout a range of speed corresponding to that which would ordinarily prevail in service. At each of the various speeds the endeavor was made to vary the cut-off through as wide a range as the capacity of the boiler or of the grate would permit. The adhesion between the drivers and the supporting wheels in the laboratory is less than the adhesion between the drivers and the rail on the road, and consequently it was impossible at low speeds to run at maximum cut-offs. All tests were made with the throttle wide open.

The lowest water rate attained was 27.17 lbs. of dry steam per indicated horse power per hour. This steam consumption is not so low as has been previously obtained in tests of locomotives of this type under similar conditions, being almost 17 per cent. in excess of the lowest figure previously recorded. The minimum heat content of the dry coal fired per indicated horse power per hour was 50,872 B. T. U. and the minimum dry coal fired per hour per indicated horse power was 4.00 lbs.

sults of the tests, any inferences concerning the performance of locomotives in service, it should be remembered that during the tests the boiler was forced somewhat beyond the limits which would ordinarily be maintained in service; so that the maximum test values of such measures of boiler activity as draft, rate of combustion and rate of evaporation are somewhat greater than the values which would be maintained on the road for any except very short periods.

Work of American Locomotive Company

For the first six months of the present fiscal year, the American Locomotive Co. showed gross earnings of $14,398,859. This is an increase over the same period of last year of $9,039,630. Operating expenses for the six months ending December 31 last were $11,442,452, and the surplus, after deducting interest charges and preferred stock dividends, was larger by $3,508,584 than in the first six months of the previous year.

Unfilled orders on the books of the company December 31, 1915, amounted to $52,240,000. While a large part of these orders covered shell contracts with the Allies, a very considerable portion belongs to the locomotive business proper. The American Locomotive Co. is gloriously working out of its set backs due to hard times and is taking its former place among the country's first-class enterprises.

It is not possible to know how far the influence of any amiable, honest-hearted, duty-doing man flies out into the world.—Great Expectations.

The Development of a Fuel Department

Details of Problems of Organization and Operation of Efficient Fuel Service

L. G. Plant, Fuel Engineer, Seaboard Air Line Railway, among other things, at a recent meeting of the New England Railroad Club, said: Were it possible to get a composite picture of the fuel department as it does, or does not, exist on each railroad, to compare the "average" with the "potential" fuel department, the comparison would invite criticism from at least a dozen standpoints. The conspicuous results that have been obtained on a few railroads through a well organized fuel department, indicate how much remains to be accomplished on American railroads as a whole before the fuel department can be regarded as an entire success.

The fuel department has failed to establish its position in the organization of the railroad; it has never been recognized as an essential and integral part, equal in importance to the transportation, engineering and motive power department. In the original structure of the railroad only those departments essential to actual operations were included. Efficiency in operation has not until recently been given the attention it has always received in private enterprises. To appreciate its importance, one has only to review the expenditures for fuel on American railroads or to consider the cost of this item on his own road in comparison with other operating costs. The position and responsibilities of the fuel department should be as well defined as that of any other department on the railroad.

The fuel department has never developed any well defined form of organization. The organization of the average fuel department is haphazard, its responsibilities are vague and it may be misplaced in its affiliation with another department. The transportation, engineering and motive power departments have each a generally accepted type of organization found to be the most practical and efficient; the same should apply to a fuel department. This department should be responsible for efficiency in the selection, distribution and use of locomotive fuel. It should include two elements: —One experienced in the use of coal, the handling and drafting of locomotives; the other technical, familiar with available fuels, their preparation and relative efficiency. The first element should include only experienced enginemen whose personality assures them cooperation from the men they supervise. It has not yet adopted standard methods for supervising the selection, inspection, distribution and use of locomotive fuel.

The fuel department has not been successful in arousing any widespread interest in fuel economy. Fuel consumption is, in a sense, the pulse of the railroad. Failure to provide supervision in proportion to that found in any other branch of railroad service is the most conspicuous defect in the average fuel department. The best ratio of supervision generally in effect is one traveling representative of motive power or fuel department, to 50 engine crews. A well-managed shop usually provides a better ratio of supervision, although the potential saving in the shop is a fraction of the possible saving on the locomotive. This comparison does not reveal as great a discrepancy between the wages of the shop men and their foreman as is usually found between the enginemen and the road foremen, where, in many instances, the road foreman earns considerably less than many of the men whose work he supervises. Supervision over fuel use at terminals is important for the opportunity usually exists for making a greater saving at terminals in proportion to the fuel used, than on the road.

Education in the economical use of fuel is a relatively neglected feature in the work of the fuel department. Instruction in the use of the air brake and many other details connected with railroad operation is considered necessary. Instruction should be arranged for both engineers and firemen. Cars designed for this purpose are equipped with a simple apparatus for demonstrating the process of combustion and a screen where pictures may be effectively used to illustrate details in connection with the proper firing of locomotives. Motion pictures can be used to the greatest advantage and these should be taken to illustrate local conditions. The value of this car simply as an "advertisement" for fuel economy must not be overlooked.

This department has not assumed the same responsibility in the selection of fuel as for its economy in use nor has it shown the same discrimination in the purchase of coal as is exercised in the purchase of many other materials. The fuel department has not furnished any tangible incentive for exercising economy in the use of fuel. One of the earliest attempts at fuel economy was the money premium awarded enginemen for saving coal. This has been discarded because it was impossible to award premiums with accuracy and fairness and because it was objectionable to the engineers as a whole. The individual fuel performance record, however, remains as the best possible incentive that can be offered, provided an accurate and effective record can be published currently. The average fuel record is a failure because it disregards the effect of conditions beyond the control of the engineer. It includes his performance with light, as well as with full tonnage trains, and superheater engines are often compared on the same sheet with engines using saturated steam. If based on correct principles, a very satisfactory and effective record can be computed without facilities for weighing individual coal issues. A record of every engine movement must be kept, giving the name of the engineer, the coal consumed, the freight ton-miles or passenger car-miles as the case may be, and the coal consumption per ton or per car mile. This record is based on daily reports received from each terminal and is posted daily in a book similar to the familiar car record. Where operating conditions are taken into account and the engineer's weekly or monthly average includes only records made with tonnage trains under normal conditions, the record will prove a very fair estimate of the engineer's relative standing.

Where the department has recognized the necessity for fuel inspection, it has not always appreciated its possibilities. It has given comparatively little attention to economical distribution of coal. Important questions relating to the effect of foreign freight, the necessity for storage and the actual cost of distributing coal upon the line of road, enter into the problem of economical distribution. The effect of foreign freight should be considered in connection with the purchase of coal. The necessity for storing coal depends upon fluctuations in its price and other current conditions affecting each railroad. Distribution of coal upon the line of road should be arranged and supervised by the fuel department. A careful estimate of the actual cost of moving company coal should be made in place of estimating this cost upon an arbitrary charge per ton-mile. The relative cost of coal at each chute, quality considered, should be determined and a schedule arranged requiring engines to take as large a portion of coal as possible at points in their district where the cost is lowest. Observance of this schedule will result in an indirect but substantial saving.

The charge that the fuel department has failed to take its part in developing the economy devices that have made the efficiency and capacity of the modern locomotive possible, is perhaps unfair. It is generally assumed that it is not within the scope of this department to attempt this phase of the fuel problem. From a broad standpoint, however, why should this be so. Apparently the fuel department has neither time nor money for perfecting new devices; in some instances it has not even the facilities for giving them a fair trial. It is an unfortunate commentary on the fuel department that manufacturers of important economy devices must keep traveling representatives on the railroads to insure their proper use and maintenance.

Serial Transmission of Brake Action

Loss of Time, Shocks, and Slow Release Eliminated by Use of Electro-Pneumatic Brake

In the course of some remarks made in a paper on "Recent Development in Brake Engineering Principles and Practice," by Mr. W. S. Dudley, chief engineer of the Westinghouse Air Brake Company, before the New York Railroad Club at a recent meeting, a phase of the subject, that of serial transmission of brake action, was taken up.

The speaker referred to the fact that if the brakes on each car begin to apply at the same instant and with equal force, the train will commence to slow down with the least possibly delay and with an entire absence of shock between the cars. Compressed air, however, possesses inertia, and its flow is retarded more or less by friction in the pipes, there must be an appreciable interval of time between the moment of starting brake action on each one of the successive cars in the train.

With short trains and light cars this was of little consequence either in shocks or increase in length of stop. With trains of 10 to 16 heavy passenger train equipment and having coupler and draft rigging which permit of several inches slack between the cars, the effect of the serial application feature of the brake (PM Equipment) when stopping from certain speeds is considerable, and judgment and skill are required to handle such trains without rough slack action and shocks. The longer the train the greater the length of the stop because of the longer time elapsing before all the brakes applied. Every second's delay at 60 M. P. H. means 88 ft. added to the length of the stop. Every instant's delay in the transmission of the brake action from car to car means that much more opportunity for the slack to run in and cause shocks.

The first modification of the brake apparatus was the "quick service" feature of the triple valve which was demonstrated on the New York Central at West Albany in 1905. This feature (in the LN Equipment) causes a slight but definite reduction in brake pipe pressure locally at each triple valve, similar to the local serial venting of brake pipe air in emergency applications, but much less in amount and under the complete control of the triple valve slide valve. This tends to transmit the service application of the brake more quickly and uniformly throughout the train, thus reducing the tendency to shocks and lost time in getting the brake applied. A high degree of ingenuity and much patience and labor were required before this was finally worked out.

This quick serial service action was primarily developed for and is of greatest advantage on long freight trains. It is now recognized that it is impossible to apply all the brakes on trains of from 75 to 100 cars or over with certainty by an ordinary service application except by the aid of this quick service feature. In passenger service, the cars are much longer and the brake pipe volume for each car is being increased as new developments come into use, so that even with the quick service feature there is an appreciable time element in the service application of passenger train brakes.

The same is true of the quick action features of the brake in emergency, which requires two to three seconds to travel the length of a 12-car passenger train. For emergency applications the shortest possible stop is the first consideration. The limit of transmission of quick action seems to have been reached with the quick action triple valve, opening a vent from the brake pipe which would drop its pressure as fast as the air could flow through the pipe to the vent. Recent developments in the emergency features, while they have done much to give this action the effectiveness and certainty required by modern train service, have not produced any quicker rate of serial quick action.

The time element, inseparable from a simple air brake, disappears with the electro-pneumatic control of the brakes. Through the general use of electric lighting, the handling of electric apparatus has long been a part of the daily routine of passenger service, so that the desire to employ electrically controlled pneumatic apparatus for braking no longer suggests any insuperable difficulty.

After more than ten years of experience in the successful operation of electro-pneumatic brake apparatus under such exacting conditions as those of the subway in New York, in Philadelphia and in Boston, a state of the art has been reached which enabled the best design to be determined upon. The opportunity for a practical demonstration of these advances in the art came with the investigation of the whole subject of braking requirements in heavy passenger train service made by the Pennsylvania R. R. and the Westinghouse Air Brake Co. in 1913. In these tests it was proved that the electric control of the air brake (UC Equipment) was practicable. It permitted full advantage to be taken of the improved service and emergency features of the air brake, and that the time element in serial transmission of brake action was eliminated. Shocks during brake applications are due to slack, modified by speed. This was shown by both kinds of stops being compared at high and low speeds. At high speeds, 60 to 80 M. P. H., the serial action of the emergency application produced shocks which increased in severity at lower speeds. At 10 M. P. H., the shock was practically equal to a collision last and front cars, the train being stopped in 45 ft. A maximum emergency pressure of 100 lbs. was obtained on the first car in 1 second, counting from the moment of application. The retardation thus brought about at the front end was capable of stopping the train in 6 seconds at this speed of 10 M. P. H. It was over 5 seconds before an equal pressure was had on the twelfth car. The head end was therefore practically stopped before the brakes became effective on the rear cars. The last car came to rest practically by impact with the cars ahead. Improvement made in the serial action of the emergency brake reduced the time from 5 to 3 seconds, but the still greater improvement gained in the use of the electro-pneumatic emergency stop is very remarkable.

With the electro-pneumatic brake, which causes all the triple valves to act at the self-same moment, the application of just as great a retarding force entirely eliminated violent slack action at all speeds. The 10 M. P. H. stop being in 37 ft., was made without shock. The action of the electro-pneumatic apparatus when releasing brakes provides simultaneous control over all the brakes on the train. All brakes come off together; and it thus leaves nothing further to be desired, so far as the elimination of serial action, application or release, in the service, as well as in the emergency applications. A train on the Pennsylvania R. R. has been running between New York and Philadelphia since August, 1914, completely equipped with the electro-pneumatic brake, and it has proved to be thoroughly satisfactory in every way.

Summing up, the speaker said: "Briefly, the time element in the serial transmission of brake action from one end of the train to the other cannot be eliminated from a purely pneumatic brake equipment; it is detrimental in service applications, in emergnecy applications, and when releasing, on account of the resultant slack action, shocks and loss of time. It can be eliminated with corresponding nullification of slack action, shocks and loss of time from this cause by the use of electric control of the brakes, which electro-control has proved to be entirely practicable, and at the same time permits the employment of the present possibilities in the pneumatic brake to a degree otherwise impracticable.

Resuscitation After Electric Shock

The increasing use of the electric current on railways for the movement of locomotives, motor cars, shop machinery, signals, etc., as well as for lighting shops, cars, lamps, and for the production of heat and other purposes, has introduced a new form of danger to menace the unwary. This is the possibility of receiving an electric shock. These shocks may be either permanent or temporary in their effects. If the former, death takes place, usually instantaneously, and as far as we can judge, without any pain. The temporary effects of electric shock produce complete unconsciousness, which, if the victim be not restored, will result in death.

The temporary effect has all the appearance of death, and the beholder has no alternative but at once to resort to restorative measures. Medical aid should be summoned without any delay and the witness of the accident should at once begin to produce artificial respiration, and persist in it for hours if necessary in order that life may be saved. The rule of action may be very simply stated. It is, that the sufferer from electric shock should at once be treated as one partially drowned. In any case, the victim can do nothing for himself, he appears to be dead and will certainly die, if not effectively cared for, without loss of time.

At first sight the reason for the same restorative measures being applicable alike to cases of apparent drowning and of electric shock does not appear. A man apparently drowned has his lungs filled with water.

The diaphragm is the muscular partition in the body separating the heart and lungs from the abdominal vicera, such as the stomach, liver, spleen, intestines, etc. In the case of a man apparently drowned, the diaphragm is unable to act and respiration ceases. Artificial respiration and the consequent emptying out of the water from the lungs is essential. In a case of electric shock the lungs are full of air, but the "stroke" or the shock of the electric current acts on what physicians call the medulla oblongata, and affects the nerves from it so as to inhibit, or stop the movement of the diaphragm. The medulla oblongata is at the base of the brain and is the part at the back, low down, near the neck. A man buttoning his back collar stud can, by raising his hand up to the head, touch the place where this division of the brain is situated. This region is the origin of the nerves which control involuntary action, such as the nerves which govern the action of the heart and of the diaphragm, which latter is most largely used in respiratory action.

The partially drowned man, and the man electrically "shocked," both have the diaphragm action stopped. In the first case it is like a clock whose pendulum becomes stationary because the hands have jammed. The second is as if the mechanism of the clock was free, but the pendulum had been arbitrarily stopped. In either case the pendulum must be made to swing again. In the human frame artificial respiration brings back the normal action of the diaphragm and the process of resuscitation goes on.

A pamphlet issued some years ago by the United Gas Improvement Co. of Philadelphia sets forth the procedure to be followed in case of electric shock. In it the patient is represented as placed upon his back. This is the supine position. In a treatise lately published by John Wiley & Sons, of this city, by Dr. Lauffer, the patient is placed face down. This is the prone postion. Both methods have their advocates and both are effective.

The imperative necessity for prompt action by the man who would render first aid, becomes apparent when we remember that human beings have been able to live without food for forty days, and to subsist two days without water, but no one can be without air for more than two minutes without most seriously endangering his life. In these cases the victim is absolutely helpless, the friend who attempts to render help cannot take time to telephone or hunt up a physician, he must get to work on the instant. If he is fortunate enough to send for assistance, or to receive it, well and good, but in any case he must work, steadily, perseveringly and without cessation in the interest of his fellow man.

In all this the man who works unfalteringly must not measure his time nor his endurance. He must put success before him as the one, only, and paramount consideration. He must encourage himself in his efforts by the assurance of success, he must not stop to doubt. Who may say that the influence of his persistence and his will may not evoke a faint response in the helpless and stricken but still living friend to whom he ministers? The effects of individual rage or fright in a mob of people reveal themselves in the actions of many who do not see or hear the frenzied man, and may it not be that the action of what has been called "mob psychology," applied in a particular case, to a being who appears not to see or hear, yet may turn the scale or at least give him the full benefit of what power there is in resolute and continued effort backed by the kindly thought.

The Pennsylvania Railroad does not throw away anything that has any value to man or beast. It sells everything the Company has no further use for, if there is any market for it. In 1914 the scrap material sold brought in to the railroad $2,157,241.24, and this was $1,000,000 less than in 1913. Waste paper alone sold for $19,211, oil barrels for $22,439, and old rubber for $15,222. Locomotives and wooden passenger cars sold for $114,326. Other odds and ends brought in $121,997. Old wheels, metals and wrought iron yielded more than $780,000.

Practical Suggestions from Railway Shop Men

Pattern Records and Whistle Elbow

By A. H. WILTSHIRE
Draughtsman, A. G. S. R. R.

The illustration given here is a sample or duplicate of our pattern record. This 3x5-inch filing case board system has been in use since 1910 and has proved to be very satisfactory. It should be of special value to shops which have no engineering department. Usually these have but a few blueprints and so they need an

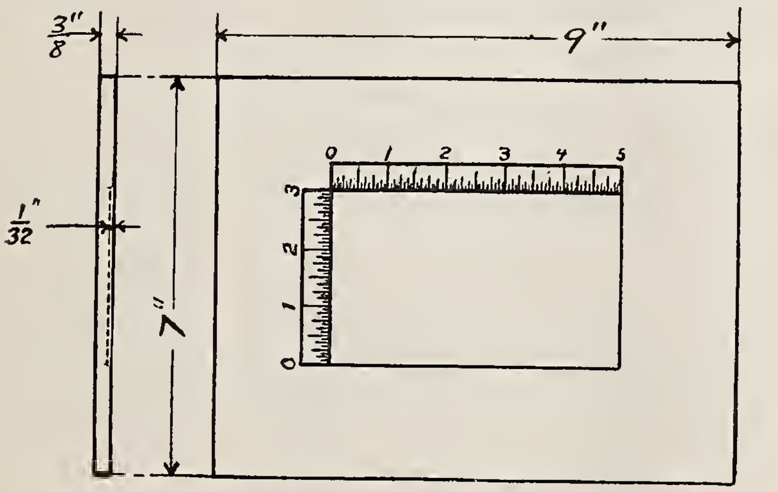


Fig. 1. Drawing Board for Pattern Records

accurate record of repair parts for all shop equipment and rolling stock.

Each card contains the following information: Number of pattern; name of owner; weight of one casting; name of casting and its use; number of blueprint or sketch by which pattern was made; kind of casting;

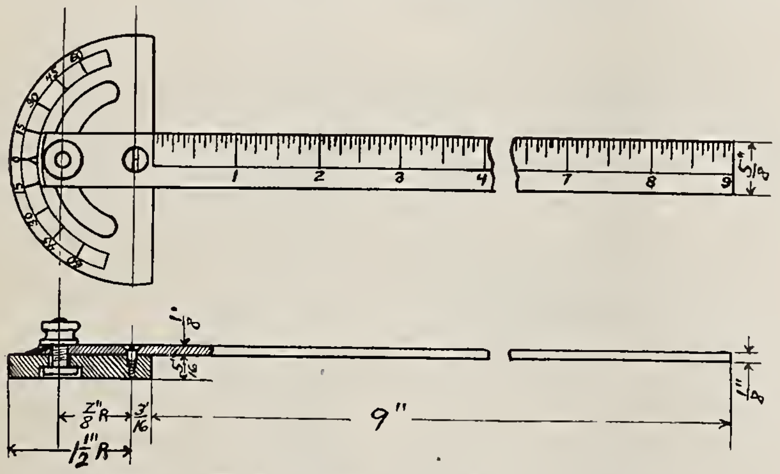


Fig. 2. Tee Square for Pattern Records

number of parts of the pattern and coreboxes; date pattern was made; when and to what foundry it was shipped, and an accurate dimension sketch of the rough casting.

It requires an average of 15 minutes to prepare each card, using the drawing board and tee-square, illustrated in Figs. 1 and 2, and a few drawing tools.

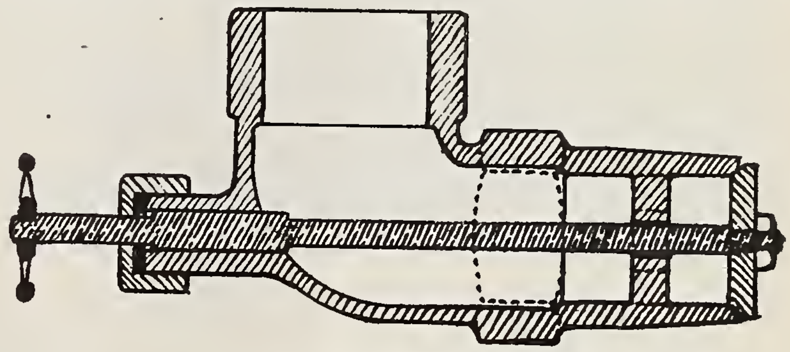
A good index is essential but is rather hard to prepare on account of the many names and nick-names applied to the same part. A locomotive and M. C. B. dictionary should be referred to.

The drawing board (Fig. 1) is made of any kind of close-grained wood. The center is recessed 1/32 inch to hold the card instead of thumb-tacks. The standard scale can either be marked on the wood or drawn on paper and glued to the board in a small recess made for it. A coat or two of shellac should be applied to protect the lines.

The tee-square (Fig. 2) is made of wood and will also answer the purposes for scale and triangles. The small bolt, from a dry battery, has a long flat head to prevent turning, and a knurled nut to tighten by hand. A pinpoint indicator is used on the protractor for accuracy.

Working drawings could also be made quickly with a larger board and tee-square of the same design.

Engine failures caused by whistle failures can be eliminated by adding a valve to the whistle elbow as shown on the drawing. The end has a bevel surface, against which a valve is seated by turning the handle. The ½-in. stem is supported by a light bridge across the steam opening, while the other end, ⅝-in. thread, has a



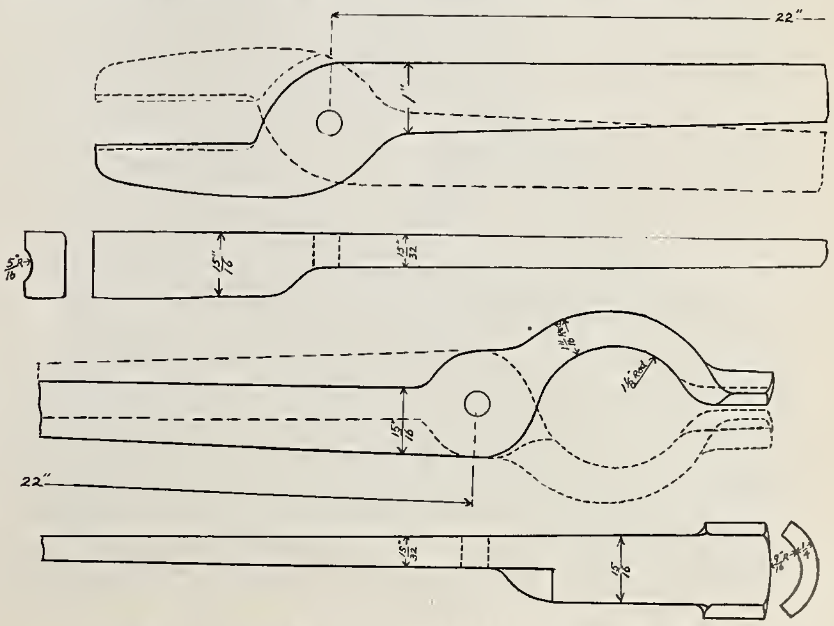
Improved Whistle Elbows

stuffing box and a threaded bearing of sufficient length to allow the valve to open wide. A left-hand thread is preferable.

Tongs for Holding Round and Hexagon Stock

By W. H. WOLFGANG
Toledo, Ohio

In the illustrations are shown tongs for holding round and hexagon stock when forging out work under the steam hammer. These tongs are made of wrought iron and have proved very useful to the smith.

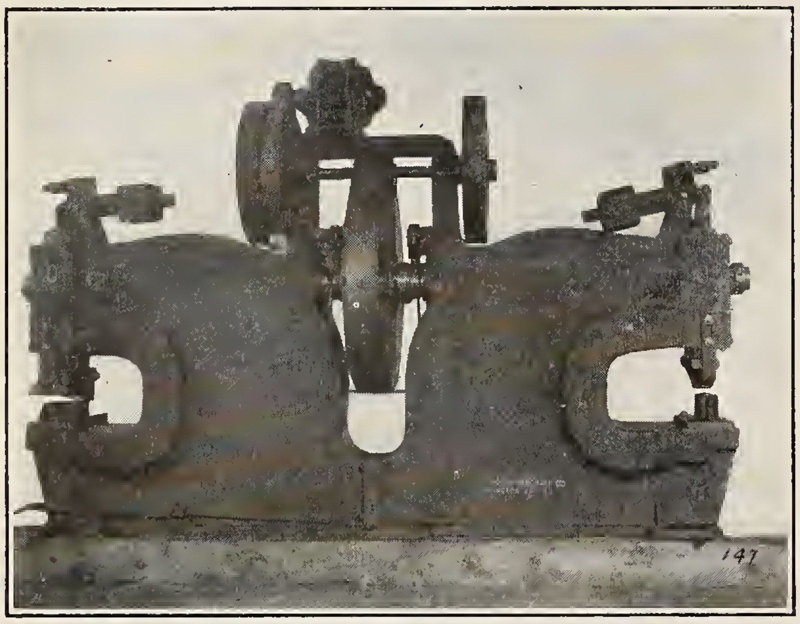


Tongs for Holding Round and Hexagon Bars

New Methods and Appliances

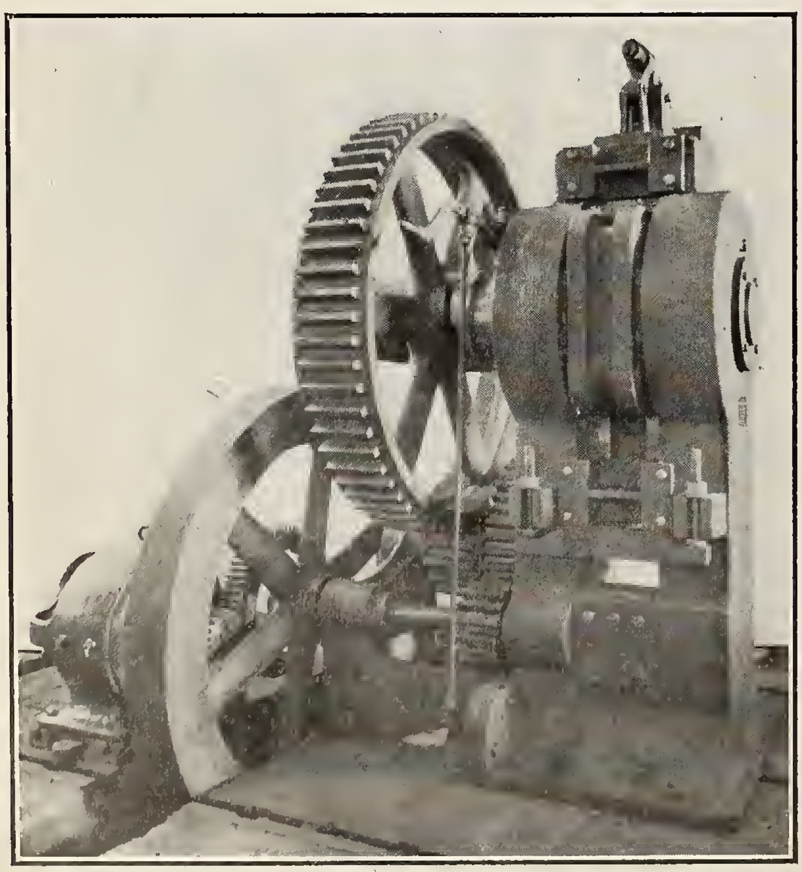
Special Double-End Punch and Shear

The Covington Machine Co., 88 Wall St., New York City, have recently built a special double-end punch and shear with 25 in. throats on each end for the Norfolk & Western R. R. shops at Bluefield, W. Va. The machine will punch up to 1½ in. diameter holes in 1⅛ in. stock, will shear or split 1⅛ in. soft steel plates,



Covington Double-End Punch

will cut 2⅛ in. rounds or 6 ins. by 1½ in. flats or the equivalent of any of these operations. The photograph shows one end of the machine equipped for punching and the other for shearing. Special punches on die blocks have been provided for punching angles and for



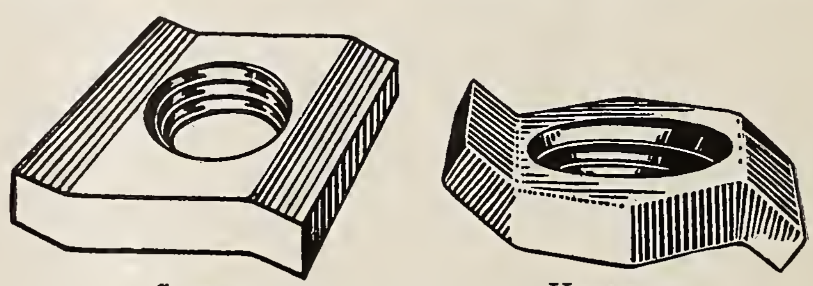
Covington 6-Inch Square Guillotine Shear

structural shapes and splitting and angle shears were provided. The machine is motor-driven, heavy and sturdy, weighs 39,000 lbs., and is designed for hard and continuous service. All gears are enclosed with sheet metal guards.

The second illustration shows the Covington Machine Company's latest pattern of Guillotine shears. This very powerful machine is designed for cutting 6-in. square bars or equivalent and can be arranged with wider spacing between the housings for flat sections or other forms. It can be supplied either for belt or motor drive and is equipped with gear guards.

New Nut Lock and Bolt for Hollow Work

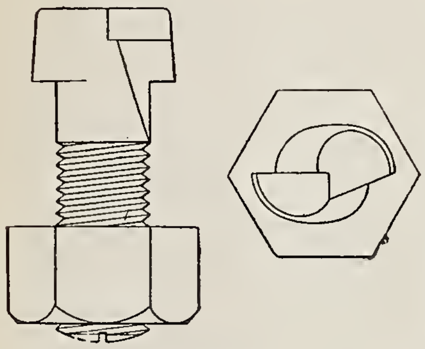
The Columbia Nut and Bolt Co., Inc., Bridgeport, Conn., have just placed on the market the Columbia Jib Nut Lock, a three-thread lock made either square or hexagon, as illustrated, which has several advantages. The threads are cut straight through the nut which can, therefore, be applied up to the holding nut with fingers and a wrench is only required to set it tight.



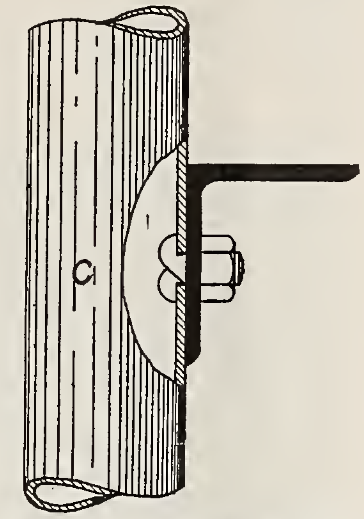
Square Hexagon
Columbia Jib Nut Locks

The bent edges of the nut being on opposite sides, it can be applied either side up, and owing to its shape it does not injure or mar the threads of the bolt in any way. The bent edge of the jib nut comes in contact with the surface of the holding nut, tipping the jib nut over at an agle and forcing its threads into the threads of the bolt, making a jam. These bolts are made in all sizes from ⅜ in. up to and including 2 ins. and both square and hexagon threads.

The Kling bolt has been designed in such a way that the head will pass through a hole of the same diameter as the stem of the bolt and will give a firm anchorage for the head on the opposite side, making it available for all hollow construction work. The bolt is split in order that the head may be passed through a hole the size of the bolt stem. This splitting does not reduce the area of the metal nor affect the tensile strength of the bolt. The area of the metal at the head is greater than the area of metal where the thread is cut. The illustrations show the general appearance of the bolt and it is applied by passing the reinforced half of the bolt head through the hole first and following with the plain half. Holes should not be drilled larger than the diameter of the stem of the bolt. This bolt is available for attaching brackets, hinges, swivels, loops, guy wire attachments, braces, etc., to piping and hollow column work. Where conditions are such as to put the bolt under heavy strain or shearing stress, it is recommended that nips or shoulders be applied for the brackets not only to assist the bolts, but to reduce the number necessary. In steel or semi-steel passenger

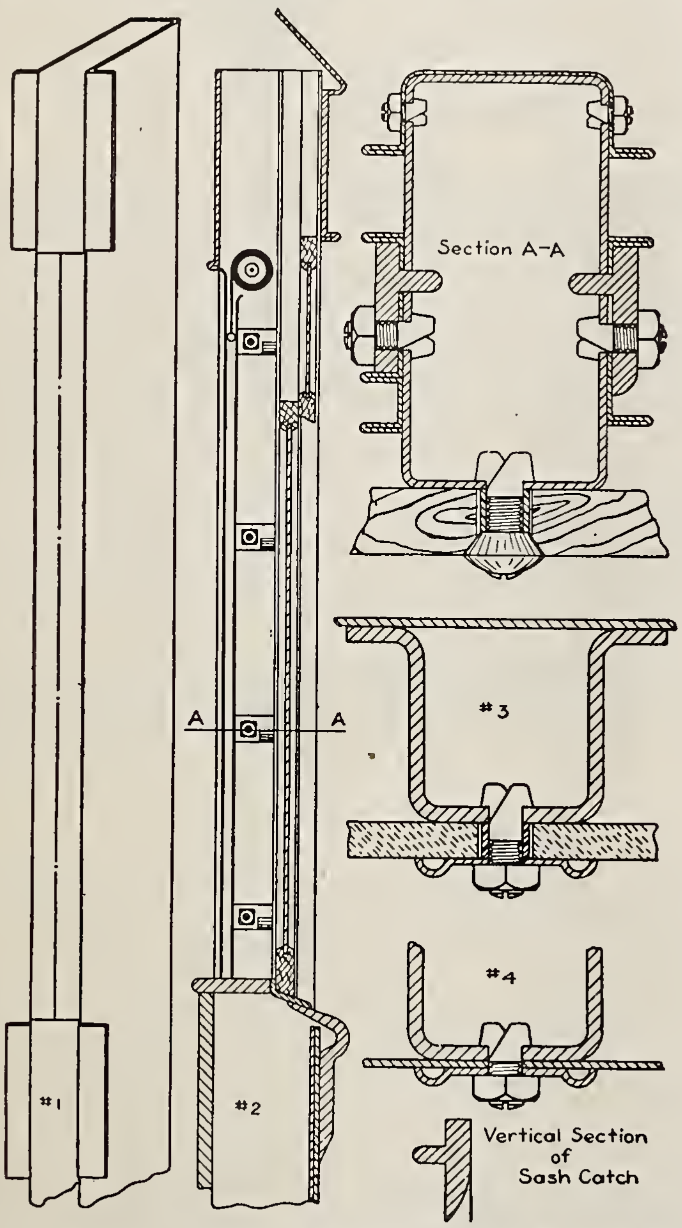


Kling Bolt



Application of Bracket to Hollow Post with Kling Bolt

car building this bolt makes possible mechanical construction involving the use of tubular posts. Sash and curtain guides may be bolted to the tubular posts with Kling bolts without tapping or threading and composi-



Application of Window and Curtain Stops to Hollow Post with Kling Bolts

tion wood or steel lining can be attached to posts and carlines to advantage by their use.

To apply the bolt the head is passed through the hole in the post or carline and a short piece of rubber tubing can be slipped over the bolt temporarily to hold it in place or a spring clamp of steel wire may be slipped on the bolt to hold it until the nut is applied. A hole should be drilled in the lining large enough to pass over the tubing, and the nut then applied.

When this form of construction is used the linings, and sash and curtain guides, can be readily removed for repairs and repainting, and as easily reapplied.

Cyclodial Wier for Water Meter

The Kennicott Co., Chicago, Ill., have recently placed on the market a water meter embodying a wier with a cycloidal notch. The thought of a wier calls to mind the wiers of "V" notches and rectangular notches now in general use, and all the experience that has been secured in their operation lies back of the design of the new cycloidal notch.

Water flowing from a round hole in the bottom of the container, or wier, passes out at a rate varying in proportion to the square root of the head. The rectangular notch in the side of the wier permits the water to flow at a rate proportional to the 3/2 power of the head. The "V" notch changes this ratio to the 5/2 power of the head.

For a constant head, these ratios would any of them be sufficiently convenient for use, for once the rate of flow had been established, the mathematician could devote his time to other duties. Or, were the head to vary, and only an occasional reading be desired these ratios of rate of flow to head can be used.

It is when a record is to be kept of the water flow that these fractional exponents in the proportion com-

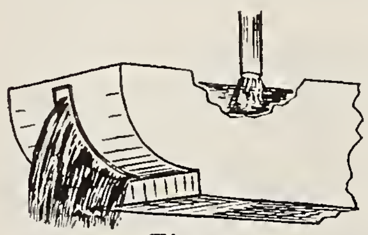


Fig. 1

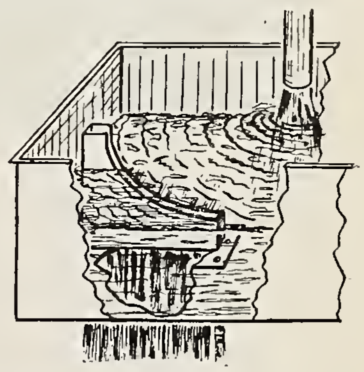


Fig. 2

Cycloidal Notch Wiers.

plicate matters. A continuous recording device capable of recording the square root of the cube of the continuously varying reading of a rectangular notch wier is not a simple mechanism, nor is a similar device for recording the square root of the fifth power.

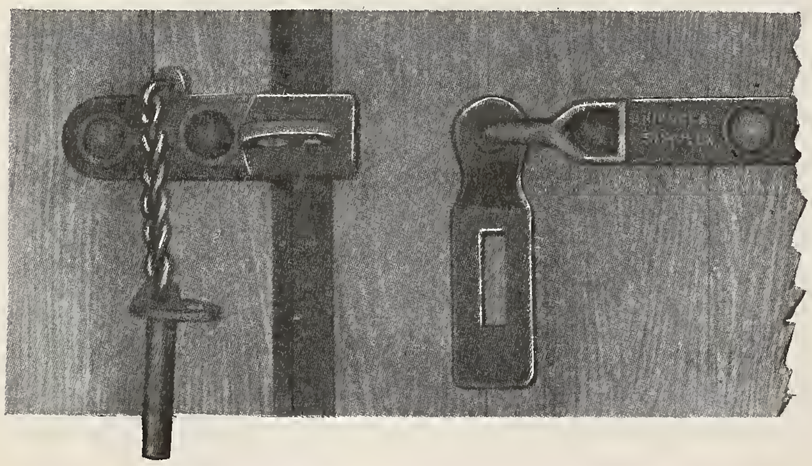
With these facts in mind, the Kennicott Co. began experimenting to find what shape of notch would permit the water to flow at a rate proportional to the head, with no intermediate computations. Starting with a rectangular slot in the bottom of the wier, experiments were made to determine how long the slot would need to be at each height for the water to flow at a rate proportional to the height or head. These lengths of slots, when plotted into a curve, formed the basis for the construction of a wier box with a curved end and a rectangular slot, shown in the sketch Fig. 1. Exhaustive tests confirmed the results of the experiment.

After the perfecting of this form of wier a mathematical investigation of the curve demonstrated it to be a right cycloid, that is, a curve generated by a point on the circumference of a circle rolling on a straight line in the same plane with the circle.

Having developed this form of wier and thoroughly tested its dependability the Kennicott Co. has incorporated it in its new cycloid wier meter, used in connection with that company's water softening and storage apparatus, the form of notch used being indicated in sketch Fig. 2. This device makes possible much more accurate measurement of water by simpler means than have hitherto been employed. Though an astonishingly rational development and one perfectly reducible by mathematical computation, no previous investigators or experimenters appear to have attempted this result—at any rate, basic patents covering the principle have been allowed the inventors by the United States patent office.

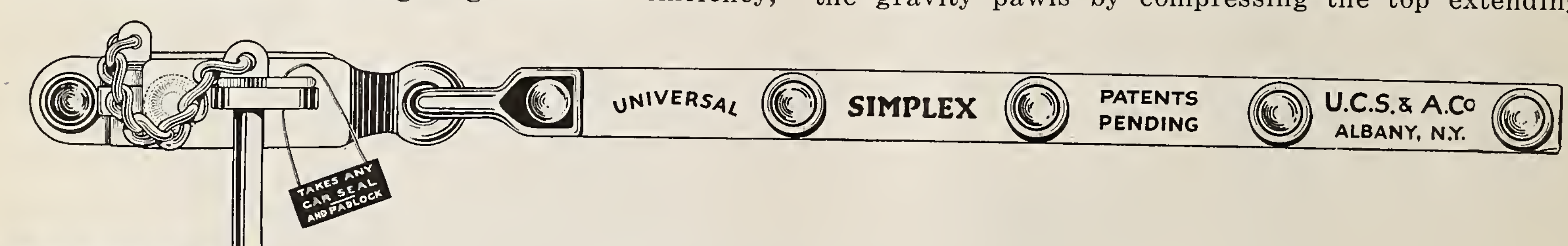
New Car Door Stops and Locks

The Universal Car Seal and Appliance Co. have recently added to their line the "Universal Simplex" metal door stop, lock and guide. It has been designed to meet the M. C. B. standard requirements, is made of malleable iron, weighing about 6½ lbs., and is, mechanicallly, very strong. In operation the hasp is thrown over the lug and the drop pin placed through the hole in the lug. Seal or padlock may then be applied through registering holes in the extended tops of the

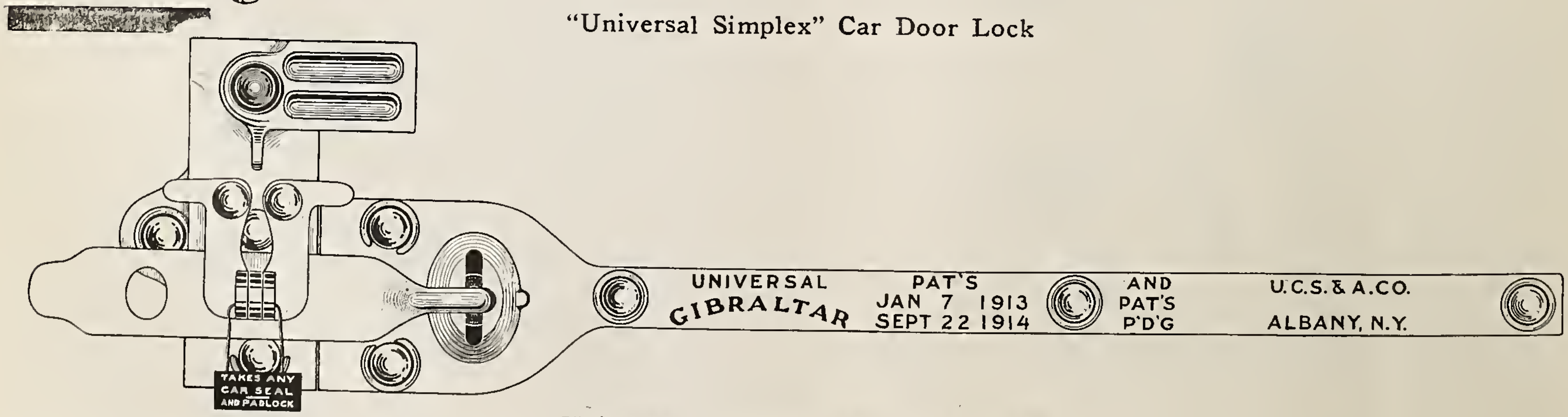


"Universal Simplex" Car Door Lock

pin and lug. This lock has been worked out so that it may be applied either to wood or steel doorway construction. Some recent improvements have been made in this company's "Universal Gibraltar" metal door stop, lock and guide. The lock is illustrated with these new improvements. While giving maximum efficiency,



"Universal Simplex" Car Door Lock

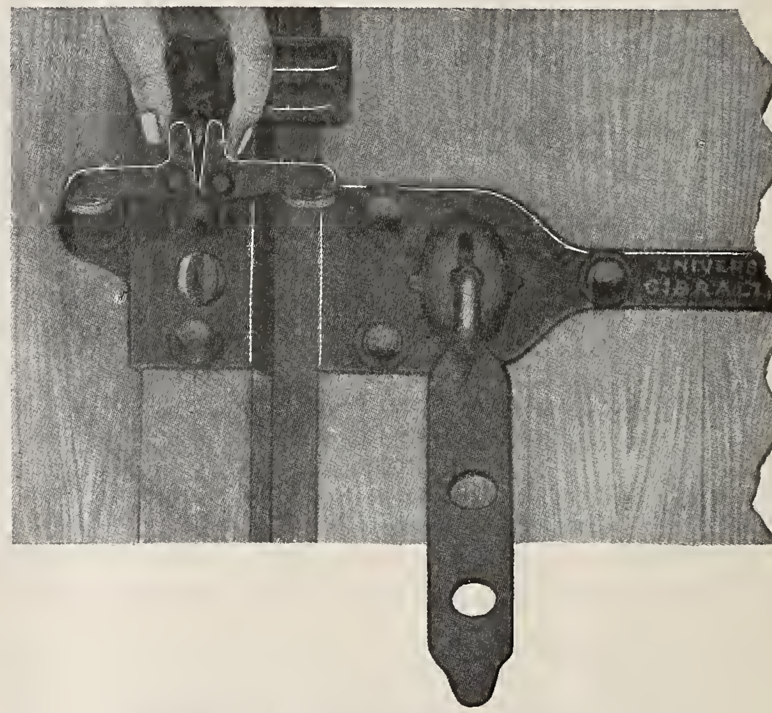


"Universal Gibralter" Car Door Lock

this device is simple, quickly operated and sealed, and easy to inspect.

It is M. C. B. Standard and is genuinely burglar-proof, having inaccessible bolts, and it is impossible to separate one part from another. It accommodates any car seal in use and a padlock and is made for wood or steel door or doorway construction.

The device weighs about 12 lbs., is made of malleable iron throughout. Its design and construction reduces to the minimum upkeep or repair expense. It prevents splitting and battering door stops, doors and car bodies. The car door stop is kept intact; there is no splicing of



"Universal Gibralter" Car Door Lock

the metal stop into the car door stop, with the consequent high cost of application, and weakening the door stop as a whole.

The metal door stop is a channel casting and envelops the car door stop; it also has a side bolting flange for the purpose of reinforcing the car door stop. This stop casting is gained into the door stop, which is likewise the case with the door strap casting, providing metal surfaces touching, and allowing for readily prying a binding door without injuring the woodwork.

The operation of the lock is illustrated: first spread the gravity pawls by compressing the top extending portions with the thumb and index finger of the left hand; then throw the hasp over the post with the right hand; let go pawls. Apply seal (or padlock) through registering holes of pawls and post.

New Trade Literature

The American Shop Equipment Co., Chicago, Ill., have recently issued a 36-page illustrated catalogue covering shop furnaces which have been equipped with an improved type of combustion chamber. A number of the furnaces are built with a layer of insulation brick between the fire brick and the plates, to reduce fuel consumption, maintain a more uniform temperature in the furnace and maintain a cooler temperature outside for the operator. Furnaces are described for forging, welding, hammer, bulldozer, spring fitting.

The Chicago Pneumatic Tool Co., 1010 Fisher Bldg., Chicago, have recently issued a 16-page illustrated booklet giving a brief survey of the variety of types of compressors and oil engines which they manufacture. Some 24 represented types selected from over 300 are illustrated and the classes for service for which they are most advantageous are described.

Watson-Stillman Co., Aldene, N. J., have recently issued a 16-page illustrated catalogue No. 93, describing the Strucke-Watson-Stillman testing machine for cylindrical gas containers. The catalogue includes a discussion of various methods of testing cylinders and the safety disks with which they must be equipped. Examples of testing operations and data are incorporated.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., have issued a 16-page illustrated reprint of a paper presented at a meeting of the Railway Club of Pittsburgh, by E. M. Herr, president of that company. The paper deals with electric power development, through successive sizes of generating units with relation to industrial and railway electrification projects.

Gustave Wideke & Co., Dayton, Ohio, have recently issued a 96-page illustrated catalogue covering boiler tube expanders. A variety of devices are illustrated and the conditions of service which would make one expander of greater use than another are analyzed thoroughly. Charts of locomotive construction, both American and foreign, are valuable features of the book.

Book Reviews

Proceedings of the 23rd Annual Convention of the International Railroad Master Blacksmiths' Association, held at Philadelphia, Aug. 17, 18, 19, 1915.

These proceedings have been put together in a very presentable book form, which has recently been issued. The officers of this association for the ensuing year are President T. E. Williams, of Davenport, Iowa; Vice-President W. C. Scofield, Chicago; Second Vice-President John Carruthers, Proctor, Minn.; Secretary and Treasurer A. L. Woodworth, Lima, Ohio; Assistant Secretary and Treasurer George P. White, Parsons, Kan.; Chemist George H. Williams, Boston, Mass.; Chairman Executive Committee George P. White, Parsons, Kan. From the address of the retiring president, Thomas Buckley, to the last address delivered the proceedings were marked by intelligent and forceful action. All the papers read are full of interesting matter, and subjects of all kinds relating to railroad blacksmithing were discussed, noticeably piece work, best method of reclaiming scrap, spring making and repairing, case hardening, drop forging, electric welding, heat treatment of metals, shop kinks, carbon and high-speed steel and tempering of taps and dies, and also efficiency in shop work. Chicago was selected as the next meeting place and the third Tuesday in August, 1916, was the date agreed upon. The attendance was very large and many ladies were present to add to the interest of the occasion. There are 247 active members of this association and a large number of associate members. Mr. Cattell, of Philadelphia, represented the Mayor of that city and was extremely happy in his address, especially so when he remarked that he had received the best lesson of his life from a lady with whom he was once dancing. "What a splendid floor to dance on," he said. She replied: "Why not dance on it, then, and keep off my feet."

This book is appropriately illustrated and is well worth having in a collection of books relating to railroad subjects. Conventions like this are of great help to the railroads; go a long way toward standardization and bring together men devoted to their callings.

Conversion Chart and the **W-PVT Chart**, by Merl Wolfard, S. B. and M. M. E., and Charles K. Carpenter, M. E. John Willey & Sons, Inc., New York.

The Conversion Chart, 12 in. by 34 in., represents more than 40 complete conversion tables, including power, speed, linear, surface and volumetric conversions by means of a novel of logarithmic co-ordinate paper.

The W-PVT Chart, 24 by 38 ins., is divided into two quadrants by use of a heavy diagonal line bringing the PV quadrants close to the TV quadrant, so that pressure temperature and volume relations throughout any gas engine or air compressor cycle may be easily determined. The chart may be entered directly in any units of pressure, temperature or volume, and cube or cube root and the 3/2 or 5/2 power or root of any number may be obtained.

The chart is printed on accurately divided logarithmic co-ordinate paper and all plotted scales are open enough to insure a high degree of accuracy.

Principles and Practice of Cost Accounting, by Frederick H. Baugh, Baltimore, Md., Box 682.

This book has been prepared for the use of mechanical engineers, accountants, and manufacturers. It is a comprehensive and practical presentation of general principles upon which cost accounting for manufactured articles is based. Its various chapters treat of the outline of accounting, principles of cost accounting, specific job cost, departmental cost, process cost and illustration of department cost accounts. The methods outlined in this work call for little, if any, addition to the books which a corporation should ordinarily possess for recording its transaction and it cannot help but be useful to any one interested in cost accounting. All matters discussed are presented in a clear and adaptable manner. In these days of efficiency a book of this kind is of great value and makes an excellent acquisition for reference and study.

The Mechanical World—Pocket Dairy and Year Book for 1916. This is the twenty-ninth year of its publication. Emmott & Co., Manchester and London, England; The Norman Remington Co., Baltimore, U. S. A., and the Marnzea Kabushhiki-Kaisha, Japan. Price, 30 cents, postpaid.

It is a collection of useful Engineering Notes, Rules, Tables and Data. It is truly a pocket diary readily carried so as to be consulted at any time most conveniently. It is virtually all the "world of mechanics," snugged up for quick and oft needed information.

Supply Trade Notes

Atkinson & Utech have announced their incorporation to conduct a railroad supply business in iron and steel products at 111 Broadway, New York City. Lloyd H. Atkinson, president, was for several years rail sales agent of the Bethlehem Steel Co. John J. Utech, vice-president, has been connected with the Carnegie Steel Co., American Steel Foundries, and for the last six years has been manager of the New York office of the Alliance Machine Co.

William Edward Ballentine, general railway sales manager of the Willard Storage Battery Co., Cleveland, Ohio, died January 11, after an illness of four days. Mr. Ballentine was first associated with the Fort Scott & Memphis R. R., then with the Pullman Co., and later was head of the electrical department of the Rock Island. In 1909 he was appointed manager of the western territory of the Willard Storage Battery Co., and in 1913 was appointed general railway sales manager of that company. The success of the Willard Storage Battery Co. in the train lighting field is greatly due to his efforts.

E. H. Bell has recently been elected president of the Railroad Supply Co., of Chicago, succeeding the late Henry S. Hawley. Mr. Bell has been vice-president of that company for some years.

James M. Buick, recently elected first vice-president and general manager of the American Car & Foundry Co., at St. Louis, succeeding E. F. Carry, has been second vice-president of that company. The sales offices of the American Car & Foundry Co. will remain in Chicago, Herbert W. Wolff having been appointed vice-president in charge of sales.

E. F. Carry, recently elected president of the Haskell & Barker Car Co., has resigned as vice-president of the American Car & Foundry Co., to accept that position.

Maynard D. Church has recently been appointed chief engineer of the Terry Steam Turbine Co.

D. A. Crawford, recently elected treasurer of the Haskell & Barker Co., entered railroad supply work as secretary to E. F. Carry, vice-president of the American Car & Foundry Co. In 1912 he was elected assistant secretary of that company, where he remained until his recent change.

John E. Dixon, recently elected vice-president in charge of sales of the Lima Locomotive Corporation at 50 Church Street, New York, has been assistant manager of sales for a number of years of the American Locomotive Co. His training has included general shop work in a number of locomotive plants, and since 1905 his experience has included a variety of work in the sales department of the American Locomotive Co.

The Duntley Product Sales Co., 810 Fisher Bldg., Chicago, Ill., has organized a railway department under the management of W. F. Caspert, formerly connected with the Monarch Steel Castings Co., of Detroit. The W. O. Duntley interests are represented by C. A. Duntley, who will be actively connected with the management of the new department.

J. H. Guess, recently elected secretary and treasurer of the Lima Locomotive Corporation, began railway work as telegraph operator on the Seaboard Air Line in 1895. In 1900 he was appointed clerk to the vice-president and general manager of that line, and in 1901 clerk to the vice-president and general manager of the Atlanta, Birmingham & Atlantic. In 1902 he was appointed assistant general purchasing agent of the National Railroad of Mexico, and in 1905 assistant secretary and assistant treasurer of that company. In 1901 Mr. Guess became assistant general purchasing agent of the Grand Trunk, and in 1912 general purchasing agent on that road, from which he has resigned to become secretary and treasurer and to have charge of all purchases of the Lima Locomotive Corporation at Lima, Ohio.

The Haskell & Barker Co., of Manhattan, has recently filed articles of incorporation at Albany, N. Y. Formal transfer of the Haskell & Barker Co., of Michigan City, Ind., has been effected. The new officers are Edward F. Carry, president and general manager; C. A. Liddle, vice-president; and D. A. Crawford, mentioned elsewhere on this page. The directors include Mr. Carry and Mr. Liddle, and Wm. Ellis Corey, Ambrose Monel, and Frank A. Vanderlip.

The Kay & Ess Co. have announced the appointment of H. N. Turner, formerly eastern representative, as sales manager, with headquarters at Dayton, Ohio.

The Kilby Locomotive & Machine Works, Anniston, Ala., has changed its name to the Kilby Car & Foundry Co. There has been no change in management.

Charles A. Liddle, recently elected vice-president of the Haskell & Barker Car Co., entered the service of the Allison Manufacturing Co. of Philadelphia, builders of freight cars, and has since that time been identified with car manufacture in the service of the Jackson & Sharp Co., the Harlan & Hollingsworth Co., the Pressed Steel Car Co., and the American Car & Foundry Co.

The Lima Locomotive Corporation is reported to have had control of its stock acquired by a syndicate headed by Joel S. Coffin and Samuel G. Allen, president and vice-president respectively of the Franklin Railway Supply Co.

The Locomotive Stoker Co. has removed its New York office from Room 1032, 30 Church Street, to Room 1381, 50 Church Street.

Waldo H. Marshall, president of the American Locomotive Co., and first vice-president of the Merchants' Association of New York, has been appointed to the executive committee of the Merchants' Association, succeeding Irving T. Bush.

The J. C. Russell Shovel Co., Pittsburgh, Pa., announce that they have made an arrangement with R. L. Mason, 1501 Oliver Bldg., Pittsburgh, Pa., to act as special representative in the railway field. Mr. Mason will have charge of railroad sales on track shovels and locomotive scoops and his broad experience in the last fourteen years especially qualifies him to be of service.

A. E. Schafer, who has for the past two years been vice-president and general sales manager of the Flint Varnish Works at Flint, Mich., has severed his relations with that company.

E. C. Waldvogel has recently been appointed general manager of the Yale & Towne Manufacturing Co.

J. W. Wilson has been appointed eastern railway representative of the Kay & Ess Co., succeeding Mr. Turner.

Personal Items for Railroad Men

R. E. Anderson, recently appointed air brake instructor on the Chesapeake & Ohio, has his office at Richmond, Va.

Charles A. Bingaman, recently appointed mechanical engineer of the Philadelphia & Reading and subsidiary companies, has been serving that road in the capacity of assistant engineer of motive power, which position has now been abolished.

H. N. Cathcart, recently appointed fuel and locomotive inspector on the Philadelphia & Reading at Reading, Pa., has been serving as traveling fireman.

Philip Connif, recently appointed assistant superintendent of motive power and machinery for the Florida East Coast Ry., with headquarters at St. Augustine, Fla., has resigned as special inspector in the mechanical department of the Baltimore & Ohio.

E. M. Cooney, recently appointed master mechanic at Zanesville, Ohio, of the Pennsylvania Lines west of Pittsburgh, entered the service of the Pennsylvania Railway Co. in 1895 as boiler maker helper. In 1899 he was made flanger and layer out. In 1904 he was made boiler maker foreman at the Mt. Vernon shops, and in 1912 he was appointed on special work for the superintendent of motive power of the Central System. Mr. Cooney succeeds F. O. Peoples, who has been relieved from service.

J. G. Crawford, fuel engineer of the Chicago, Burlington & Quincy R. R., has recently been elected secretary and treasurer of the International Railway Fuel Association, succeeding C. G. Hall, resigned.

I. H. Drake, has recently been appointed master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe Ry., with headquarters at Clovis, N. M., succeeding Hugo Schaefer, appointed pilot engineer in the valuation department.

G. J. Duffey, recently appointed superintendent of motive power of the Lake Erie & Western at Lima, O., has been serving as master mechanic, that office being abolished with his appointment as superintendent of motive power.

W. E. Dunkerley, recently appointed master mechanic of the Yellowstone division of the Northern Pacific at Glendive, Mont., succeeds B. P. Johnson.

H. I. Fipps, recently appointed general foreman of engines of the Middle division of the Nickel Plate at Bellevue, O., entered the service of the Nickel Plate 31 years ago. In 1880 he was appointed engine-driver on the Lake Shore & Michigan Southern and in 1884 he returned to the Nickel Plate, where he has remained until his recent appointment, for which he gives up a preferred run on the Cleveland division.

W. E. Grove recently appointed assistant general car inspector of the Philadelphia & Reading, has his office at Reading, Pa.

J. B. Halliday has recently been appointed acting master mechanic of the Central and Western division, of the Minneapolis & St. Louis, R. R., with headquarters at Minneapolis, succeeding Wm. Gemlo, resigned.

J. H. Hanna, recently apointed road foreman of engines of the Pennsylvania Lines West of Pittsburgh, western division, succeeding C. R. Colmey, deceased, has been serving as road foreman of engines.

John P. Kendrick, recently appointed master mechanic of the Buffalo, Rochester & Pittsburgh Ry. at the Du Bois, Pa., shops, has been serving the same capacity at Punxsutawney, Pa.

F. G. Lister, recently appointed mechanical engineer of the El Paso & Southwestern at El Paso, Tex., began railroad work in 1901 as machinist's apprentice with the Wabash Railroad at Springfield, Ill. In 1902 he was appointed locomotive draftsman and in 1906 was appointed locomotive and lead draftsman on the Northern Pacific. In 1911 Mr. Lister was appointed chief draftsman of the Spokane, Portland & Seattle and affiliated lines and held this position until his recent appointment. He succeeds in his new work H. P. McCann, resigned.

I. A. McFerran, recently appointed master mechanic of the Louisville & Nashville R. R. at Covington, Ky., entered railroad service with the L. & N. R. R. in their shop, and after serving as fireman and engineman, he has been traveling engineer on that road for the last five years. He succeeds at Covington R. B. Salmons, deceased.

J. A. MacRae has recently been appointed mechanical engineer of the Minneapolis & St. Louis, R. R., with headquarters at Minneapolis, Minn.

O. E. Maxwell, recently appointed road foreman of engines of the Pennsylvania Lines West, assumes the duties of J. H. Hanna, promoted.

J. A. Mitcham, recently appointed erecting shop foreman of the San Pedro, Los Angeles & Salt Lake R. R at Las Vegas, Nev., succeeding G. F. Smith, resigned, leaves the position of roundhouse foreman of the Denver & Rio Grande at Ogden, Utah.

F. E. More, recently appointed assistant road foreman of engines of the Pennsylvania Lines West of Pittsburgh, succeeds F. E. Wilmore, promoted.

George Mott has recently been appointed district master mechanic of the Alberta division of the Canadian Pacific.

I. C. Newmarch has recently been appointed superintendent of shops for the New York Central R. R. at Collinswood, Ohio, succeeding R. H. Montgomery, deceased.

C. J. Quantic, recently appointed master mechanic of the Pacific division of the Canadian Northern, is located at Port Mann, B. C.

T. L. Reed, recently appointed master mechanic on the North Carolina division of the Seaboard Air Line at Hamlet, N. C., has been serving as assistant master mechanic, and that office has now been abolished.

John D. Rogers, recently appointed roundhouse foreman of the Oregon Short Line, has his headquarters at Pocatello, Ida.

F. Ronaldson, recently appointed district master mechanic of the Canadian Pacific at Farnham, Que., has been serving as locomotive foreman at Lambton, Ont.

James D. Searle, recently appointed master mechanic of the Buffalo, Rochester & Pittsburgh Ry. at Punxsutawney, Pa., succeeding John P. Kendrick, has been serving as erecting shop foreman at Du Bois.

H. J. Whyte has recently been appointed supervisor of car work on the western lines of the Canadian Northern.

John Wintersteen, recently appointed general master mechanic of the Lehigh Valley, with headquarters at South Bethlehem, Pa., entered railroad service in the Lansford shops of the Lehigh Coal & Navigation Company. After holding a number of government positions he was connected with the Baldwin Locomotive Works and was later boiler inspector on the Norfolk and Western at Roanoke, Va. Following this work he was appointed general foreman of the Philadelphia & Reading shops at Richmond. Mr. Wintersteen's duties as general master mechanic will be assigned to him by the superintendent of motive power.

Obituary

Oliver C. Gayley, vice-president of the Pressed Steel Car Co., died at his home in New York City January 9. He entered the service of the Pennsylvania R. R. in the engineering corps, and soon became supervising engineer. Later he was division engineer on the Philadelphia & Reading, and afterwards was identified with the St. Louis Car Wheel Co. He then became general manager of sales of the Safety Car Lighting & Heating Co., and was a director of that concern at the time of his death. He entered the service of the Pressed Steel Car Co. as general manager of sales, and since was made second vice-president and recently first vice-president of that company.

John Alexander Hill, whose death occurred last week, has been a unique figure in the ranks of technical journalists, and the president and founder of the Hill Publishing Company. He was born on February 22, 1858, at Sandgate, Vermont, but early removed to Wisconsin, where he was educated. His start in life, at the age of fourteen, was in a small printing office, in which he became foreman at seventeen. His love for machinery, which was gratified in the printing office, led him to seek its further expansion in railroad life.

He took the position of fireman on the Denver & Rio Grande, and shortly afterward became a locomotive engineer. It was his practical experience on the road which enabled him later on to write those inimitable sketches entitled "Jim Skeever's Object Lessons," which faithfully portrayed the actual railroad man as he is on the real railway. Leaving active railroad life, his printing house training enabled him to found the "Daily Press" of Pueblo, Col. He edited this paper for about a year, but again turned his attention to railroad work, at which he remained until 1887. During these years he was a frequent contributor to the "American Machinist." Many of his writings appeared under the simple name of John Alexander.

In 1891 Mr. Hill formed a partnership with Angus Sinclair, another D. & R. G. locomotive engineer, and together they acquired the "Locomotive Engineer," They changed its name to include the science, and made it "Locomotive Engineering." In 1885 they bought the "American Machinist," and later, when the partnership was dissolved, Mr. Hill took the "American Machinist." Under his guiding hand the property advanced in standing and in value, and its success enabled Mr. Hill to form a company which acquired

John Alexander Hill

not only the "American Machinist," but "Power," "The Engineering and Mining Journal," "The Engineering News" and established the "Coal Age."

In acquiring these technical publications, Mr. Hill was able to give tangible form to his enlightened ideas of the printer's life and his art. He did not see any good reason why printers should work surrounded by disorder and amid printing ink, oily rags and waste paper. He believed a printing office might be as bright and clean as any other establishment where work is done, and he made this belief a reality in his building at Tenth avenue and 36th street, New York. This building is painted white inside, and even the machinery is of the same color. It contains a tablet put up by the employes some years ago with the inscription, "Within this monument to independent truth and service in engineering journalism, the employes of the Hill Publishing Company have placed this tablet, as an appreciation of the man and employer, John A. Hill."

There was in this no idle flattery, for all had confidence in his justice and fair dealing. He is credited with many practical improvements in printing machinery and practice. He stood squarely behind his editors and never allowed the hope of advertising patronage to warp judgment or to bind honest opinion or stifle its expression. His wish was to die in harness and the grim reaper found him at his post.

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Measurement of Economy

Economy originally meant the management of a household, but the word has been altered in significance to include the idea of thrift, or the elimination of waste. On a railway when one speaks of economy of oil, one is generally understood to imply that less oil is to be used, or less will be used, than formerly. This off-hand assumption of what may be intended is not strictly accurate because cases may be cited where more lubricant, and not less, is actually consumed, and yet economy may be had.

It is quite possible to pour water into a wash basin and so increase the amount in the bowl, and yet have the total quantity run out of the waste pipe faster than the smaller volume did, and this result is not due to the increase of weight owing to there being water added. Such a state of affairs may sometimes be seen in the washroom of a Pullman car.

Here the swaying of the train may produce a circular motion of the water in the basin, so that very little of it flows over the orifice of the waste pipe in a given time and gets away. The addition of water by a few strong strokes of the pump adds water to the mass, but it destroys the circular motion, and the whole of the water flows rapidly out. In this case it is not the amount of water used that makes for economy. It is the rapidity of outflow that counts, for the sooner the basin is empty the sooner another passenger can be accommodated.

On a freight train in case oil is used so sparingly in the axle boxes that after the first half hour's run several hot boxes develop, with accompanying worn or injured brasses, the actual saving in the quantity of oil used may not only cause a delay to the train in question but it may retard the advance of following trains so much as to be "bad railroading." Here is a saving in oil, and such a reduction of the quantity poured out of the oiler's can will have an equivalent figure quite visible on the railroad ledger, if done often enough. The less used, the less money will be paid out, thus producing a saving which is in no sense economy. The true measure of economy would be to consider the facility with which traffic can be moved. Enough oil to effect this, though greater than the restricted amount, is economy.

Instances are easily found of locomotives which are designed to develop a given amount of power, or, to put it more simply, these engines are so made that they are capable of pulling a definite number of tons, when loaded in the fewest number of cars. If the limit of the fireman's capacity to shovel coal is reached and the load remains below what the engine can handle, the addition of a mechanical stoker may be necessary to replace the fireman who did his utmost. The stoker will throw on more coal than the fireman could handle, and of course more coal will be burned, and the company will have to pay for the extra coal, but this is not extravagance, and the fireman, with his less amount, did not bring about any economy by what he did, though he undoubtedly saved the coal pile. The true measure of economy must here be gauged by the tons hauled or the time occupied on the road.

A good example of economy may be observed in the loading of cars, because it readily appears that the less number of cars used with a given load, the greater the economy. If 1,000 tons be distributed in 25 cars, and the same amount, by more careful loading, be got into 20 cars, it is a manifest economy in train operation, because five cars loaded in the first case are left free to receive other paying freight in the second, and forty wheels with their flange and rail friction are eliminated, which is an advantage for the engine.

In the matter of economy a simple saving of the thing used is not necessarily the full measure of it, though it may turn out to be so. The fairer way to estimate the value of any procedure intended to give economy is to judge what is to be done and to observe how far the free but judicious use of materials tends to bring it about. Too little is scarcity, and too much is waste. The required amount used to the full is economy.

What Some Railroad Necessities Cost

The New York Central has recently prepared some interesting data relating to its own lines and service which will apply in a general way to many other systems. The practically stationary rates, both passenger and freight, and the steady increase in the cost of operation are the basis for the preparation of these interesting figures.

In the past ten years the New York Central has expended $400,000,000 for new stations; electrification; the separation of grade at highway crossings; safety devices of all kinds; rock ballasting; heavier bridges; heavier locomotives; coaches and equipment of various sorts, and all this in the interest of the public good.

Wages of train employes alone have advanced 45 per cent in the last decade. Supplies of all kinds have steadily increased in prices in the same time. In the matter of equipment alone there have been some tremendous increases. Steam locomotives formerly costing on the average $17,300 each, are now to be had at $25,000, while electric locomotives have gone up in price from $30,000 to $50,000. Seven years ago steel passenger coaches could be purchased for $12,000 each. Today $16,000 is the standard figure, and within three years the price of a steel baggage car has advanced from $8,000 to $8,800—an increase of 10 per cent. Additional heavier equipment has forced the company to rebuild its roadbed; construct more substantial bridges and culverts and lay heavier steel rails, while the consumption of fuel has greatly increased on account of the larger engines in service.

Eight years ago steel rails cost $29.30 per ton. In 1914 the price was advanced to $30.02 and today it would be impossible to secure them at this figure. The standard weight of rails, of a few years ago—85 lbs. to the yard—has been abandoned, so that now requirements call for a 105-lb. pattern, or, as in many instances for a 140-lb., in order to safely handle the increased weight of equipment. By the M feet, ties cost $21.64 in 1910. Today the price for the same class of material is $24.64 per M feet. The vast quantities of stone ballast required, formerly purchased at 60 cents per yard, now cost 65 cents. The cry for "safety first" and efficiency has resulted, too, in enormous expenditures in the way of improved signal systems. What are classed as "current improvements" have increased $4,000,000 since 1910. Not including the vast outlay in the Grand Central terminal, these current improvements aggregate $39,000,000 for the past five years. Electrification work beginning in 1903 has involved an outlay of $24,000,000. These are all most interesting facts, not to mention an increase in taxes of more than $1,250,000 since 1910.

It is no wonder that a desire for better rates is encouraged on the part of this and other great railroad systems. The New York Central refers to the present rates as "ancient" and most of them truly are. All outgo and no income goes much harder with a railroad than the dullness which is the lot of a boy who does not bear in mind that "all work and no play is apt to make him dull."

Standardization of Freight Equipment

About eighteen months ago the American Railway Association appointed a special committee to devise plans for the adoption of standard freight car equipment. This committee was composed of Messrs. E. P. Ripley, president, Atchison, Topeka & Santa Fe Ry. (chairman); Fairfax Harrison, president, Southern Ry.; Samuel Rea, president, Pennsylvania R. R.; A. H. Smith, president, New York Central Lines; J. Kruttschnitt, chairman executive committee, Southern Pacific Co.; Darius Miller, president, Chicago, Burlington & Quincy R. R., and Howard Elliott, chairman, New York, New Haven & Hartford R. R. The committee on maintenance were instructed to assist the special committee in this matter. The special committee has been actively engaged in the consideration of the subject it has in hand, though it has not as yet presented a final report.

It may be said, however, that there are about 2,500,000 freight cars in this country, of which approximately 1,000,000 are box cars, the average cost being $1,000 for each car. There are an immense number of types of freight cars in service, the result of efforts by various designers. Each railroad has been a law unto itself in style and size of freight cars, and also of equipment, so that the freight train of to-day is a strange jumble of types of cars, one a foot higher than its neighbor, another wider, and another longer. There is most certainly need of cars of different sizes for different uses, but the present arrangement can, and eventually will, be modified. It is believed by many that fifty or seventy types would serve as far as general purposes go, better than a thousand. Another expense due to the large number of types of freight cars is that which involves repairs.

The matter of losses in all directions is commanding the attention of railroad men, and this statement is made: "The standardization of the box car is only one of the various economies that are possible. A freight car is at the money-making task of moving goods only one-tenth of the time. It is idle or imposing upon its owners for switching, storage repairs, etc." This statement is reported to be the opinion of Mr. L. F. Loree, president of the Delaware & Hudson. In nearly every other branch of industry there has been a marked advance in efficiency.

Mr. Loree is further quoted as saying that an unduly high proportion of time is wasted in terminals owing to poor arrangement of tracks and general inadequacy of facilities; in fact, it has been said with some show of truth that "the railroad terminal is the weakest feature in the whole structure of American railroads." This of course refers to freight handling.

Some years ago the structural steel mills rolled commercial shapes of approximately the same design, though each mill differed from the others by some dimension. It so happened that this worked a good deal of hardship to railroads by reason of the fact that bridge renewals were seriously delayed. A bridge built with steel from a certain mill might require the renewal of several systems of members. In such a case, steel shapes had to be made at the mill where the original structural steel had been manufactured. The rolls for that particular size and shape might then be out of commission, and delay and trouble was the result.

A time came when the steel men got together and agreed upon a set of standard shapes that all should roll. They reduced the number of types by about two-thirds, and though each designer and each mill sacrificed something, the result was most distinctly beneficial, and soon all began to enjoy the benefits of cheaper production, and less warehousing came into vogue. The problem, difficult as it was, has been solved, and the principle, beneficial to the steel makers, can be applied to railway rolling stock. The problem is difficult even up to the limit of complication, but it is by no means beyond the resources, the skill and the mental acumen of our railway men, and the prospect of its final establishment is practically within sight.

Railroad Accidents

A certain amount of self-congratulation on the part of the railways is due on the showing made concerning accidents in the year 1915, as tabulated by the Interstate Commerce Commission. Last year was the best year for passengers since 1906, as far as injuries are concerned, and the best for employes since 1911. Last year, however, the improvement has been very good in the safety of operation all through. Safety in its baldest sense means life, and immunity from injuries comes second in the general application of the word. The improvement indicates a general awakening not only of the public, but of railway men themselves. They, too, must stop, look and listen.

The absolute safety of human life is the main thing and by all odds the first consideration. The fact that the dead do not come back to haunt railroad men, nor by their bitter words do they "make mad the guilty and appall the free"—they have been blotted out and are gone, but that fact does not prove that their taking off had even the shadow of palliation for it. The increasing and more extensive use of the automatic block system is often referred to as an evidence of the kind of improvement we have spoken of, and the safety-first campaign all over the country has done much to specifically direct attention to the proper use and the value of safety appliances generally.

The block system, most excellent as it is and coming more and more to be regarded as indispensable, and rightly so, is nevertheless advisory in its function. It gives information or tells its tale. It is the advance agent of the fact, but it is not that which slows down the train nor haults it on the threshhold of impending disaster. The block system needs the intelligent cooperation of a man or men. The mechanism is excellent, its conception is good, its indications are reliable and its failures, when they occur, are all on the side of safety. Its weak point lies in its human partner. It is true the man does not often fail, but occasionally he does, and his failure is not always on the side of safety.

It is a matter of common knowledge that witnesses in a trial in court describe the same occurence very differently from each other and no two of them will exactly agree in all particulars. So deeply does the personality and temperament of the observer govern his impressions that he frequently sees what he expects to see or makes such mental deductions from what he beholds as to actually color his appreciation of fact. A traveler from this country may see London, not as it may really be, but as he is temperamentally impressed by it. The man of science will tell you of the Royal Observatory at Greenwich and the South Kenzington Museum, while the bon vivant enthusiastically describes the restaurants and the houses of the rich in Mayfair.

One may not at once see the connection between this form of loose generalization by a traveler and the sober contemplation of a railway signal by a trained man, but back of it all there is the same quality of mind in each case, and the same liability to make mental deductions which may not entirely square with the facts. There is always the tendency to see what one expects to see, and close and concentrated effort is required to overcome this tendency, and in the case of momentary distraction (and distraction is ever ready to make entrance to the brain) the faculty of concentrated and intelligent attention may at a critical moment become weakened.

It has been stated by many that the patent office is full of patents on useless schemes designed to prevent a slight distraction from finally resulting in disaster. Models of stop-signal apparatus are piled shelf upon shelf, dusty and unused. All this represents a waste of money and effort, and that it has so far come to naught. As far as mere statistics go or patent office records make it clear, not a tithe of the effort put forth in this direction is of any practical use, yet the subject is not properly disposed of by saying that such effort is wasted or the money involved has been thrown away.

The unused, patented appliances at Washington are yet a silent reminder that this very question is not merely an effort to hit upon a good selling article, but it shows that the subject is a live one, and that the eager quest for a practical solution is still being pursued. There is need for an effective and workable stop signal, and its need it constantly evidenced in the railway world. Its *raison d'etre*, when it is found, will be the fallibility of the human element.

There is room here for the work of a joint committee of railroad men, signal men, manufacturers, thinkers and inventors of standing and of resource to formulate a schedule of requirements which a stop signal must possess. The Westinghouse air brake had practically such an origin, and the clear definition of what is actually wanted and of what must be provided narrows the field and would prevent wandering in the woods, however pleasant to inventors, by indicating at least to them the general direction of the road by which they might attain some form of practical realization of the needs of the situation, if it did not finally lead them to success.

Government Trade Directory

This Directory does not aim to include the names of the exporters, nor are the names of manufacturers given, except those who are, or seem likely to become, purchasers of American materials or merchandise. The Directory is in octavo form, bound in buckram, and is sold at 60 cents a copy. Those desiring copies should write to the Superintendent of Documents, Government Printing Office, Washington, D. C.

American Locomotives for Greek and Serbian Governments

More Prompt Delivery of American Designs of Locomotives than of Foreign Types Leading to their Introduction in European Military Service

Twenty 2-8-2 type locomotives for the Greek Government Railways, ten 2-6-6-2 type and twelve 2-8-0 type locomotives for the Serbian Government, have recently been delivered by the American Locomotive Company. These engines are of interest in showing how foreign railways are accepting American design in order to facilitate delivery which at present is the important factor with reference to future trade opportunities.

The twenty 2-8-2 type locomotives delivered to the Greek Government will be tested on a section of the road comprised between the stations Lianocladi and Derely, a distance of 43 kilometers (26.72 miles). The major portion of the curves are 300 meters (984.3 ft.) radius. Beginning from Lianocladi, and for a distance of 3½ kilometers (2.17 miles) the grades vary from 4.5 to 2 per cent; then for a stretch of 30 kilometers (18.64 miles) a continuous grade of 2 per cent; then for 6½ kilometers (4.04 miles) a down grade of 2 per cent, and the remaining section to Derely is level. Trains must cover this distance without taking water.

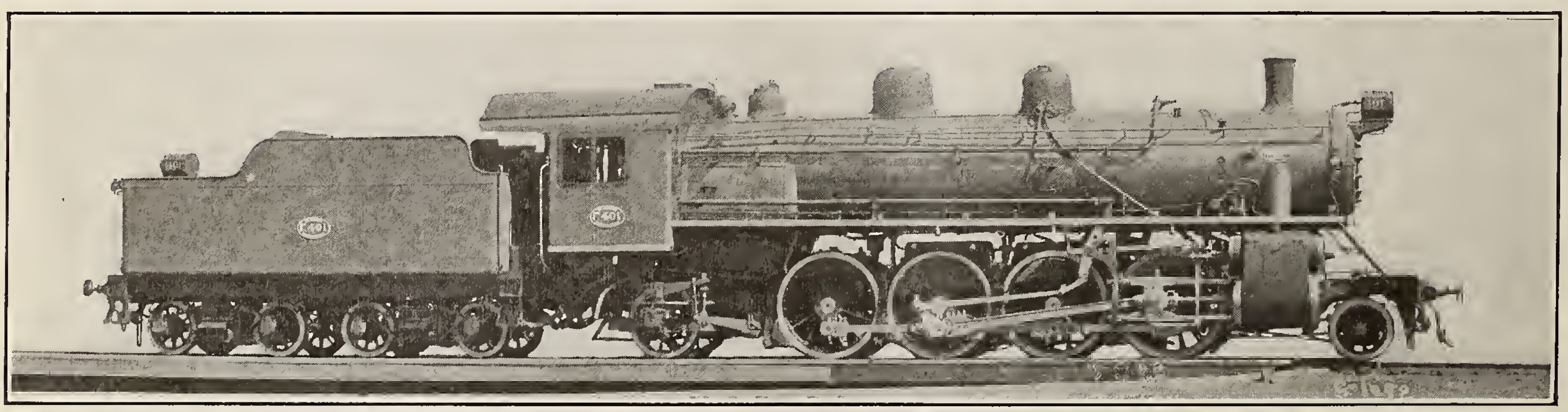
A guarantee was given that the locomotives would haul on the section of road mentioned above and without imposing hardship on the crew train loads as follows: First, a train of 250 metric tons (275.6 tons) back of tender at a speed of 25 kilometers (15.53 miles) an hour on the continuous grade of 2 per cent, and at 60 kilometers (37.28 miles) an hour on the level. Second, a train of 190 metric tons (209.5 tons) back of tender at 40 kilometers (24.86 miles) an hour on the continuous grade of 2 per cent, and at least 80 kilometers (49.71 miles) an hour on the level. All the locomotives were completely erected and tried under steam at the builder's works in the U. S. before shipment.

Having a specified axle weight limit of 15 metric tons (16.54 tons) these engines, with a weight on drivers of 131,800 lbs., and a total weight of 187,500 lbs., are as large as it was possible to build. With 23 x 26 ins. cylinders, a boiler pressure of 170 lbs. and 60 ins. drivers, they have a tractive power of 33,200 lbs. Gauge of track is 4 ft. 8 11/16 ins.

The boiler is of the straight top radial stay type. It is 61 ins. inside diameter at the front end and is fitted with 134 2-in. diameter tubes 19 ft. long, a 21-unit Schmidt superheater and a brick arch supported on tubes. The firebox is of copper and is 83¾ ins. long and 59¾ ins. wide. The tubes have copper ends 6 ins. long at the firebox end. All water-space stays are copper and have tell-tale holes drilled in both ends. While the boiler and grate surfaces are less than would be considered good practice in this country they are as large as was possible to be obtained within the imposed limitations of weight, and in comparison with continental locomotives they represent liberal proportions.

Among the interesting details it may be mentioned that all side rods have strap ends and adjustable brasses. Cylinder safety valves, by-pass valves and water gauge cocks are provided. Cylinder safety valves are attached to each end of and underneath the cylinder barrel. The design follows the builder's standard cylinder head relief valve with the exception of the casting, which makes the connection with the cylinder. Advantage was also taken in making this new casting to accommodate a cylinder cock, thus avoiding any additional holes in the cylinder barrel. The by-pass valve differs from practice in the United States in that it is operated from the cab by a system of levers and rods. The water gauge cocks are designed to close automatically in case the glass breaks.

Other details of interest are steam heat equipment, electric headlights on both ends, self-centering valve stem guide, Cole latest trailing truck, screw reverse gear, Le Chatelaier water brake, speed recorder, and pyrometer. Engine and tender are equipped with vacuum automatic brakes as these brakes are now in use on the Greek railroads. The use of air brakes is contemplated and the engines were therefore arranged so that air brakes can be applied with the least possible trouble.



American Locomotive Company 2-8-2 for the Greek Government Railways

These locomotives follow American practice with the exception of threads. All outside connections and parts subject to interchange have international threads. Metric threads were used on all bolts, boiler studs and staybolts. Our illustration shows the Greek 2-8-2 type of locomotive.

Greek Government Railways, 2-8-2 Type

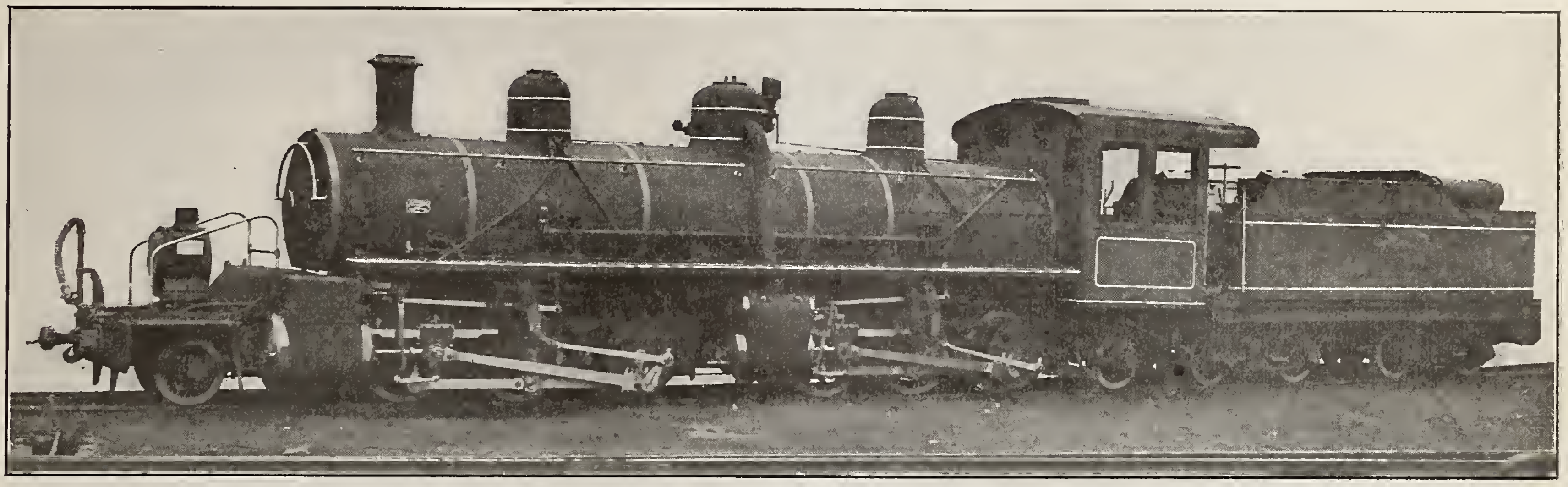
Track gauge, 4 ft. 8 11/16 ins. Fuel, Cardiff coal. Cylinder, diam. 23 ins.; stroke, 26 ins. valve piston. Tractive power, simple, 33,120 lbs. Factor of adhesion, simple, 3.98. Wheel base driving, 15 ft. 9 ins.; rigid, 15 ft. 9 ins.; total, 32 ft. 2 ins.; total, engine and tender, 57 ft. 8 ins. Weight in working order, 187,500 lbs.; on drivers, 131,800 lbs.; on trailers, 31,500 lbs.; on engine truck, 24,200 lbs.; engine and tender, 293,200 lbs. Boiler, type, straight top radial; O. D. first ring, 62 ft.; working pressure, 170 lbs. Firebox, type, wide; length, 83¾ ins.; width, 59¾ ins.; combustion chamber, 3/16 ins.; length, 1 3/16 ins.; thickness of crown, ⅝ ins.; tube, ⅝ ins.; sides, ⅝ ins.; back, ⅝ ins; water space front, 4 ins.; sides 3½ ins.; back, 3½ ins.; depth (top of grate to center of lowest tube), 23½ ins. Crown staying, radial. Tubes, material, cold drawn seamless steel; number, 134; diam., 2 ins. Flues, material, cold drawn seamless steel; number, 21; diam., 5⅜ ins. Thickness tubes, No. 11 B. W. G.; flues, No. 9 B. W. G. Tube, length, 19 ft.; spacing, ¾ ins. Heating surface, tubes and flues, 1,881 sq. ft.; firebox, 134 sq. ft.; arch tubes, 16 sq. ft.; total, 2,031 sq. ft. Superheater surface, 458 sq. ft. Grate area, 34.7 sq. ft. Wheels, driving diam. tire, 60 ins.; center diam., 54 ins.; wheels, driv. material, main, C. S.; others, C. S.; engine truck, diam., 33 ins.; kind, C. S. spoke; trailing truck, diam., 42 ins.; kind, C. S. spoke; tender truck, diam., 33 ins.; kind, C. S. spoke. Axles, driving journals main, 9 ins. by 9 ins.; other, 8 ins. by 9 ins.; engine truck journals, 5½ ins. by 12 ins.; trailing truck journals, 6 ins. by 14 ins.; tender truck journals, 5 ins. by 9 ins. Boxes, driving, main, C. S.; others, C. S. Brake, driver, vacuum and hand. Engine truck, two-wheel radial. Trailing truck, two-wheel radial. Exhaust pipe, single; nozzles, 5 1/16 ins. 5 3/16 ins.; 5 5/16 ins. Grate, style, rocking. Piston rod diam., 3¾ ins.; piston packing, C. I. rings. Smoke stack, diam., 13 ins.; top above rail, 13 ft. 10 ins. Tender frame, built up. Tank, style, "U" shape level top; capacity, 5,000 gals.; capacity, fuel, 8.8 U. S. tons. Valves, type, piston; travel, 6 ins.; ex. lap, clear, ⅛ in.; setting, lead, 3/16 in., constant.

Serbian Government Railways

An order was received for ten 2-6-6-2 Mallet locomotives of new design. All drawing room work was done in nineteen working days. The first engine had been designed, built, tested, knocked down and shipped in record time. These ten Mallets and the twelve consolidations have outside frames which were necessitated by the gauge of track which is 30 ins. As many details as possible were made interchangeable in the 2-6-6-2 and the 2-8-0 types of locomotives.

The Mallet engines have a total weight of 126,000 lbs., cylinders are 13 ins. and 20½ ins. in diameter by 20 ins. in stroke, driving wheels are 36 ins. in diameter and the steam pressure is 200 lbs. Being fitted with the builders system of compounding, they have a tractive power working compound of 24,300 lbs. and 29,200 lbs. working simple. The boiler is of the straight top type, 52 ins. in diameter at the front end, one hundred and fifty-seven 2-in. tubes, 15 ft. 1½ ins. in length. By means of a brick wall a grate 85 ins. long by 39¼ ins. wide is installed in a firebox 114⅛ ins. long by 39¼ ins. wide. A screw reverse gear was applied.

An order for seven of the consolidation engines was also received. This order was later increased to twelve. Five of the engines were soon shipped and the remaining seven were shipped later on. The consolidation engines have a total weight of 80,500 lbs., cylinders 15 ins. in diameter and 20 ins. in stroke, steam pressure 160 lbs., giving a tractive power of 17,000 lbs. The boiler is of the straight top type, 47⅞ ins. in diameter at the front end; it is fitted with one hundred and twenty-six 2-in. tubes, 15 ft. 1½ ins. in length, and a firebox 48 3/16 ins. long by 39¼ ins. wide. American Locomotive Company's standard methods of design and construction were used on these engines throughout.



American Locomotive Company 2-6-6-2 Type for Serbian Government Railways

Serbian Government Railways, 2-6-6-2 Type

Track gauge, 30 ins. Fuel, soft coal. Cylinder, type, simple; diam., 13 ins.; stroke, 20 ins. piston valves. Tractive power, compound, 24,300 lbs. Factor of adhesion, compound, 4.3. Wheel base driving, 7 ft. 6 ins.; rigid, 7 ft. 6 ins.; total, 34 ft. 6 ins.; total, engine and tender, 55 ft. Weight in working order, 126,000 lbs.; on drivers, 103,000 lbs; on trailers, 11,000 lbs.; on engine truck, 12,000 lbs.; engine and tender, 156,500 lbs. Boiler, type, straight top radial; O. D. first ring, 52 ins.; working pressure, 200 lbs. Firebox, type, narrow; length, 114⅛ ins.; width, 39¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space front, 4 ins.; sides, 3 ins.; back, 3 ins; depth (top of grate to center of lowest tube), ⅜ in. Gates fire brick arch used. Crown staying, radial. Tubes, material, cold drawn seamless steel; number 157; diam., 2 ins. Thickness tubes, No. 12 B. W. G. Tube, length, 15 ft. 1½ ins.; spacing, 11/16 in. Heating surface, tubes and flues, 1,236.5 sq. ft.; firebox, 95 sq. ft.; total, 1,331.5 sq. ft. Grate area, 23.2 sq. ft. Wheels, driving diam. outside tire, 36 ins.; center diam, 31 ins. Wheels, driving material, main, C. I.; others, C. I.; engine truck, diam., 24 ins.; kind, C. I. spoke; trailing truck, diam., 24 ins.; kind, C. I. spoke; tender truck, diam., 26 ins.; kind, C. I. spoke. Axles, driv. journals main, 6½ ins. by 7 ins.; other, 6½ ins. by 7 ins.; engine truck journals, 4 ins. by 7 ins.; trailing truck journals, 4 ins. by 7 ins.; tender truck journals, 3¾ ins. by 7 ins. Boxes, driving, main, C. I.; others, C. I. Brake, driver, Hardy system; tender, Hardy system. Engine truck, two-wheel radial. Trailing truck, two-wheel radial. Exhaust pipe, single; nozzles, 4⅜ ins., 4½ ins., 4⅝ ins. Piston, rod diam., 2¾ ins.; piston packing, C. I. rings. Smoke stack, diam., 11 ins.; top above rail, 10 ft. 10 ins. Tender frame, A. L. Co.'s steel channel. Tank, style, "U" shape level top; capacity, 2,500 gals.; fuel, 5 tons of coal. Valves, type, piston; travel, $4\frac{3}{4}$ ins.; steam lap, $\frac{3}{4}$ ins.; ex. lap, clear, 3/16 ins.; setting, lead, $\frac{1}{8}$ in.

Serbian Government Railways, 2-8-0 Type

Track gauge, 2 ft. 6 ins. Fuel, soft coal. Cylinders, diam., 15 ins.; stroke, 20 ins. slide valves. Tractive power, simple, 17,000 lbs. Factor of adhesion, simple, 4.3. Wheel base driving, 10 ft. 7 ins.; rigid, 10 ft. 7 ins.; total, 18 ft.; total, engine and tender, 42 ft. 8 ins. Boiler, type, straight top radial stay; O. D. first ring, $47\frac{7}{8}$ ins.; working pressure, 160 lbs. Firebox, type, narrow; length, 48 3/16 ins.; width, $39\frac{1}{4}$ ins.; thickness of crown, $\frac{3}{8}$ in.; tube, $\frac{1}{2}$ in.; sides, $\frac{3}{8}$ in.; back, 5/16 in.; water space front, 3 ins.; sides, 3 ins.; back, 3 ins.; depth (top of grate to center of lowest tube), $20\frac{1}{8}$ ins. Crown staying, radial. Tubes, material, cold drawn seamless steel; number, 126; diam., 2 ins. Thickness tubes, No. 12 B. W. G. Tube, length, 15 ft. $1\frac{1}{2}$ ins.; spacing, $\frac{3}{4}$ in. Heating surface, tubes and flues, 992 sq. ft.; firebox, 69 sq. ft.; total, 1,061 sq. ft. Grate area, 13.1 sq. ft. Wheels, driving diam. outside tire, 36 ins.; center diam., 31 ins. Wheels, driving material, main, cast iron; others, C. I.; engine truck, diam., 24 ins.; kind, C. I.; tender truck, diam., 26 ins.; kind, C. I. Axles, driving journals main, $6\frac{1}{2}$ ins. by 7 ins.; other, $6\frac{1}{2}$ ins. by 7 ins.; engine truck journals, 4 ins. by 5 ins.; tender truck journals, $3\frac{3}{4}$ ins. by 7 ins. Boxes, driving, main, C. I.; others, C. I. Brake, driver, similar to the Hardy system of vacuum brake; tender, similar to Hardy and hand brake.

American Locomotive Company 2-8-0 Type for the Serbian Government Railways

The Subject of Railway Mail Pay

Since our last reference to this matter, the railways have added to their backing by the country at large, in their efforts to secure suitable compensation for carrying the mails, in resolutions passed by the Boston Chamber of Commerce, the Chamber of Commerce of Jackson, Mich.; the Baltimore Chamber of Commerce, the Board of Trustees of the Seattle Chamber, the Washington, Pa., Board of Trade; the Pittsburgh Chamber of Commerce, the Stockton, Cal., Board; the Chamber of Commerce of Berkeley, Cal.; the Ogdensburg, N. Y., Chamber, and the National Industrial League of Chicago. The sentiment in favor of adequate compensation to the railways, covering the mail service, is country-wide, and such actions as all these important boards have taken should go a long way toward effecting legislation at Washington in the right direction.

The Clinkering of Coal

The Cone Method of Determining Fusibility of Ash Suggested for Purchasing Specifications

There is a growing feeling that the matter of clinkering ought to be taken care of when making contracts for coal, said Mr. L. S. Marks at a recent meeting of the A. S. M. E. It has been suggested that specifications ought to include the melting temperatures of the ash as indicating the clinkering characteristics of the coal.

The difficulty in determining the melting point of ash lies in the definition of melting temperature. An ash is usually composed of a number of ingredients of different fusibilities. The only method that seems to be available for measuring both melting temperature and viscosity, is the Seger cone method, or some modification of it. It is a rough method of measuring the temperature at which the ash reaches a standard viscosity. The method fails if the most fusible constituents of the ash become very fluid, as a skelton may be left long after its more fusible elements are fluid. If the cone is placed horizontally projecting over the edge of its support, the indications are more satisfactory.

The Seger cone method often yields results which are variable. A tabulation of such results shows an extreme variation of as much as 700 deg. Fahr. between different laboratories. The causes of this variation are the kind of atmosphere and the rate of heating. If the melting takes place in a reducing atmosphere, the observed temperatures will be from 250 to 450 deg. Fahr. higher than in an oxidizing atmosphere. The rate of heating the cone has a marked effect on the apparent fusing temperature, when a thermo-electric pryometer is used.

Laboratory tests of coal ash by the method finally adopted by the writer when compared with the clinkering results actually observed when burning ten different coals under normal power house conditions, show a general relation between the two, but not definite enough to be reliable.

A further indication seems to be of value when combined with melting temperature observations. This indication is the appearance of the melted cone and the range of temperatures between initial and final bending. The coals which gave most trouble were those of which the ash cones showed a very liquid constituent and a small range of temperatures between initial and final bending. For the plant investigated, an ash with a fusing temperature below 2,550 degs. Fahr. would probably give trouble if the ash cone shows a fusible constituent; whereas it will not give trouble with a fusing temp. above 2,215 degs. F., if the ash is viscous.

Steel Hopper Car for the Carriage of Iron Ore

Fifty-ton Cars Built by the Ralston Car Co. for Duluth Missabe & Northern, Embodying Acute Angle of Slope and Large Door Opening

The Duluth, Missabe & Northern Railway has recently received from the Ralston Car Co. of Columbus, O., some steel hopper cars for hauling ore and rough freight. With the rapid development of iron ore operations the matter of handling this commodity with the greatest dispatch and in as few cars as possible has become quite an interesting question, especially when considering Northern ore properties, where transportation and handling take place only during the warm season. As ore is far more difficult to dislodge from a loaded car than coal is, it is plainly to be seen that a dump car designed for coal is practically useless for the purpose of dumping ore; consequently, it is necessary in the transportation of this material that the cars used must be so constructed as to facilitate the instantaneous removal of the ore by dumping, and also to eliminate the bridging of the material over the door opening.

This has been accomplished by the skillful embodyment of various elements in limited space, with a large door opening and an acute angle of hopper slope, and with an operating device which is very substantial and accurate.

The side sills are composed of channel beams having their flanges turned inward, to provide a flush surface for the application of channel side stakes. The end sills are securely connected to the side sills, which have connected to them corner posts, the upper edges of which are attached to the top end angles, and to these the upper ends of the front and rear inclined hopper sheets are secured. The draft sills extend forward beyond the end sills and back to the inclined sheets, to which they are secured. An angle is connected to the draft sills at the forward ends of the latter, extending to the corners of the frame at the point of the side sill, where they are riveted. The bolsters are composed of diaphragms connected to the side and center sill and bottom cover plate; the upper edges of the diaphragms being riveted to a floor plate which covers the entire portion of the frame from hopper sheet to striking plate; this floor cover plate is riveted to the end sill angles, draft sills and side sills, and has a flange at its rear end which is firmly connected to the hopper slope sheet, forming a substantial girder, allowing the buffing stresses to be equally distributed over all parts of the underframe.

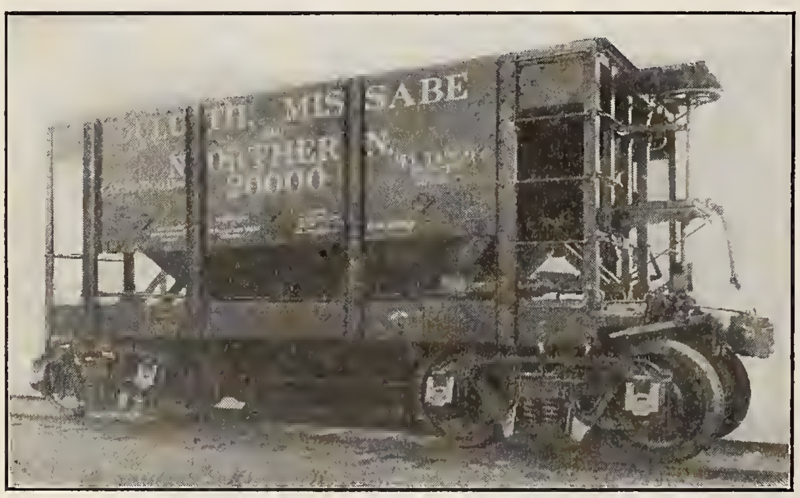
Secured to, and extending from, one bolster to the other, are longitudinal or sub-sills spaced short distances from the side sills, serving not only to increase the strength and rigidity of the underframe, but also performing the function of providing a connection for the door bracket hinges and sloping side floor sheets. This sub-sill, in turn, is firmly connected to the side sill proper. The hopper slope sheets are composed of three pieces, sides and center, supported on the outside by an angle member, the ends of which are riveted to the side floor sheets; this angle, in turn, derives its support from diagonal bracing connected thereto, and to the end sill. The door mechanism consists of links suspended from brackets secured to the draft sills at the respective ends of the lower portion of the car body, and the links at one end of the hopper bottom

Side View of Duluth, Missabe & Northern Hopper Car, Built by the Ralston Car Co.

are connected with those at the other end by shafts disposed under the doors, and on these shafts rollers are mounted running into a track-way on the doors.

Near the end of the hopper body, short shafts are mounted in bearings, having applied thereto armed cross-heads with curved links attached to the arms and the door shafts. A worm segment is mounted upon each short shaft, and the hub of this segment is made with a clutch member, having a lug thereon; another clutch member is secured to each shaft and made to co-operate with the lugs on the other clutch members; the lugs in the two clutch members are so proportioned as to permit of relative movements of the segment and shaft. Worms are mounted between the draft sills near respective ends of the hopper body and are disposed over and enmeshed with semi-gear or worm segments. A transverse shaft passes through the worms for rotating the same, and this shaft is mounted near its ends in bearings secured to the side sills, the ends of the shaft being made to project beyond the side sills for the reception of a device for manually operating it.

A transverse shaft is connected with a worm at the other end of the hopper body and extends to one side only of the car, where it is mounted in the bearing, secured to one of the side sills which projects somewhat beyond for the reception of a hand-operating device. Sprocket wheels are secured to the cross shafts, and these sprockets are connected by a sprocket chain so that when one or the other of these shafts is rotated, motion will be imparted to both worms for turning the gears beneath the worms. When the doors are closed, retention in such position is insured by the worm gearing, without necessity for the use of pawl or ratchet



Doors Open on D. M. & N. Hopper Car

devices, which are generally used in operating dump doors. When the sub-shaft has been rotated sufficiently to overcome the dead centers of the link mechanism, the weight of the load in the hopper body will force the doors fully open. To secure the closing of the doors the trainman operates one of the cross shafts to impart motion to the worms and cause the latter to operate the worm segments. Motion is thus imparted by the worm segments to the sub-shaft through the medium of the clutch device, and the rotation of the sub-shaft will operate the link mechanism to close the doors. The improved construction of the worm gear operating mechanism placed in line with the longitudinal axis of the car at respective ends of the hopper, and operated from the sides of the car, is exceedingly simple and provides powerful means for effecting the closing of the doors with the expenditure of a minimum amount of energy, and also provides efficient means for locking the doors in the closed position.

A test was made recently with one of these cars loaded with fifty-two tons of ore, in order to ascertain the length of time required to dump the load with one man doing the work. It developed that from the time the man applied the wrench to the operating shaft, dumping the load, closing the doors, the car was ready for a return trip to the mines. And all this had been done in thirty-five seconds. These cars are built by the Ralston Steel Car Company, under patents owned by that company and designed by Mr. R. R. Weaver, their mechanical engineer, who is also the inventor.

Story of Transportation Progress

To unify the great New York Central system, as it exists today, was a stupendous undertaking, and in its accomplishment many obstacles were presented. The task was exacting, but the results finally obtained now reflect great credit on the owners and management.

An interesting pamphlet quite recently issued by President Smith gives a brief history of the evolution of the New York Central from its beginning down to the present day. Those who assisted in this development with heart, mind and money, which eventually brought together 186 distinct organizations, are entitled to especial consideration. It is a narrative in which many heretofore unpublished facts appear. From the chartering of the Mohawk & Hudson Railroad Company in 1826, to the practical completion of that marvelous terminal—the Grand Central Station—we are presented with a story of transportation progress which is amazing. At the close, the president contributes a suitable moral, when he says: "The fundamental idea upon which the whole organization has been built is 'service'—service not alone to the traveling public, but to shipper, manufacturer and whole communities. The law of progress, the law of growth, of unity and of service." There are many rare illustrations in the booklet. We see the tiny Dewitt Clinton struggling with its burden, consisting of three early day stage coaches, which thrilled the country in 1831; the old Harlem Station, now the site of the Madison Square Garden; a scene at the old freight station near the Tombs prison in the early 50's; the Twentieth Century Limited of today and other especially interesting scenes.

Iron-Silicon Alloys in Vacuo

Magnetic and Other Properties of Iron-Silicon Alloys Melted in Vacuo, by T. D. Yensen, has been issued as Bulletin No. 83 of the Engineering Experiment Station of the University of Illinois. This bulletin describes methods employed in producing a number of iron-silicon alloys which the author has subjected to mechanical and electrical tests. It is shown that silicon increases the mechanical strength of iron in almost direct proportion to the amount added, until the maximum strength is reached with a silicon content of about 4.5 per cent. The elastic limit of this alloy was shown to be 94,000 lbs. per sq. in. and its ultimate strength 105,000 lbs.

With regard to magnetic properties the vacuum, alloys are shown to possess most remarkable characteristics. The maximum permeability is above 50,000 and the hysteresis loss is only one-eighth to one-third of that for commercial silicon steel. The specific electrical resistance increases about 11 microhms for each per cent of silicon. Copies of Bulletin No. 83 may be obtained gratis upon application to W. F. Goss, Director, Engineering Experiment Station, Urbana, Ill.

The art is greatest which conveys to the mind of the spectator, by any means whatsoever, the greatest numbers of the greatest ideas.—Modern Painters.

Pulverized Coal for Locomotive Fuel

Theory of Coal Dust Combustion, Arrangement of Locomotive for Firing Powdered Coal, and the Problems Involved in Successfully Burning this Fuel

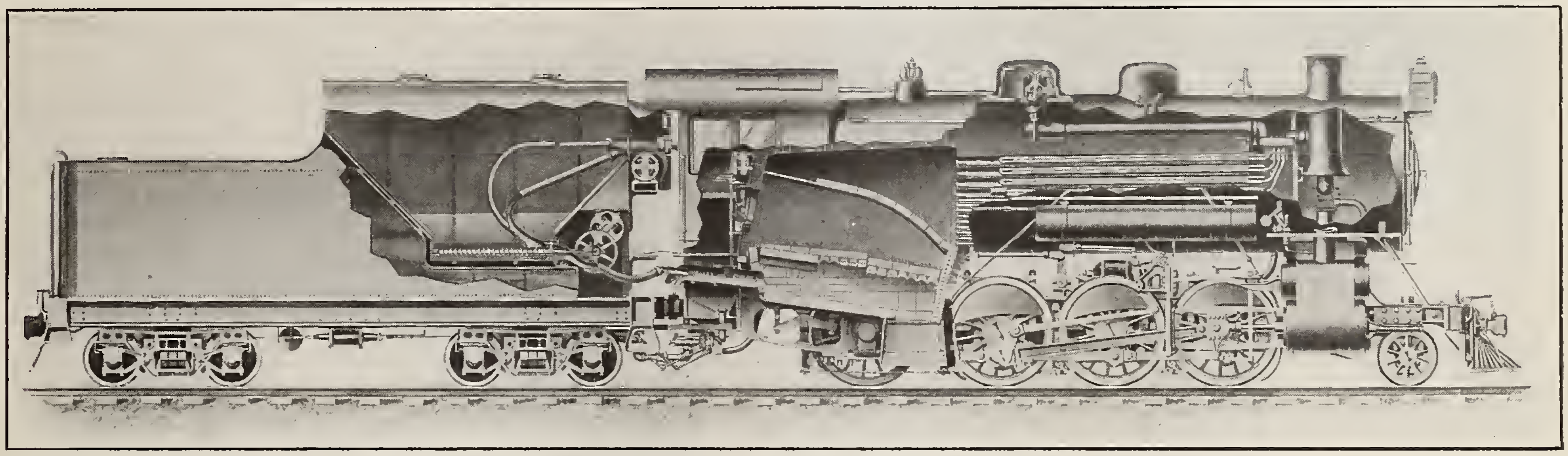
A piece of chalk lying on the shelf of a school blackboard is an example of a very closely compressed form of carbonate of lime. It is small in size and concentrated in structure. If it is possible to conceive of this school crayon being burned it is evident that it would be hard to accomplish, because the air could not get at it. That is really why books, each page of which is highly inflammable, are so difficult to burn in bulk, and it is the principle used in slow-burning wooden construction in mills and factories.

If, however, a teacher covered the school blackboard with innumerable parallel lines of chalk, each touching the other, he might cover 50 sq. ft. of blackboard with a film of chalk, in using up the concentrated white crayon he found at the board. The chalk so spread out would be in contact with the air, indeed every separate particle of chalk would then be in close contact with the air of the room. It would not burn, of course, but this illustrates a method of very fine physical division. The same quantity of chalk is on the blackboard as was formerly consolidated in the small crayon. Although chalk will not burn in this way, coal will, and the idea of the fine division of solid particles has long been made use of in permitting the oxidizing of various substances in the arts.

The subject of pulverized fuel for locomotives was recently summarized by Mr. John E. Muhlfeld in a paper read before the New York Railroad Club, which forms more the text than it does the matter of what follows. It seems that at present the annual consumption in the United States of about 7,000,000 tons of solid fuel in pulverized form, in industrial kilns and furnaces, has demonstrated the effectiveness and the economy of this method of combustion. The Interstate Commerce Commission estimated the expenditure of $249,507,624, or about twenty-three per cent of the transportation expense of 242,657 operated miles of steam railway in the United States had taken place during the fiscal year ending June 30, 1915. This is, next to labor, the largest single item of cost in steam railway operation.

The waste of coal in modern steam locomotives is known to all. When we consider the quantities of fine coal blown off tenders by the wind, the quantity of ashes containing combustible material which is daily thrown away. Unproductive burning of coal when an engine stands still, or having been worked hard, is suddenly shut off, causes the muffled safety valves to buzz furiously, the small nozzles required to draw air through ash pan openings, grates, ashes, burning coal, flues and stack, cause back pressure in the cylinders which requires power, represented by fuel consumption, to overcome.

The tendency to-day in the handling of coal is to break it up from large lumps to small and from small to dust. Shallow seams of coal are constantly encountered and mechanical and powder methods of mining; together with the greater security demanded for labor; the high cost of developing, tunneling, timbering, pumping, ventilating and inspecting mines. The scarcity of, and higher wages for, labor; more rigid legislation and regulations all tend to increase the cost of solid fuels. Co-operation between the railways and the mine operators necessitate that the railways make use of the constantly increasing percentage of dust, slack, screenings, and other small sizes of gas, soft and anthracite coals, as well as of coke breeze, lignite and peat which cannot now be effectively or economically burned on grates in locomotives.

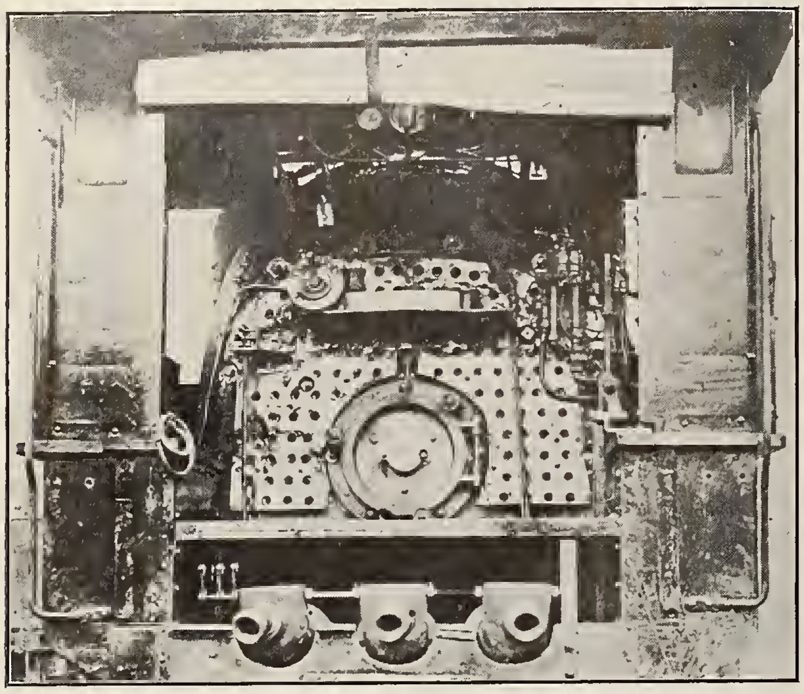


Sectional View of Locomotive Fitted for Use of Purverized Fuel

The trend of development to-day points to steam locomotives being equipped to approximate to the condition of electric locomotives as regards the elimination of smoke, soot, cinders and sparks; reduction of noise, time for dispatching at terminals, and standing losses; and to increase the daily mileage by producing longer runs and more nearly continuous service between periods of general repair.

There is a feeling that labor of a higher average standard should be induced to enter the service as firemen, to make capable enginemen. This may be done by reducing the arduous work such as is now required to shovel ahead and supply coarse coal to grates; and to rake and clean fires and ash-pans on the modern steam locomotives of great power. The future steam locomotive will be required to produce maximum hauling capacity per unit of total weight, at the minimum cost per pound of draw-bar pull, and with the least liability for mechanical delay.

The burning of pulverized coal in the firebox of an ordinary locomotive is nothing more than an approximation to a series, and one might almost say, to a continuous explosion of dust. The theory of dust explosion which is a menace in coal mines, mills, etc., may be made clear by an analogy. A stick of timber, about the size of a railway track tie may be made to burn in say a week, if allowed to slowly consume away. If the timber had been split up into cordwood, it would have perhaps burned in a day. If, however, it had been reduced to shavings by the action of a wood plane, and kept in the form of loose twirls of wood, free from compression, it might have burned in an hour. Still more divided, as with each shaving split and sliced and cut into small chips, still without compression, it might become a heap of ashes in a few minutes, and lastly, if each split and sliced and diminutive chip had been made so small as to resemble dust which would float



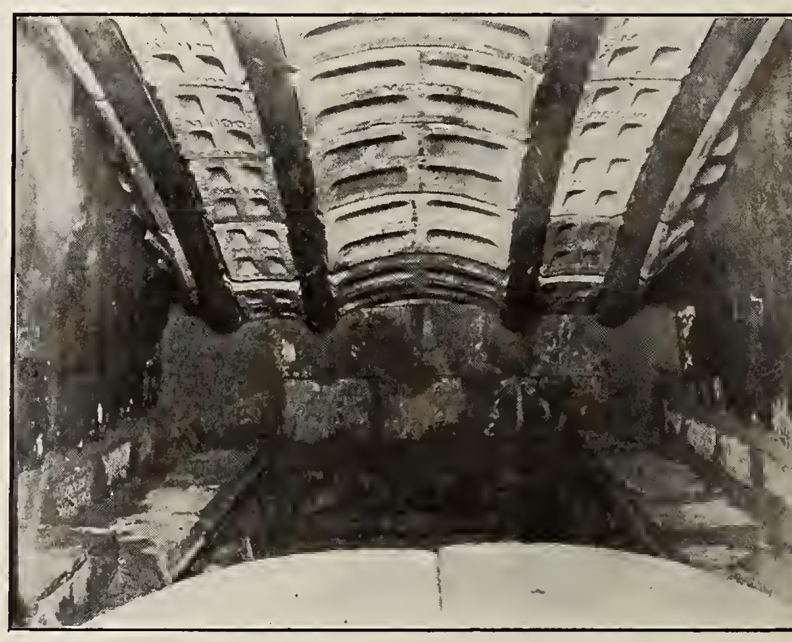
Interior of Cab Arranged for Pulverized Fuel

in the air, the almost simultaneous burning of each particle would give rise to a volume of carbon dioxide, so expanded by the heat generated as to act as an explosion. This is practically the theory upon which explosives are made, the difference being that the explosive mixture carries with it, in chemical form, the oxygen necessary for its own combustion.

The problem for the mechanical engineer when using pulverized coal is to so mix it with air that the particles of coal dust shall not adhere to one another, but that each shall be surrounded by a quantity of air. One cubic inch of solid coal exposes only 6 cu. ins. of surface for the attack of oxygen, a cubic inch of powdered coal provides an area of from 20 to 25 sq. ft. on which the oxygen may act. Like soldiers in solid or extended formation, it has been found that the more loosely the composition of the ranks is maintained the more effective is the work of each dissociated unit.

The first steam railway locomotive of any considerable size to be fitted up in the United States or Canada with a successful self-contained equipment for the burning of pulverized fuel in suspension, was a 10-wheel type on the New York Central Railroad. This locomotive has 22 x 26 ins. cylinders; 69 ins. diameter drivers; 200 lbs. boiler pressure; 55 sq. ft. of grate area; 2,649 sq. ft. of firebox and boiler heating surface; is equipped with Schmidt superheater and Walschearts valve gear; has 31,000 lbs. tractive power, and was first converted into a pulverized fuel burner during the early part of 1914. Since that application another similar installation has been made to a Chicago & Northwestern Railway existing Atlantic type locomotive, and also to a new Consolidation type of locomotive recently built for the Delaware & Hudson Co. This latter locomotive has 63 ins. diameter drivers and about 63,000 lbs. tractive power, having been designed by the superintendent of motive power, Mr. J. H. Manning, for heavy and fast freight service.

The burning of pulverized fuel in steam locomotives has now passed the experimental stage. The equipment, shown in general in our illustration, gives a good idea of the mechanism used. The apparatus is self-contained and is housed in a removable hopper which fits on the tender. A screw conveyor lies in a horizontal position at the bottom of this large hopper. The conveyor is made with increasing pitch so that the movement of coal from back, middle and front shall be practically continuous. The increased pitch of the screw permits coal at the front to drop in and be moved, without disturbing that from the back, which is already in the thread of the conveyor. An air pressure of about one-half ounce forces the coal dust into the commingler at the front end of the conveyor. The shaft is fitted with fins or paddles which destroy any tendency to adhere which damp coal dust may have, and the slight pressure of air not only mixes the loose mass with oxygen but urges it through the flexible hose to the "fuel and pressure air nozzle" as it is called. This portion of the apparatus is a nozzle in a larger receptacle, like the nozzle of an injector in the combining chamber. From this point the influence of the blast pipe carries the fuel (already separated completely and mixed with air in the commingler) on through the large tube into which induced air is brought in ample quantity and this action delivers the fuel under the short primary arch situated below the fire door. Ignition takes place here and the flame flows up around the edge of the primary arch and passes back along the underside of the main arch and over its end close to the crown sheet and onward to the flues. Along the sides of the firebox and on the level of the primary arch the firebrick presents openings corresponding with those passing through the water legs. It is the arrangement of these holes and their size and position that exerts



Interior of Firebox, Showing Arches

practically a determining influence on the automatic disposal of the liquid slag.

The process of feeding and burning pulverized fuel is as follows: The prepared fuel having been supplied to the enclosed fuel tank, gravitates to the conveyor screws, which carry it to the fuel and pressure air feeders, where it is thoroughly commingled with and carried by the light pressure of air from the fan through the connecting hose to the fuel nozzles and blown into the mixers.

The light pressure from the fan has been able to place the coal dust in the air and fuel mixer. Its further progress, in the form of flame and hot gas, is induced by the draft action of the nozzle in smoke induced by the draft action of the nozzle in the smoke and air mixers, and this air-surrounded coal dust, now in combustible form, is carried into the furnace by the smokebox draft.

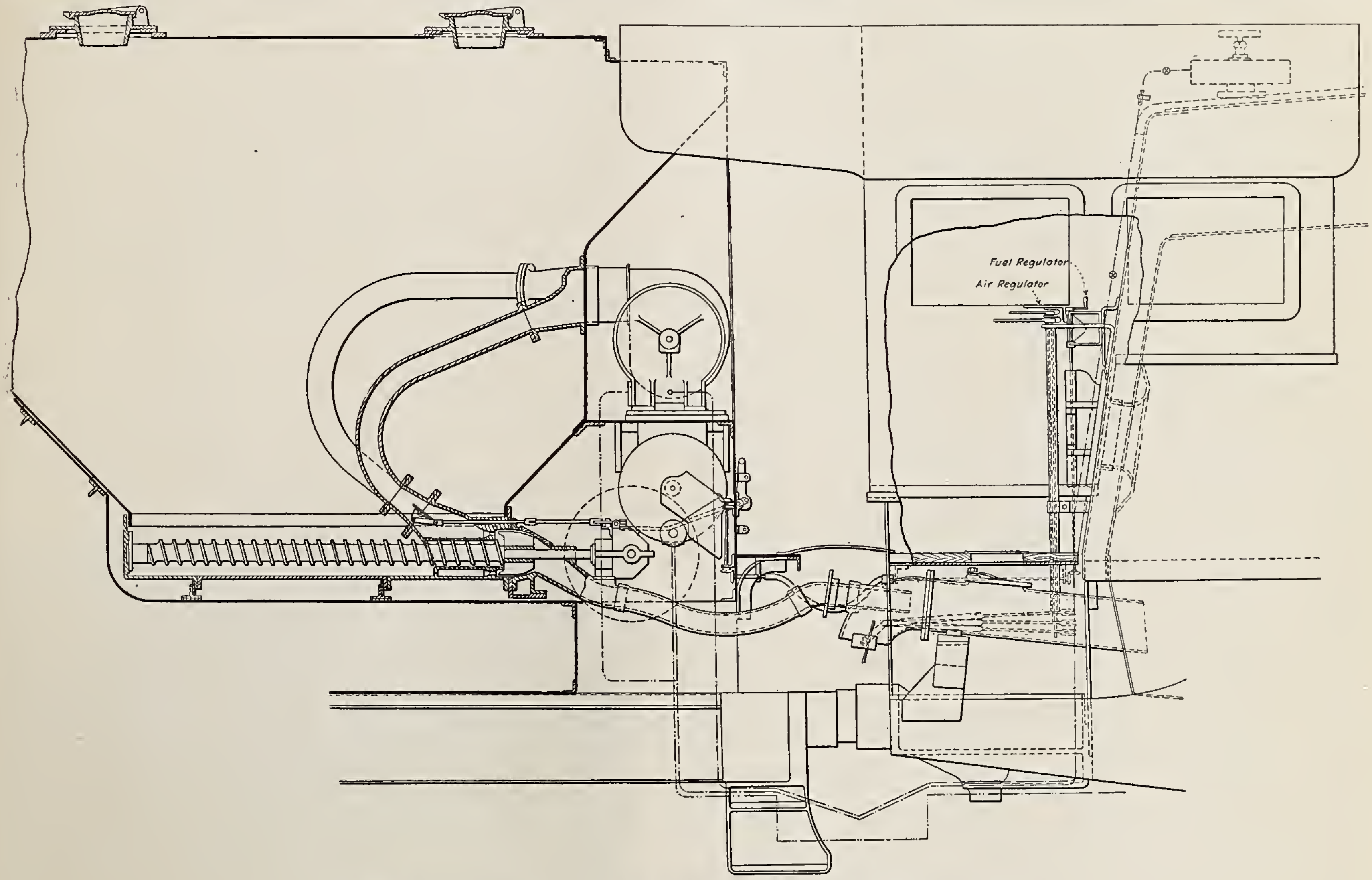
For firing up a locomotive the usual steam blower is turned on in the stack, or a portable blower arrangement from a nearby engine may be used. A piece of lighted waste is then entered through the firebox door and placed on the furnace floor, just on the front of the primary arch, after which the pressure fan and one of the fuel and pressure air feeders are started. From 45 to 60 min. is ordinarily sufficient to get up 200 lbs. of steam from water at about 40 degs. Fahr. After lighting up, the regulation of the fuel and air supply is adjusted to suit the standing, drifting or working conditions, the stack blower being employed only when the locomotive is not using steam.

The flame produced at the time the combustible mixture enters the furnace, obtains its average maximum temperature, from 2,500 to 2,900 degs. Fahr. at the forward combustion zone under the main arch, and at this point axuiliary air is induced to enter through holes in the firebox sides by the smoke box draft and this finally completes the combustion process.

The smokebox gas analysis averages between thirteen and fourteen per cent of CO_2 when coal is fired at the rate of 3,000 lbs. per hour; between fourteen and fifteen per cent at the rate of 3,500 lbs. per hour, and between fifteen and sixteen per cent at the rate of 4,000 lbs. per hour, so that as the rate of combustion increases, there is no proportionate falling off in efficiency. While the smokebox temperatures have varied between 425 and 500 degs. Fahr., the superheat in the steam will vary between 200 and 325 degs. Fahr., depending upon the rate of working.

The only form of ash produced by pulverized fuel is a liquid slag. The liquid ash runs down the underside of the main arch and the front and sides of the forward combustion zone of the furnace and is precipitated into the self-clearing slag-pan, where is accumulates and is air-cooled and solidified into a button of slag which can be dumped by opening the drop bottom doors. The formation of this liquid ash or slag has been studied and its final or automatic disposal, without collecting and dumping it, is a problem which has been practically solved and adds that advantage to this system of combustion, as it stands.

Coal is never absolutely pure and the reason of its contamination was made plain in our issue of December, 1915, page 393. In the case of pulverized fuel, the presence in the coal of iron, which fuses and holds any other non-combustible material, has a plugging action on the flues if it gets to them in the solid form. Iron becoming soft in the flame readily takes up oxygen and forms what is known to chemists as Ferrous Oxide, Fe_2O_2, and this substance, while viscous or pasty, settles on the protruding heads of crown staybolts, and takes up or holds any other matter, if present, that will not burn. In time the mass of soft ferrous oxide breaks away and may be drawn against the flue sheet by the induced draft from blast pipe. This ferrous oxide very readily forms another combination with oxygen, just as CO burns to CO_2 in a full and adequate supply of oxygen. With plenty of oxygen within its reach, the ferrous oxide turns to ferric oxide, sometimes called the sesquioxide of iron, Fe_2O_3. This ferric oxide is practically iron rust and is in a powdery state. In this form it does not hold other mineral dust particles, and it does not settle or drip, but being, if one may so



Diagramatic View of Apparatus for Burning Powdered Coal

say, impure iron rust, it is dry and is easily drawn along in the flame-way, round the edges of the brick arch, through the flues and out of the stack. The definite location of the air inlets along the line of the primary or lower brick arch to suit various kinds of fuel is now being determined by experts, so that the automatic elimination of the liquid slag will soon be part of the process of combustion, and not necessarily requiring collection and disposal at the end of the run.

The burning of a pure gas with an adequate supply of oxygen is more or less of an ideal process, to which the burning of fuel oil approximates. It may be that as the further advance of physical science, gradually establishes, as it has already distinctly indicated, the fundamental unity of matter, we shall find a close analogy in the complete oxidation or burning of the strictly combustible elements of fuel in a state of fine division, as but another approximation to the combustion of gas. Who shall say that pure carbon brought to the most exceedingly minute state of microscopic division, almost reaching to that of an inpalpable powder, may not be but a step below the constitution of a gas, which our senses are unable to apprehend. If this is so, the worker along these lines most probably has placed his foot on the lower rung of the ladder of truth, as it is in nature.

Not only is the combustion of coal dust, as here attempted, a modification of the Bunsen burner, in that the combustion is practically complete, but there is an absence of the blow-pipe action on the arch, owing to the inductive effect of blast in the smoke box. The blow-pipe action is practically the constant application of flame to one comparatively restricted area with more or less deleterious results. This induction of air, having to carry with it only light particles of coal or more correctly to draw the flame in a broad and unchecked sweep below and above the arch and through the flues, is produced by a nozzle larger than can otherwise be used in the smokebox. This permits reduction of back pressure in the cylinder with consequent advantage in steam consumption and fuel burnt.

A mechanical advantage in the arrangement shown in our illustration is at once apparent to the railway man. It is the absence of carrying wheels under the cab. In this case the ash pan, dampers, shaker rigging grates and cinder dump have been done away with, the lower edge of the brick-lined combustion chamber is on a level with the mud ring, and the slope of the firebox enables a pair of driving wheels to be placed below the cab instead of a trailing truck. This pair of wheels carries weight and therefore adds its quota to the increased tractive effort that may now be obtained. The alteration of the firebox for pulverized fuel brings with it changes which eliminate the present smoke-box arrangement, and may lead to the abandonment of the extended front. The necessity for grates, ash pans, firedoor and operating gear disappears, a mica peep-hole in the door only is required. When closed, the door makes an air-tight joint. The connection between engine and tender is made by the use of one or more hose, which connect the fuel and fan pressure air outlets on the tender with the fuel and air nozzles on the engine. Also the use of metallic flexible conduits for conveying steam for the fan and fuel feeding motive power. After the hose connections are disconnected, engine and tender may be pinched or pulled apart. The enclosed fuel container on the tender makes the change to or from liquid fuel possible and easy, and when coal dust is in the container it cannot be stolen or blown away by wind or washed away by rain.

The use of pulverized coal eliminates the waste products of combustion and fire hazards in towns and timber limits, and permits the enlargement of exhaust steam passage. It permits of the use of such fuel as cannot be readily disposed of by mine operators in commercial trade, and provides for the utilization of existing refuse, and of lignite and peat. It renders possible the elimination of smoke, soot, cinders and sparks; and does away with the time required on ash-pit tracks and thus increases the time available for transportation use. It also minimizes the necessity for selecting firemen on account of physical ability, and makes the position more attractive. Like the oil-fuel fireman, the pulverized coal man shuts off the fire as the engineman does the throttle and the heat of the firebox lights the flame again when the flow of fuel is turned on once more.

Curious Old English Passenger Car

Among the relics of the past in the railway world, the old passenger coach shown in our illustration is unique. This old car performed its service on the West Somerset Mineral Railway and was laid by at Watchet. It dates somewhere between 1840 and 1850.

The railway was discontinued for many years, but was recently opened up again for traffic. The car was carried on four wheels with a semi-eliptic spring above each journal-box. The roof is slightly arched and the end paneled in what was the approved style of days gone by.

There were evidently three compartments in the car, possibly having the class system of fares as the reason. The up-and-down motion of the car was provided for by guide cylinders between journal boxes and side sills.

Looking at the end of the car, one may observe the slight taper or rounding of the body as it approaches

Old English Passenger Coach

the side sill. This small structural detail never had any necessary function, but marks the curious survival of design which once had a use. It is derived from the stage coach, where the body was suspended, or rather supported, on broad leather straps, and the rounding of ends and sides prevented any sharp corner from being introduced into the design, which would in time cut through the strap. In this car, the survival of this slight curve of the body is either for ornament or adherence to custom.

At the present time a large number of English car bodies are built, like those in this country, with no curves other than those dictated by considerations of utility, but yet, here and there, English designs show what is technically known as the "fall under" at the ends of the cars.

Friction with Reference to the Chilled Iron Wheel

Brake Efficiency of the Chilled Iron and the Steel Wheel Compared, Rail Abrasion Analyzed, Tests Given, Friction and Train Resistance

Having pointed out in our February issue the researches of Mr. F. K. Vial, chief engineer of the Griffin Wheel Co., of Chicago, on the various chemical, metallurgical and physical properties of chilled iron and steel wheels, the next step is to consider how these properties shown to exist adapt themselves to the rail and the brake shoe, and the item considered is friction. A comparison of the following items are fundamental: First, brake efficiency; second, brake shoe durability; third, rail abrasion; fourth, rail friction.

Brake efficiency is measured by the coefficient of friction between the brake shoe and the moving wheel. This is a variable quantity, depending upon the shoe pressure; the length of time shoe is applied; the kind of shoe; the kind of insert, and the condition of shoe. The M. C. B. Association has carried on a large number of tests on both chilled iron and steel wheels to determine the coefficient of friction under widely varying conditions. The result of the tests made in 1910 are shown in M. C. B. Proceedings for 1911, and are here given in Table No. 1:

This would indicate that the M. C. B. Association requires for a minimum condition that the brake shoes on the chilled iron wheel shall exceed in brake efficiency the same shoe used on steel wheels by 15 to 20 per cent. The average of all the tests in Table 1 shows an advantage in favor of the chilled iron wheel of from 20 to 25 per cent. The difference is even greater, and shoes with the highest coefficient of friction cannot be used on the steel wheels on account of their scoring effect. Engineers of tests often point out that the shoe with the highest wearing value cannot be used because of the cutting action of inserts on steel wheels, none of which injure the chilled iron wheel.

Taking these things into consideration, the conclusion is that the coefficient of brake shoe friction for modern brake shoes is fully 25 per cent greater on chilled iron wheels than on steel wheels. This brings out the very important fact that when brakes are applied, the retarding effort or the work done on chilled iron wheels is 25 per cent greater than on steel wheels. It is essential that cars equipped with steel wheels should have 20 to 25 per cent greater brake leverage in order to do the same work that is used on the chilled iron wheel. This indicates that chilled iron is superior to steel for car wheels, in this respect at least.

Table 1—Mean Coefficients of Friction Developed by Various Brake Shoes on Both the Chilled Iron Wheel and Steel-Tired Wheel. Purdue University Tests.

Shoe No.	Designation	Mean coefficient in per cent. Initial speed of 40 M. P. H. chilled iron wheel — Shoe Pressure, Pounds			Mean coefficient in per cent. Stops from an initial speed of 65 M. P. H. steel tired wheel — Shoe Pressure, Pounds		
		2808	4152	6840	2808	6840	12000
282	Plain cast iron	22.1	21.6	20.4	16.0	12.4	10.4
284	Plain cast iron without reinforcement	30.3	27.7	24.5	16.3	13.5	11.6
286	Congdon 7 inserts	22.2	19.8	16.4	20.6	14.0	11.3
288	Congdon steel back, 5 inserts	24.4	22.6	19.1	15.1	11.9	11.7
290	Streeter steel back	21.3	20.6	16.4	13.6	10.8	10.7
292	Lappin chilled ends	20.5	19.6	18.9	17.0	13.0	11.1
294	Lappin chilled ends	18.4	17.8	17.5	16.9	12.7	12.2
296	Plain cast iron steel back	21.0	20.3	18.5	16.2	13.2	11.1
298	Columbia	21.0	18.9	17.3	16.8	13.1	10.7
300	Diamond S. steel back	22.8	20.5	18.3	17.3	13.6	12.3
302	Walsh	23.7	20.5	19.8	16.6	14.4	11.5
304	Pittsburgh malleable shell	26.8	25.4	21.5	22.8	18.9	17.6
306	Pittsburgh steel shell	29.4	27.5	23.4	25.8	23.2	22.2
308	National	19.3	16.4	14.3	15.2	12.2	11.2
	Averages	23.1	21.4	19.0	17.6	14.1	12.5

A study of this table shows the greater coefficient of friction on the chilled iron wheel, and therefore in making up specifications for brake shoes the M. C. B. Association calls for standard coefficients as follows: Chilled iron wheel from an initial speed of 40 m. p. h., 2,808 lbs. pressure, 22 per cent; 4,152 lbs. pressure, 20 per cent; 6,840 lbs. pressure, 16 per cent. Steel wheel from an initial speed of 65 m. p. h., 2,808 lbs. pressure, 16 per cent; 4,152 lbs. pressure, 14 per cent; 6,840 lbs. pressure, 12 per cent.

It is found that the coefficient of friction per chilled wheels at 40 m. p. h. is about 15 per cent greater than at 65 m. p. h., where steel wheels are used. Reducing the coefficients for the steel wheel to the same basis as those at 40 m. p. h. on the chilled iron wheel by adding 15 per cent, we get:

Shoe press.	Coefficient of friction — Chilled iron	Steel wheel	Difference	Per cent in favor of Chilled iron
2,808 lbs.	22.0	18.4	3.6	16.4
4,152 lbs.	20.0	16.1	3.9	19.5
6,840 lbs.	16.0	13.8	2.2	13.7

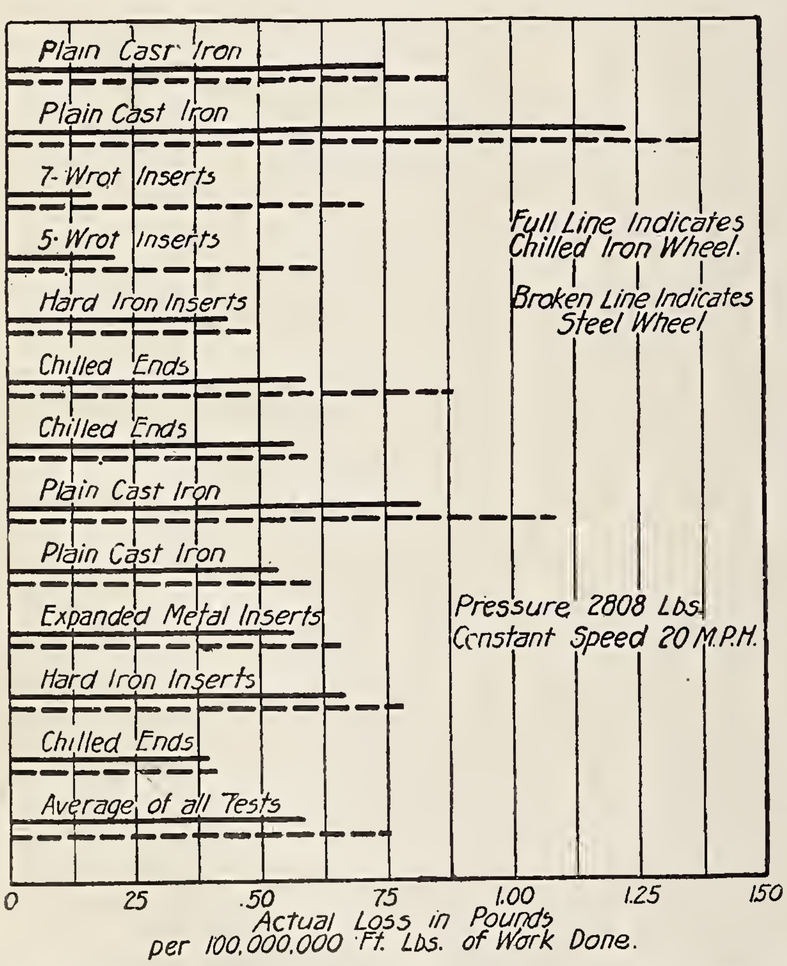
Another very important point is the relation that the kind of metal used in the wheel may have on brake shoe durability. This feature has been determined in extensive tests made by the M. C. B. Association, Engineers of Tests of various railroads, and other associations, have verified the results by the use of the brake shoe testing machine at Purdue University, and they have still further been verified by the American Brake Shoe & Foundry Co., at Mahwah, N. J. The results of these tests are shown in the chart, which is a graphical illustration of the tests on 12 various kinds of brake shoes under a shoe pressure of 2,808 lbs. at a constant speed of 20 m. p. h. One hundred to three hundred applications of each shoe were made for approximately 200 revolutions at each application. A greater metal loss occurred in every case with shoe on the steel wheel than when on the chilled iron wheel.

Table 2—Brake Shoe Loss Per 100,000,000 Ft. Lbs. Work Done.

		Pressure 2808 lbs. Constant speed 20 m. p. h. Chilled iron wheel		Steel wheel		Pressure 12,000 lbs. stops from 65 m. p. h. steel wheel	
Shoe No.	Designation	No. of applications	Lbs. loss	No. of applications	Lbs. loss	No. of applications	Lbs. loss
282	Plain cast iron	400	.745	300	.856	9	1.917
284	Plain cast iron without reinforcement	300	1.225	100	1.360	9	3.135
286	Congdon	200	.163	300	.706	9	1.467
288	Congdon steel back	300	.212	100	.633	9	1.405
290	Streeter steel back	300	.433	300	.482	9	2.240
292	Lappin chilled ends	300	.592	300	.885	9	3.405
294	Lappin chilled ends	300	.572	300	.590	9	2.280
296	Plain cast iron steel back	300	.820	300	1.058	9	3.833
298	Columbia	100	.537	100	.592	9	1.594
300	Diamond "S" steel back	300	.565	300	.662	9	2.925
302	Walsh	300	.671	300	.784	9	8.780
304	Pittsburgh malleable shell	200	.292	200	.273	6	.705
306	Pittsburgh steel shell	200	.239	200	.299	6	.918
308	National	300	.396	300	.413	9	2.565
	Average	...	.533	...	.685	..	2.886

Table No. 2 shows the results of 14 shoes, in which .533 lbs. per million foot-pounds of energy were dissipated, was removed from the shoe when applied to the chilled iron wheel. It required .685 lbs. to do the same work on the steel wheel, or an increase of 28½ per cent.

The shoes excluded from use on steel wheels on account of scoring have the greatest efficiency when applied to chilled iron wheels. The metal loss in one case was .163 lbs. and in the other .212 lbs., which is less than one-third the loss from the average of all shoes tested on the chilled iron wheels, and less than one-half the loss from the most durable shoe tested on the steel wheel. This same feature has been brought out by engineers of tests for railroads, in which the Congdon shoe has been recommended for chilled iron wheels, and another shoe chosen having 100 per cent greater loss of metal per unit of work, for use on the steel wheel. This is a matter of great importance in special localities where brake shoe consumption is high, such as occurs in the mountainous mining districts of Utah, Arizona and Mexico, where, in some cases, as high as one brake shoe per week is used for each wheel. This would be approximately 50 brake shoes per year, which, at 50 cents each, would amount to $25, and if a saving of only 25 per cent is made in favor of the chilled iron wheel, this saving amounts to $5 per year per wheel; or, in other words, the full value of the wheel is saved each year in brake shoe economy, and inasmuch as the wheel lasts from four to six years under these maximum loads and maximum grades, it therefore appears that the study of brake shoe economy is of more importance than the cost of the wheel itself.



Loss of Brake-Shoe Material on Chilled and on Steel Wheels

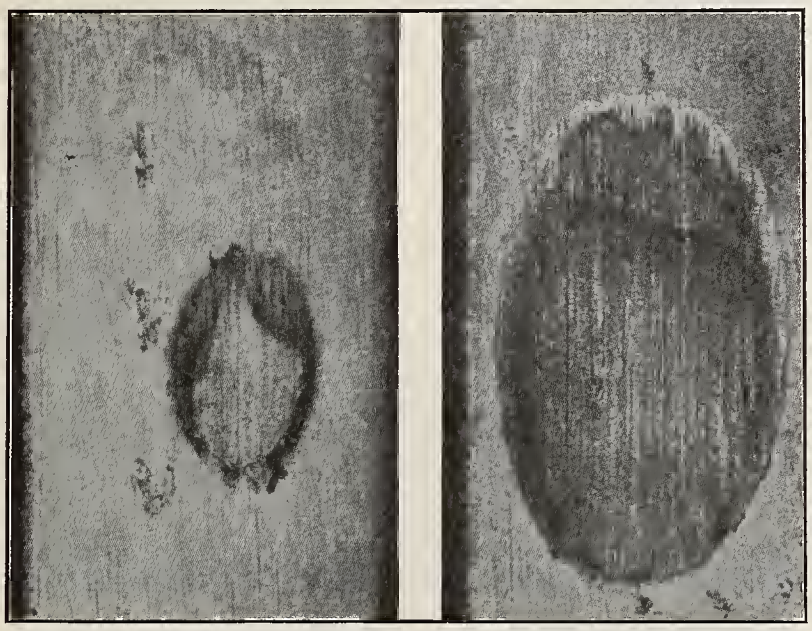
The M. C. B. specifications for brake shoe durability is that on a cast iron wheel the loss shall be determined by making 100 applications of the shoe on the wheel under a pressure of 2,808 lbs. and at a constant speed of 20 m. p. h., at each application the shoe to be in contact during 190 revolutions and out of contact during the succeeding 610 revolutions. That under these conditions the shoe shall lose in weight not more than eight-tenths pound for each 100 million foot-pounds of work done. That on a steel-tired wheel the loss shall be determined by making 10 stops from an initial speed of 65 m. p. h. under a shoe pressure of 12,000 lbs. and that the shoe shall lose in weight not more than 4 lbs. for each 100,000,000 foot-pounds of work done. The M. C. B. specifications call for much greater efficiency in the chilled iron wheel than on the steel wheel.

One of the important items in connection with wheel economy is the relation of the wheel metal to rail friction and abrasion. The effect of continuous skidding is shown in Fig. 1, the pressure on the wheel at the time being 6,840 lbs., in which case, notwithstanding that the number of revolutions of the chilled iron wheel was twice that of the steel wheel, the metal loss in the rail in the case of the chilled iron wheel was .3 gram, whereas with the steel wheel it was 23 grams.

Fig. 2 shows result of the rail after 3,800 revolutions for the chilled iron wheel and 380 revolutions for the steel wheel, both wheels being loaded to 6,840 lbs. The average loss was 2.2 grams for each revolution of the chilled iron wheel, whereas the steel wheel lost 62.5 grams a revolution. This indicates the great abrasion between steel and steel when one is slipping on the other, and illustrates the effect of a continuous rubbing of the steel flange on the steel rail, especially on curves where shavings are often cut from the rail and wheel, doing damage by loss of metal, and the flange friction is much greater in the case of the steel wheel, which results in a material increase of train resistance. This is a greater factor in the cost of operation than the mere loss of metal in wheel or rail. The small advantage which the steel wheel may have in the way of tractive efficiency in no way compensates for the excessive loss of metal and the increase in cost of motive power made to do useless work.

The average life of rails may be taken at 100,000,000 ton-miles, and since the total annual rail-borne traffic amounts to 750,000,000,000 ton-miles, the annual rail renewal must amount to 7,500 miles of track, and assuming the cost of renewing one mile of track to be $3,000, the total cost of rail renewals amounts to $22,500,000 per annum.

It was shown by tests that the abrasion from a steel rail used as a brake-shoe was about eighty times greater



On Chilled Iron Wheel On Steel Wheel

Fig. 1. Rail Used as Brake Shoe. Pressure 6,840 lbs. on Chilled Iron and Steel Wheels. Speed, 20 Miles per Hour

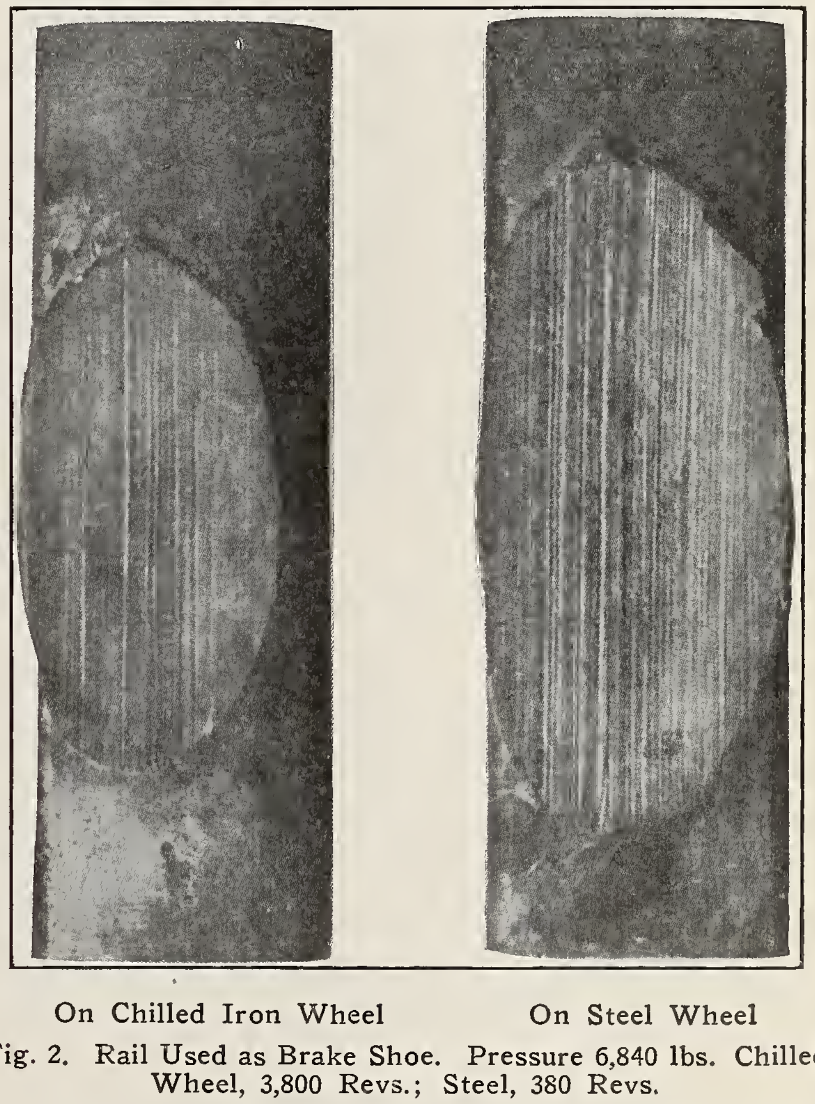
in effecting a stop from 20 m. p. h. when applied to a steel wheel than when applied to a chilled iron wheel. This ratio is too high when considering differences in rail abrasion, especially on tangents, where rails do not wear out entirely by loss of metal but give out owing to distorted ends. We may assume as a minimum that steel wheels are 10 per cent more destructive to rails than chilled iron wheels, hence, if all wheels were of steel, rail renewals would be increased.

The coefficient of friction against skidding is a variable quantity, depending upon the condition of the rail, whether clean, or greasy, and also on the kind of the metals in contact. In one case there may be friction on account of the inequalities in the surfaces without much loss in metal. There may be interlocking of the wheel and the rail, producing a heavy abrasion, in which both are scored, and so resulting in a high coefficient against skidding. This condition is illustrated in Fig. 3, showing the condition of the rail after a slip of less than one-half inch. The slipping took place under loads of 2,808, 6,840, 12,000 and 20,000 lbs., respectively. The test was made at Purdue University, in which a piece of rail, shown in the figure, was used as a brake shoe, and the wheel was made to slip. The area of contact under each of the loads is indicated in Fig. 3, especially in the case of the chilled iron wheel, in which case there was practically true friction, which means that the inequalities in the surface passed over each other with but little loss of metal, the resistance being due to raising the load over the irregularities in surface. In the case of the steel wheel, the rail and wheel were badly scored on account of the metal in contact interlocking and rolling up and cutting away. It will be noted that the scoring was even greater under the light than under the heavy load. This is because the area of contact under various loads is roughly proportional to the load, and, therefore, the pressure per square inch is similar, regardless of the load carried.

In a series of tests made by the Schoen Steel Wheel Co., and recorded in book form under the subject of "The Car Wheel," the coefficients against skidding are given as follows:

Load on wheel	Cast iron wheel	Steel wheel
2,000 lbs.	28.7	28.5
4,000 lbs.	25.9	25.4
6,000 lbs.	25.4	24.5
8,000 lbs.	24.2	24.6
10,000 lbs.	23.3	23.8
12,000 lbs.	22.3	23.7
16,000 lbs.	21.9	23.2
20,000 lbs.	22.0	23.6
24,000 lbs.	22.4	23.5
28,000 lbs.	21.7	23.6
30,000 lbs.	21.4	23.4

These coefficients are the average results of several tests and shows that the coefficients are very close to each other. In the tests made at Purdue University for the Association of Manufacturers of Chilled Car Wheels in 1913, many tests were made, which have a considerable range in results according to varying conditions of wheel and rail. The condition of contact, whether



On Chilled Iron Wheel On Steel Wheel

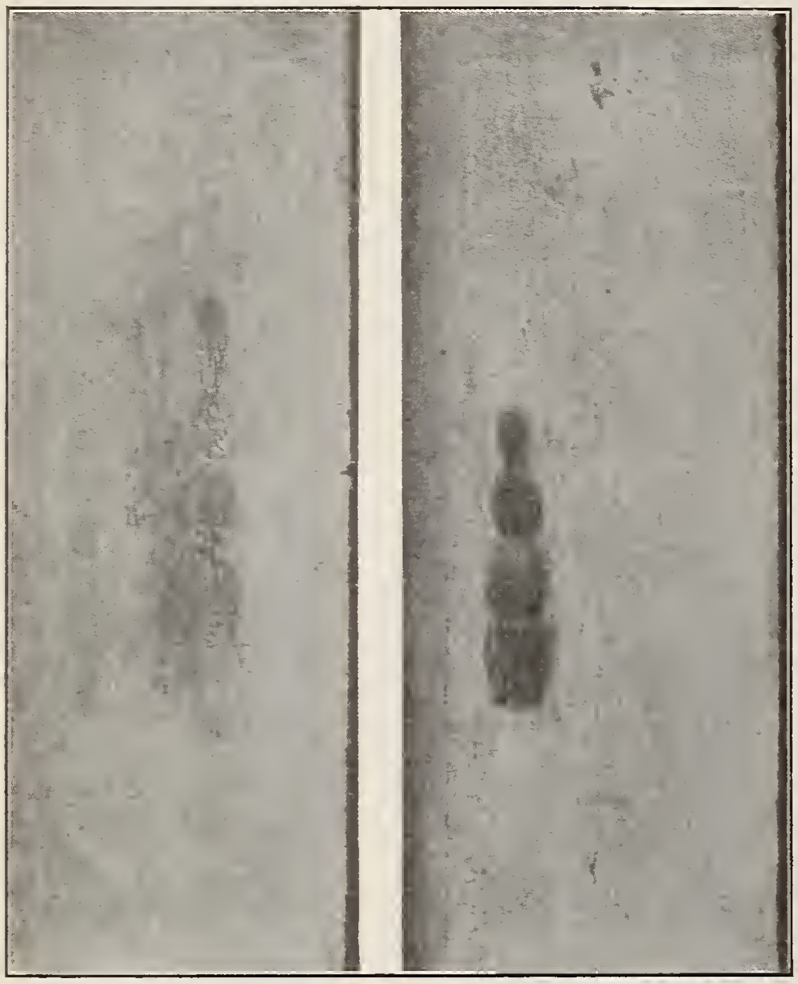
Fig. 2. Rail Used as Brake Shoe. Pressure 6,840 lbs. Chilled Wheel, 3,800 Revs.; Steel, 380 Revs.

at a single point or where the tread bears across head of rail, affects the comparison, and also whether the rail is clean or dirty and covered with grease or leaves, etc., and also the condition of wheel, whether clean or covered with graphite from brake shoe wear.

Fig. 4 shows the results when the tread of the wheel had a bearing of about 1½ in. across the head of the rail. The condition of the rail after the slip test is shown in Fig. 4, the pressure being 2,808, 6,840, 12,000 and 20,000 lbs. on each wheel. At the lower pressure very little evidence of slip is left on the rail. As the load increases, the effect on the rail is more pronounced. The actual results in this case were as follows:

Pressure between wheel and rail	Rail head planed down to fit taper of wheel — Chilled wheel: Tang. pull	Chilled wheel: Coef. of friction	Steel wheel: Tang. pull	Steel wheel: Coef. of friction
2,808 lbs.	796	28.4	558	19.9
6,840 lbs.	1,724	25.2	1,461	21.3
12,000 lbs.	2,757	23.0	2,841	23.7
20,000 lbs.	3,312	16.6	3,533	17.7

This indicates a material advantage in tractive effort for the chilled iron wheel, especially on the lighter loads, in which case the steel wheel did not score the



Steel Wheel Chilled Iron Wheel

Fig. 3. Condition of Rail After Slippage of Wheels. Pressure, 2,808, 6,840, 12,000, 20,000 lbs., Respectively.

rail. The advantage in favor of the chilled wheel at 2,808 lbs. and 6,840 lbs. is 43 and 18 per cent, respectively. Under loads of 12,000 to 20,000 lbs. the advantage in favor of the steel wheel is 3 and 7 per cent, respectively. In every case the tractive effort of the steel wheel is dependent upon the amount of scoring of the wheel and rail, which only occurs when the metal is comparatively clean.

In another test a normal rail head as rolled and the wheels with the regular M. C. B. tread with the 1 in 20 slope were tested after the rail had been flooded with engine oil, the results of this test being as follows:

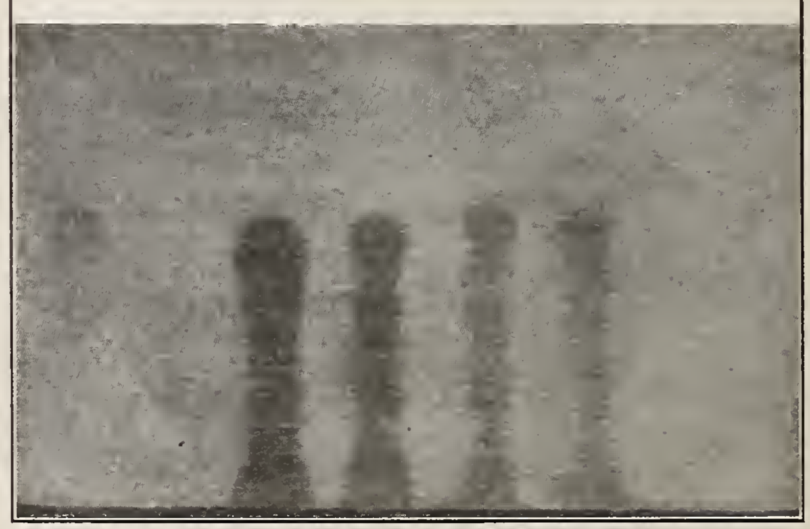
Pressure between wheel and rail	Rail head as rolled—wheel and rail flooded with engine oil — Chilled iron: Tang. pull	Chilled iron: Coef. of friction	Steel wheel: Tang. pull	Steel wheel: Coef. of friction
2,808 lbs.	537	19.1	557	19.8
6,840 lbs.	1,198	17.5	1,173	17.1
12,000 lbs.	2,289	19.1	2,116	17.6
20,000 lbs.	2,890	14.5	2,910	14.5

In this case the tractive effort as shown by the tangential pull was practically alike in both the chilled iron and steel wheel. Under the heavy load, the advantage was slightly in favor of the chilled iron wheel. In a third test with normal rail and wheel with cone 1 in 20, the following results were obtained:

Pressure between wheel and rail	Rail head as rolled — Chilled iron: Tang. pull	Chilled iron: Coef. of friction	Steel wheel: Tang. pull	Steel wheel: Coef. of friction
2,808 lbs.	818	29.1	1,127	40.0
6,840 lbs.	1,737	25.4	2,093	30.5
12,000 lbs.	2,688	22.4	2,863	23.8
20,000 lbs.	3,286	16.4	3,432	17.1

The results on the rail appear in Fig. 3. The advantage was in favor of the steel wheel. The reason is clearly indicated in the result on the rail on account of the greater scoring of the rail than when the heavy load was applied. If all conditions were averaged such as varying shape of tread and rail on account of wear and the materials picked up from the brake shoe, especially on the steel wheel, and various conditions of track, whether dry or wet, it will be found that the tractive efficiency of both wheels is so near alike that neither can be said to have the advantage over the other, but that on a clean rail and clean tread of the wheel, the abrasion between the steel wheel and steel

Steel Wheel



Chilled Iron Wheel

Fig. 4. Condition of Rail After Slippage of Wheels. Pressure, 2,808, 6,840, 12,000, 20,000 lbs., Respectively.

rail may run up very much and the damage to both wheel and rail becomes excessive.

The friction between the steel wheel and rail is high only when the rail and wheel are clean. This was also shown when considering the coefficient of friction between wheel and brake shoe. The flange and side of the rail are always clean on account of the continuous wearing away and, therefore, abrasion is abnormally high and the power required to keep the rubbing surfaces in motion in some tests reached 80 per cent of the load.

The steel flange is softer than the chilled iron flange. This prevents wearing to a smooth surface, and the loss of metal from the flange is much greater per ton-mile carried than from the chilled iron flange. For that reason, steel flanges are usually sharp, and remain so a greater portion of the life of the wheels than in chilled iron wheels. For this reason flange resistance is an item of importance, and the cost of motive power necessary to overcome the excessive resistance amounts to more than the entire cost of the wheel.

That part of train resistance arising from tread slippage and flange grinding, amounts to approximately 2½ lbs. per ton hauled on average curves of 2½ degs. It has been shown that the difference in the coefficient of rail friction between chilled iron and steel wheels is a variable quantity, and in some instances on a clean rail, roughened by the grinding action of a wheel, the coefficient is 100 per cent greater for a steel wheel than for a chilled iron wheel.

A test at Perdue University showed a material increase in train resistance when cars had sharp flanged wheels as compared with normal wheels. If we assume steel to have 10 per cent greater coefficient of friction, and include in this percentage the large number of sharp steel flanges, there is an increased resistance on curves of .25 lbs. per ton hauled, and on tangents this may be reduced to as low as .10 lbs. per ton. This affords a ready means for calculating the cost per year of the increased drawbar pull required for steel wheels, thus:

Total traffic	750 billion ton miles.
Traffic on curves (20 per cent)	150 billion ton miles.
Traffic on tangents (80 per cent)	600 billion ton miles.
Increased drawar pull in case steel should be used would amount to the following:	
150 billion x .25 lbs.	37,500,000,000 lb. miles.
600 billion x .10 lbs.	60,000,000,000 lb. miles.
Total increase	97,500,000,000 lb. miles.
Average drawbar pull per ton	8 lbs.
Equivalent inc. in ton miles	12,187,500,000
Average freight rate per ton mile is \$.0075. Assuming that any small increase in load can be hauled for one-tenth this amount, and using \$.00075 per ton miles as the actual increased cost for the increased ton mileage, or 12,187,500,000 x \$.00075	\$9,140,625

This amount, \$9,140,625, is the annual cost for the additional drawbar pull that would be required in case all railroad car wheels in the U. S. were changed to steel. It is believed that the unit cost for haulage per ton mile is so small that it more than offsets any possible error in estimating the increased train resistance due to greater coefficient of friction between the steel wheel and steel rail as compared with the chilled iron wheel and steel rail. These economies are so large that they indicate the importance of carefully analyzing all the elements that in any way are influenced by wheel characteristics.

As far as tests are concerned, the chilled iron wheel has the advantage in structure, hardness of wearing surface, in flange friction, train resistance, brake shoe durability and brake efficiency. These items at once establish the economy of the chilled iron wheel, without reference to wheel cost or wheel mileage. The only advantage enjoyed by the steel wheel is its tensile strength.

Training of Railway Apprentices

What is Done on English Railways in this Matter in Regard to Qualifications and Training

On the Great Western Railway of England young men between the ages of 15½ and 16½ years are engaged as apprentices to the trades of engine fitting and turning whenever vacancies occur. The apprenticeship is for a period of five years and the incumbent must become a member of the science and art classes in the technical schools of the company. While the apprenticeship is terminable at the end of any six months, a one month's trial without wages is required. The compensation is not extravagantly high, being 60 cents per day of 9 hours. This is the maximum, continuing for the entire course.

The applicant presents a birth certificate and also a doctor's health certificate. He receives a certificate stating his character and worth on completing the term of five years. When a young man has gone through this apprenticeship he is certainly well fitted as an engine shop man. The company and the employe both profit by it.

The Midland Railway Company secures its apprentices from among the sons of workmen in the service. This apprenticeship continues from the age of 15 to 21 years, the engagement covering a particular trade—turning, fitting, boiler making, pattern making or molding. There are privileged and ordinary apprentices on the list; the "privileged" being young men of better education and generally better qualifications at the outset, who begin work at the age of 17. These may be accepted after either an examination or by promotion from the so-called ordinary class.

The superintendent of apprentices is a sympathetic man, to whom the apprentices may appeal on occasion or from whom they may get advice to aid them in their work. The superintendent, of course, must be a thorough workman and a person of all-around training. There are evening classes and lectures, all of which are promoted by the company—encouragement being sustained by scholarship awards and suitable prizes.

The Great Eastern apprentice is any young man who starts with the company to learn a trade. In his first year he must devote 15 weeks to a course of instruction, including practical mathematics, drawing, geometry and general science. This must be followed, after a satisfactory examination, by a course of study in the evening classes of the Mechanic's Institution. Practical classes are held in the Stratford works of the company in matters relating to iron, steel, copper, bronze, setting locomotive valves and making experiments. On none of the railways is any special course taken relating to air brakes, but the subject is taken up in the general training as the young men pass from one shop to another while they are fitting themselves as mechanics. On all the railways, however, the strictest discipline is maintained, so that when an apprentice becomes a full-fledged shop man he is fitted to take charge of others, if necessary, and render at all times his best service to the company. Exceptional ability is rewarded by appropriate advancement, depending upon the situation.

In this matter of apprentices, some of our American railway managers might secure excellent information by a study of the English apprenticeship method. To Vice-Consul Ripley Wilson at London we are indebted for this general outline and brief resume of what some English railways are doing. It is noticeable how general the practice is of providing for the future in the way of first-class shop men, and similar efforts are in vogue here.

Reclamation of Condemned Freight Cars

By J. J. TATUM, Supt. Freight Car Dept., B. & O.

Method of Dismantling, Sorting and Using Material from Worn Out Cars

The Baltimore and Ohio Railroad Co. has in past years, following the custom of other roads, disposed of freight cars by having them turned over banks by wrecking cranes and piled up in heaps covering considerable space, after which they were lighted and permitted to burn, destroying good lumber having considerable value. The burning of the cars not only destroyed the lumber, but also made forgings, bolts, nuts, washers, etc., unfit for further use.

A careful study of disposing of cars in this manner developed that many items of lumber in the old cars, as well as metal parts, could be reclaimed and used in repairing similar cars; or used in putting up buildings, material platforms, icing platforms and freight sheds, giving as good value in service as if new material was used. In many instances material reclaimed in this way is of better quality than new material purchased today, for the reason that when the cars were first built the lumber market was such that a more rigid specification for lumber could be followed than in the present lumber market, due to the growing scarcity of timber. It is fair to say that a considerable quantity of this lumber reclaimed is of a quality that if purchased in the present lumber market would cost $40 per 1,000 ft.

The side lining and roofing removed from cars is made use of by cutting it to proper lengths and applying it again as the board roof on cars receiving metal roof. The better boards of siding are used in many instances in making new doors and repairing the inside lining of box cars. The flooring of the old cars is used to patch and repair floors of other equipment. Improvements were needed not long ago at Keyser, W. Va., which included a platform 90 ft. long. This was built with material furnished by the Reclamation Agent. An icing station at Cumberland, Md., 300 ft. long has been constructed in the same way. It will be readily understood that it required no argument to prove the saving that can be effected by having cars dismantled carefully, reclaiming this material so that it can be made use of in the various ways referred to. Cars which used to be spotted as "scrap" are now referred to as "reclamation" and so labeled.

A large number of nuts, bolts and washers are used just as they are reclaimed from the dismantled cars in other equipment being repaired. Bolts that have had the threads distorted or corroded in such a way as to make the bolt unfit for use with the thread it retains when removed from the old cars are shortened so that the maximum length is obtained, and they are rethreaded and made equivalent to new bolts of the sizes into which they are made. The nuts removed are carefully inspected and those that have substantial threads are given oil baths by placing them in oil vats, allowing them to soak and clear the thread of rust, making them by this process equal in value for further use to new material.

Malleable iron castings, gray iron castings and steel castings are sorted, and those of patterns still found in use on other equipment are reclaimed and put into properly designated material bins, where they are again made use of in repairing equipment or rebuilding equipment, as conditions may require. Forgings are handled in the same way as castings.

The saving in cost of material alone is not all that is to be considered by making re-use of forged parts. It further makes it possible, at points where facilities are not available to meet the demands on the blacksmith or forge shop, to relieve the overcrowded facilities, and also makes it unnecessary to go out on the open market and purchase forgings at a higher market price than the cost of manufacture in the railroad's own shops.

On large railroads where cars are dismantled careful consideration must be given as to whether it is justifiable to move all cars to be dismantled to a central point where they can be dismantled. Such an arrangement, if not carefully thought out, can be made expensive and the saving very much offset by unnecessary handling of cars, with defects, to such plants, and by further damage to other equipment in which defective cars are hauled. In some instances it might even be necessary to make repairs that would make the cars meet the requirements of the Federal Safety Appliance Law so that such cars could be hauled to these plants. All of these items would contribute toward bringing about a loss in dismantling cars over the old method in place of a saving. Therefore, on the Baltimore and Ohio Railroad this matter is given serious thought, and at points where the equipment would naturally locate through service are established points for dismantling freight equipment. The material is reclaimed at such points in the same manner as would be done at one central plant. Such a method brings about a further saving by reducing the freighting of material to and from one central plant, as many times this reclaimed material can be made use of at the point where the cars are dismantled, making it unnecessary for much of it being freighted to any distant point for use.

A saving of $20 per car seems to be a modest estimate of the possible saving, for the reason that if all parts referred to are reclaimed a much greater saving can be effected. The sale price of scrap is very much higher when reclaimed by dissecting cars than if the cars are burned. It can also be stated that a large portion of the lumber reclaimed from these cars is used in repairing similar cars, and it is not only the value of the lumber that is saved, but it is also the manufacturing of it, the freighting of the raw material, the mill work and the freighting of the manufactured material from the mill to the shops where it is to be used.

A summary of the saving which can be brought about by this method of dismantling cars and reclaiming the material includes the switching of the cars to a distant point from the shops where the burning of them would not endanger the property; the moving of the wrecking crane with its crew to points where they have been switched, to turn them over and burn them; the switching of revenue cars to points where cars are burned, for the loading of scrap; the sending of forces from the shops to points where cars are burned, to load the scrap; the moving of cars back to the scrap docks where the material is unloaded from the revenue cars and sorted into classes; the reloading of sorted material; the purchasing raw material, such as forgings and iron, freighting them to manufacturing shops, where they are unloaded and manufactured and reloaded and shipped to points for use; the damaging of good parts of the condemned cars in hauling them to the points where the wrecking crane is permitted to turn them over the bank for burning; the taking of chances in hauling condemned or crippled cars from distant points and from shops to points where they are to be burned, for, due to their condition, there is the possibility of derailments and wrecks that tie up the proper operation of the system, the expense of which is high beyond measurement.

Freight Car Repairs on the Boston and Maine Railroad

Facilities, Methods and Organization for Freight Car Reconstruction and Repairs at Concord, N. H., and East Fitchburg, Mass.

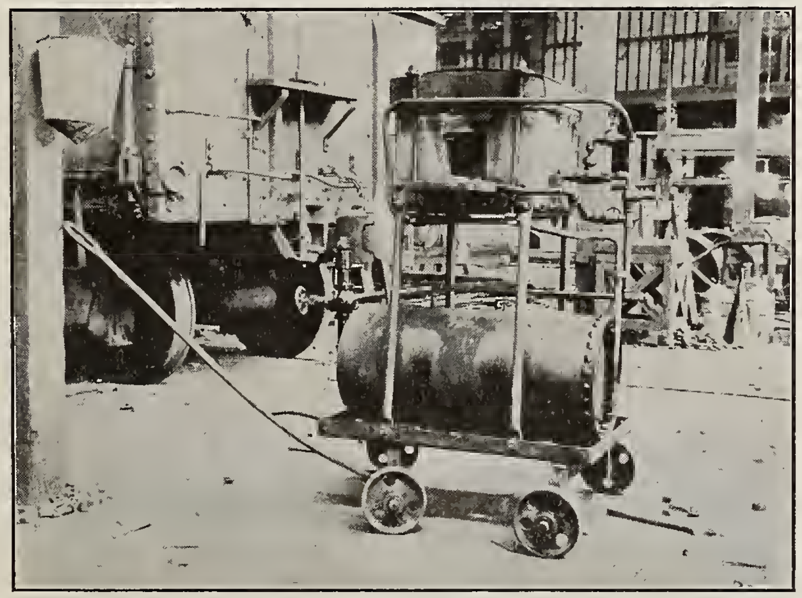
The freight car repair work of the Boston and Maine Railroad is carried on in shops located at various convenient points over the system. Conditions in the shops at Concord and East Fitchburg may be considered as representative of practices obtaining at all points on the system. At the smaller points where facilities are not as complete as in these two much heavy work cannot be carried on in the shops themselves, but heavy machine work is done for these smaller points on shop orders by the larger shops and the advantage of having machine work concentrated in points where automatic machinery can be used to advantage will be readily appreciated.

Concord Shop

The shop at Concord, in charge of George A. Wyman, Master Mechanic, carries on the locomotive repair work for the northern part of the system and all freight repairs for points north of Concord and within economical distances south. Much of the passenger repair work of the system was done in the Concord shops before the construction of the new shop at North Billerica, where passenger work is now concentrated.

The present freight shop at Concord is divided into three shops, of which the first two are under one roof, and comprise together 16 tracks, each long enough for three cars and their trucks rolled out for repair work. Shop No. 3, separated from the first two by a transfer table, contains 10 tracks, each long enough for three cars.

A shifter brings cars for repairs to a track outside of the shop and a shop shifter working on the transfer table distributes the cars through all three shops. The first two tracks in shop No. 1 are assigned to steel coal car work. A large number of these gondolas were purchased by the Boston and Maine shortly before the United States safety appliance laws were formulated, and this part of the shop is being devoted to making what changes are necessary in this class of cars to make them comply with the safety requirements.

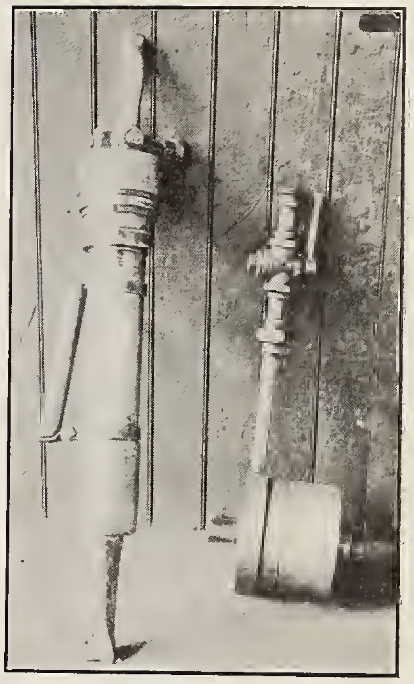


Fuel Oil Rivet Heater, Steel Gondola Having Draw-Sills Lengthened.

The principal change in the construction of these steel cars involves lengthening the underframe 3 in. at each end, in order to secure the required clearance between the cars.

A Boyer rivet buster is used to remove the rivets securing the draft sills to the ends of the underframes. Three men with this automatic machine remove the 96 rivets necessary in one and a half days, doing the work which before the use of the automatic machine required eight men with sledge hammers and chisels for two days.

A pneumatic anvil, illustrated, has been designed and constructed in these shops to go between the channels used in extending the draft sills and hold the heads of the rivets, in pairs, while they are riveted into place. The pneumatic anvil consists of a piston working in a cylinder in such a way that the heads of two hot rivets which have been inserted from between the channels are held apart by air pressure introduced between the head of the piston and the cylinder, while air riveters are used outside the channels. This anvil, holding two rivets at once, does so more securely than a hand-operated tool. These anvils have been made in 6-in. and 8-in. sizes for use on different classes of equipment.



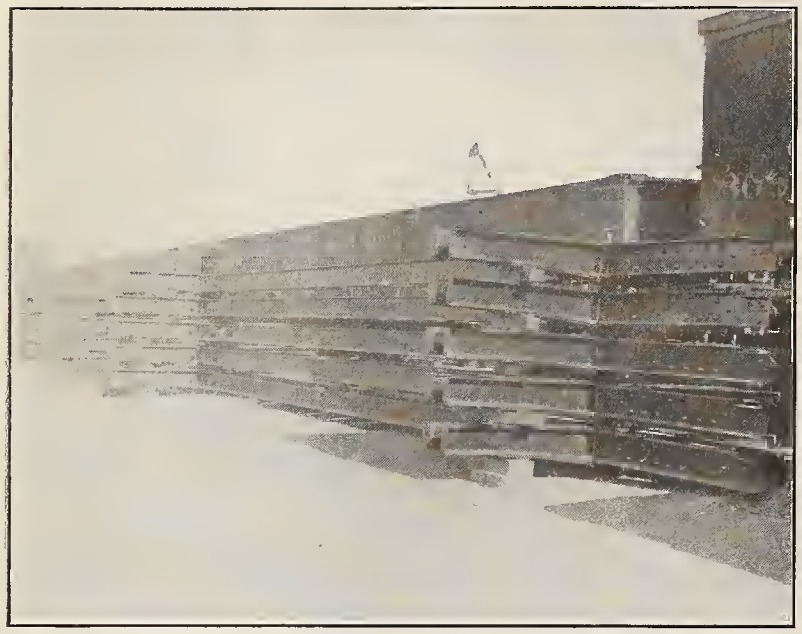
Rivet "Buster" and Pneumatic Anvil

An oil heater, illustrated, has been built to burn fuel oil by the use of compressed air. The oil is heated in the pipe, which passes around the front of the heater, and the furnace will heat rivets at a sufficient speed to keep a gang of four men supplied. One man heats and inserts the rivets, a second operates the pneumatic anvil and a third and fourth on opposite sides of the center sill drive up the rivets with pneumatic riveters. The heater has been so designed as to enclose a combustion chamber and a lining of firebrick utilizes the heat from the burner to maximum advantage and prevents wasteful radiation of heat as well as makes a more comfortable machine for the men who operate it. The heater is mounted on small cast iron wheels and can be easily moved from car to car as the work progresses. A good size oil reservoir is included and compressed air is available at convenient points in the shop.

At the same time that the clearance between the cars is being increased all necessary interstate safety equipment is being applied and whatever repairs would ordinarily be made owing to the condition of the cars when they enter the shop are being taken care of. Space in the shop for six cars at a time is being devoted to this work and the records show that with present forces six cars a week is the average output.

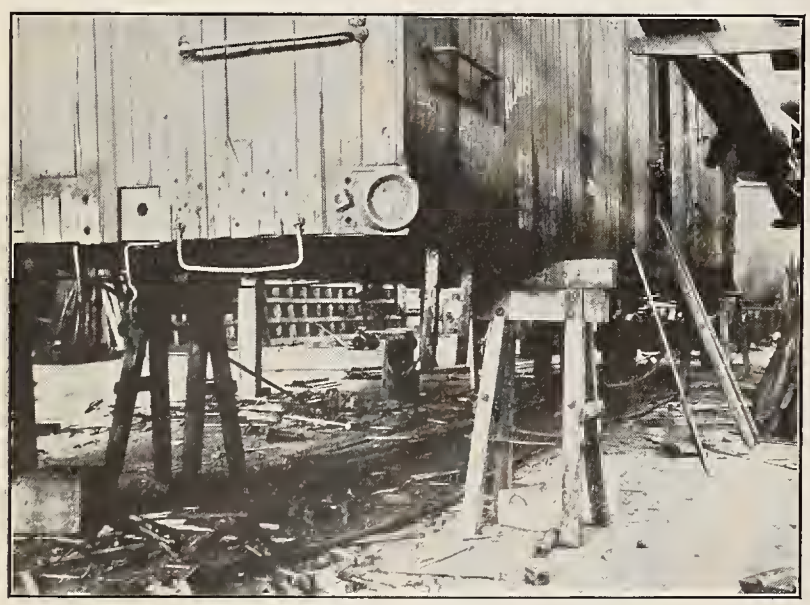
Another track in shop No. 1 is being used for caboose work and a fourth track for snow plows, cranes and special work. The remaining twelve tracks in shops Nos. 1 and 2 are being used to apply new steel sub-underframes as fast as the cars undergoing this reconstruction can be released from service. Any tracks in the shop not devoted to this work and all of the tracks in shop No. 3 are being used for miscellaneous freight repairs.

Twelve hundred 36-ft. 30-ton box cars are being equipped with steel sub-underframes as rapidly as the cars can be taken from service. The increased traffic demands and the heavier equipment being put into service in the way of cars and locomotives have made it necessary that these cars be strengthened if they are to play an active part in the movement of freight in



Steel Sub-Underframes as Received at Shop

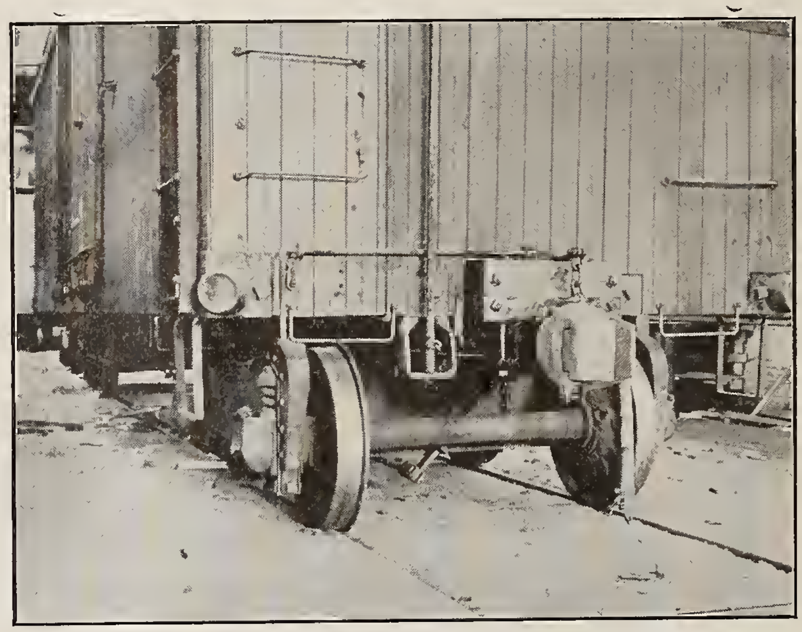
The steel sub-underframe, several of which are shown ready for use, consists of two channels, pressed steel bolsters and cover-plates at the bolsters. These frames are fabricated outside of the shops of the Boston and Maine and are delivered as shown in the illustration. Cars to be equipped with these frames enter the shop, and all parts are removed from the bottom of the car up to the level of the sills. A car so stripped is shown resting on wooden horses. Truss rods, deadwood and other parts which can be used after the new sills have been placed under the car are returned to the car if they are in good condition. Holes are bored through the sills and bolsters of the car through which bolts are used to secure the car to the underframe. The king post, queen post, cross ties, brake cylinder, reservoir and piping are secured to the underframe and the underframes are run under the car, and



Car Stripped for Application of Sub-Underframe

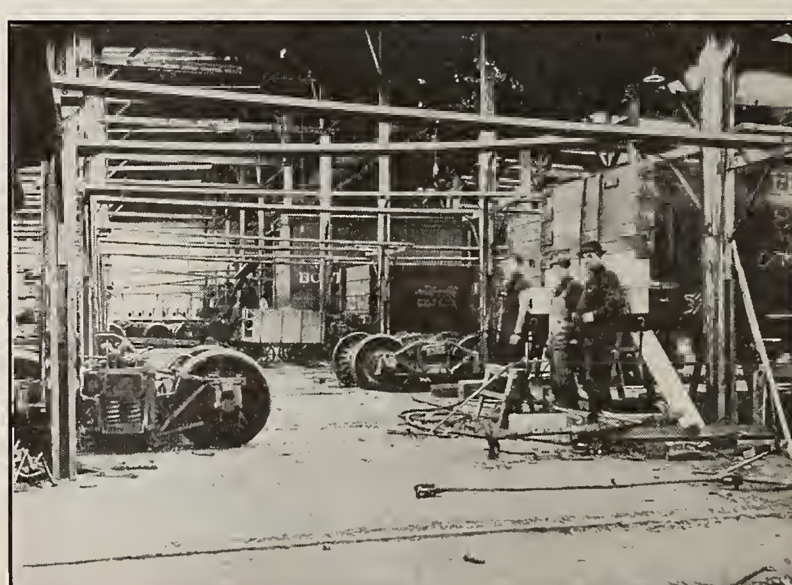
the car let down and secured with bolts through the holes previously bored in the sills and bolsters. The original cross ties are used by shaping the ends where they rest on the center sills so that they fit between the flanges of the channels, and the original couplers are used by changing the pocket strap. The appearance of the car after the new underframe has been applied is shown. The work as it is carried on in this shop takes from 40 to 45 hours for four men in a gang. Other repairs warranted by the condition of the car when it reaches the shop are carried on at the same time.

The general appearance of shop No. 3 can be appreciated from the view taken down through the center of the shop, which also shows the form of staging with which the entire shop is equipped. The experimental work done in design, construction and maintaining this staging was taken advantage of in the new passenger shops at North Billerica and the design of the staging used there has been adopted as standard for the whole road.



Re-Built Car After Application of Sub-Underframe

In the mill room there are facilities for all of the work for the Concord shop and for other outlying repair points for which heavy mill work is done on shop orders. A room is devoted to cab work for the locomotive repair shop and others to pattern work, piping and air brake work, tinsmith's work, and in the upholstery room in shop No. 3 are made the side and end curtains for all of the locomotives for the system, some 2,000 to 3,000 curtains a year.

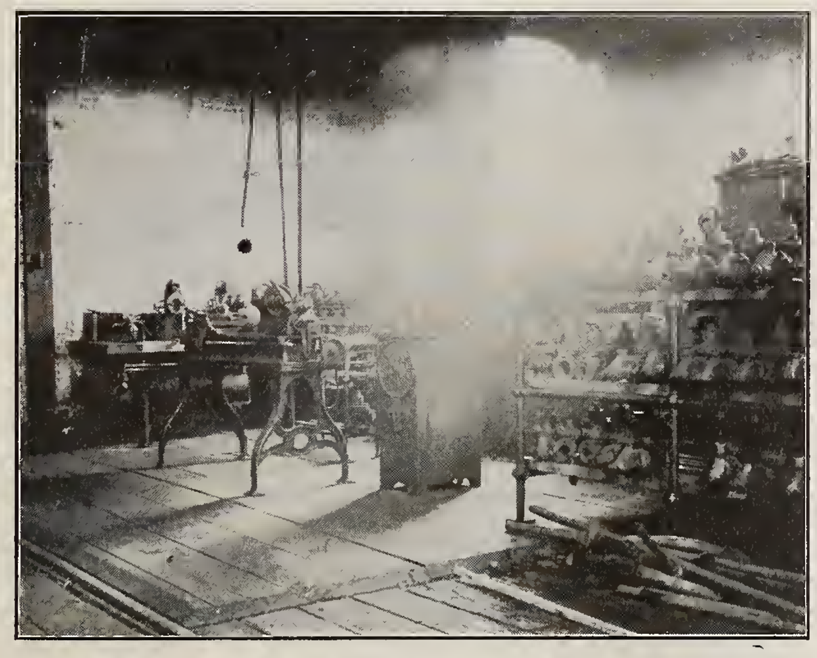


General View of Shop No. 3, Concord, N. H., Showing Staging

All three shops are under the direct charge of general foreman Hatch, who has six assistant foremen, two in shop No. 3, each with one-half of the men, and four in shops Nos. 1 and 2, one assistant foreman having charge of the work on steel gondolas, another of the steel underframe work and two having charge of the miscellaneous repair work in those shops.

Including the mill room, cab shop, pipers, tinsmiths, air brake and truck repair work, there are 256 men in the freight car repair department at this point. The men work in gangs of two and are moved from track to track in the shop in the order in which they finish the work they are on and new cars enter the shop. This arrangement has been found to work very satisfactorily as it insures an impartial distribution of the heavy and light repair work among the men in the shop.

Axle Turning Department at East Fitchburg, Mass.

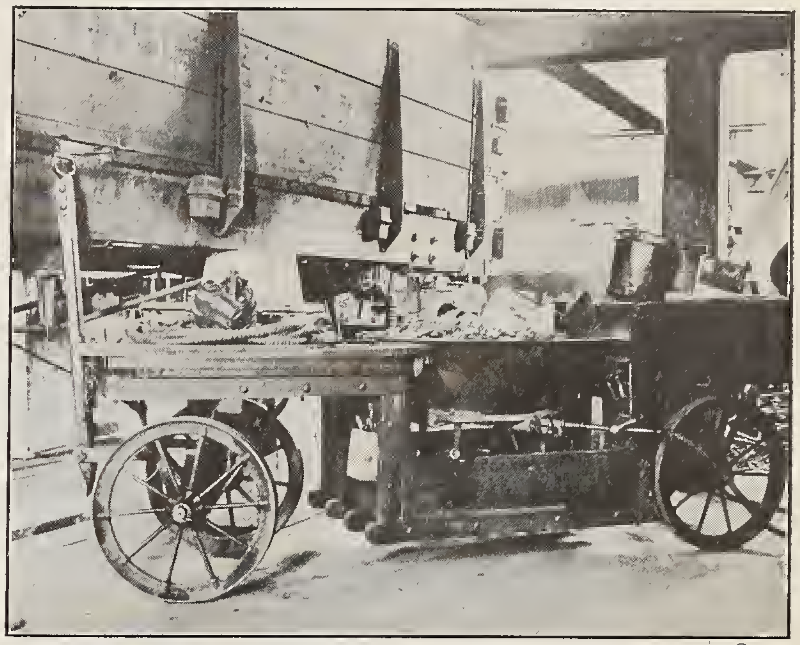


Valve Repairing and Testing Room, East Fitchburg, Mass.

East Fitchburg Shop

The freight car repair work at Fitchburg is in charge of F. H. Eddy, shop superintendent. The repair work is done in three shops—steel car repairing and steel underframe application work are carried on in shop A—general freight car repair work is done in shop B, and shop C is devoted to painting and to repairs on caboose, refrigerator and miscellaneous cars. Each of the three shops contains 24 tracks long enough for two cars each, giving the shop a capacity of 144 cars.

In the machine shop are three axle lathes served by gib cranes carrying air hoists, and the freight car axle work for the system is concentrated here where it can be done most economically. The air-brake triple-valve testing and repairing is carried on in the machine shop and facilities are provided for rapid and thorough work. This end of the shop containing the repair equipment and rack of tested triple valves is shown. The riveting gang have a portable truck, illustrated, on which is mounted a rivet heating forge and racks for pneumatic tools, piping, etc., used by this gang. The truck is moved from point to point in the shop, and conveniently located compressed air connections facilitate rapid work.



Forge Truck of Rivet Gang at East Fitchburg, Mass.

The shop operates on a piece-work basis, the men are divided into gangs of two and are definitely placed, one gang at each car location, taking the work as it comes to them in the course of operation.

In addition to these repair men, forces are maintained in the mill room, boiler room, machine shop, smith shop, pipe shop, tin shop and paint shop, a certain number of men are maintained on a basis of day work, and there is a force of laborers. The present complement of the shop includes some 400 men.

Water Power in South Central Alaska

For several years the United States Geological Survey has been making a study of the water supply of parts of Alaska. At first this work was confined to Seward Peninsula; later it was extended to the Yukon-Tanana region; and Water-Supply Paper 372, just issued, describes the water resources of the region tributary to Copper River, Prince William Sound, and the lower Susitna. Stream measurements made during only one season can not, of course, be relied upon for estimating average flows, but the Survey engineers, besides making measurements of the flow of some of the streams, obtained much information on the topography of the drainage basins, reservoirs, and power sites. The data thus obtained, when combined with the Weather Bureau's records of precipitation, will serve as a general guide to the railway engineer, who, however, will at once realize that these facts must be supplemented by careful and thorough surveys and measurements before he can plan in detail any water-power project. The paper will at least show that the water powers available throughout the year are not so abundant in the south-central part of Alaska as has sometimes been assumed.

Wrought Iron or Steel Pipes

Corrosion of Iron and Steel Compared with Reference to the Endurance of Pipes. Tables and Results of Tests Analyzed

Iron and steel may be made less susceptible to corrosion by the addition of certain elements, but even then it is found that some parts resist corrosive action better than others, without these elements being present. Iron made today is not exactly the same as it was when manufactured by older processes. These ideas are contained in an article by Mr. L. C. Wilson, printed in a recent issue of "The Engineering Magazine." It also appears that modern methods have produced a metal, chemically and physically different from that turned out formerly, and at the same time the use of iron and steel has tremendously increased.

The carrying of steam and water in pipes causes them to be exposed to somewhat unusual conditions, or at least to conditions not present in the ordinary use of steel and iron, where these metals are only occasionally wet or in contact with an excess of air containing varying amounts of moisture and gases. The inside of a pipe is constantly in contact with large amounts of water, which may contain much or little air or oxygen. In pipes drained out constantly or where they hold a large amount of air, the conditions for rapid and severe corrosion are present. From a steel pipe failure under such conditions some are led to conclude steel is inferior to iron in resisting corrosion.

Steel produced ten or fifteen years ago was not equal, in many respects, to that now made, but improvements in its mode of manufacture have brought it up to a point where it cannot be unfavorably compared with iron. A brief outline of the processes employed in the manufacture of iron and steel may here be in order. The way iron ore is reduced in the blast furnace, to produce pig, is such that several per cent of other metals and metaloids are present. The iron may be refined in several ways, such as that used in puddling or in the Bessemer process.

In puddling, the iron is melted on a bed of iron ore, which gives up part of its oxygen to combine with the carbon, silicon and manganese, and to a less extent, sulphur and phosphorus. The greater the purity of iron, the higher is the temperature at which it melts. After a time the metal in the furnace becomes pasty as the impurities are burned out and the mass is worked into a ball. This ball is rolled into bars, which are cut and piled up, then reheated to a welding heat and rolled again into a bar of convenient size.

Wrought iron thus produced is nearly pure; the greatest and most objectionable part of the impurities is the slag, which is scattered all through it and gives it the apparently fibrous structure, characteristic of its appearance after rolling. These slag lines are easily seen and are a means of distinguishing between wrought iron and that produced by other methods.

The puddling process is slow and expensive, as only a few hundred pounds at most can be treated at a time. About an hour and a half is required for a charge, and considerable skill and care are needed for a good product. The presence of 2 per cent of slag distributed irregularly throughout the mass does not increase its homogeneity, and the lack of homogeneity is of more importance, as far as corrosion is concerned, than the presence of a reasonable amount of impurities thoroughly and uniformly mixed in.

When the Bessemer process is employed, melted cast iron is run into mixers and then into the Bessemer converters and air is blown into the molten mass from the bottom. The oxygen of the air burns out the impurities. The flame issuing from the mouth of the converter indicates, by its color, the progress of the "conversion." Some iron is necessarily oxidized, but the addition of manganese corrects this. It may only take 10 or 15 minutes to convert several tons of iron into steel, so that in point of speed and economy the Bessemer process is superior to the other. This process is best for the production of low-carbon steel and the metal is purer than that obtained by hand puddling.

Generally speaking, carbon, silicon, sulphur, manganese and phosphorus may be lower in wrought iron than in steel, but the wrought iron usually contains about 2 per cent of oxides, while in steel these will not exceed about 1.2 per cent. Whatever impurities there

Investigations on the Corrosion of Wrought Iron and Steel

Authority	Date	Conditions of test	Duration of test	Material tested	Relative loss of weight
Prof. H. M. Howe	1897	Sea water norm. temp.	2 years	Steel skelp	117 per cent
				W. I. skelp	100 " "
Prof. H. M. Howe	1897	River water norm. temp.	2 years	Steel skelp	94 " "
				W. I. skelp	100 " "
Prof. H. M. Howe	1897	Weather	2 years	Steel skelp	103 " "
				W. I. skelp	100 " "
U. S. Navy Dep't	1901	Aer. dist. water norm. temp.	64 wks.	Charcoal iron	100 " "
				Pipe steel	94.5 " "
National Tube Co.	1904	Aerated brine Norm. temp.	6 mos.	Puddled iron	100 " "
				Pipe steel	106 " "
National Tube Co.	1905	Aerated water 180 deg. F.	3 mos.	Puddled iron	100 " "
				Pipe steel	90.6 " "
National Tube Co.	1906	Aerated brine 180 deg. F.	3 mos.	Charcoal iron	80 " "
				Puddled iron	100 " "
				Pipe steel	75.3 " "
Prof. H. M. Howe	1906	Aerated sea water 180 deg. F.	3 mos.	Charcoal iron	94.4 " "
				Puddled iron	100 " "
				Pipe steel	94.2 " "

are, they are well distributed. The steel is rolled without cutting and rewelding, which is part of the process of making wrought iron, and therefore the danger of laminations in steel is less than in wrought iron.

Up to twenty-eight years ago, puddling iron was used entirely for making pipe. With the increasing use of pipe and the discovery that steel could be welded, when treated properly, and the cheapening of the process of manufacture, caused it to be used even to a greater extent, and iron and steel pipe came on the market. With a large number of makers in the field, different grades of each appeared. In fact, there is as much difference between some wrought iron pipes as there is between wrought iron and the steels, and there is a corresponding difference between grades of steel pipe.

This has tended to cause confusion, and there has been engendered a lack of agreement as to the life of wrought iron pipe when contrasted with steel pipe. Owing to this, much experimental work has had to be done. An experiment, twelve years ago, was made by the Bureau of Steam Engineering of the Navy Department, on lap-welded Bessemer steel, lap-welded iron, seamless cold-drawn steel and seamless hot-drawn steel boiler tubes. The tabulated results are here given. Care was taken to secure good representative samples, and the analysis showed them to be composed, on the average, as follows:

	Cold Drawn seamless	Hot Drawn seamless	Bessemer steel	Iron
Silicon	0.005	0.005	0.008	0.024
Sulphur	0.043	0.039	0.081	0.014
Phosphorus	0.015	0.016	0.110	0.038
Manganese	0.50	0.49	0.31	Trace
Carbon	0.16	0.14	0.063	Trace
Oxide	0.23	0.30	0.28	1.03

Without going into detail, the test consisted in weighing the parts, then immersing them in distilled water, through which air was passed, for 64 weeks, divided into four periods of 16 weeks each. At the end of each period the samples were removed, cleaned and weighed. The results may be averaged thus:

Average Loss in Grams Per Square Inch

	First period	Second period	Third period	Fourth period	Total loss	Loss compared with iron as 100
Hot-drawn open-hearth steel	.3034	.5333	.3510	.5070	1.6947	93.7
Bessemer steel	.3147	.4950	.4043	.4945	1.7085	94.5
Cold-drawn open-hearth steel	.3232	.5564	.4502	.5017	1.8315	101.3
Charcoal iron	.3326	.5896	.3966	.4893	1.8081	100.

There was no great difference in the behavior of these four classes as far as loss of weight is concerned; the charcoal iron samples, which showed the greatest initial loss, ended up with a decrease about 6.3 per cent larger than that of the open-hearth, hot-drawn tubes, which had suffered the least.

From data collected by the American Society for Testing Materials, 1908, and experiments reported in "The Iron Age," a table has been drawn up:

Laboratory tests are useful in giving indications of what may be expected in practice, but the results in service are more reliable.

Later Prof. Thomson joined up a hot water line of wrought iron and steel pipe in alternate sections, so that they would all be subjected to the same conditions. After a year of service, he concluded that steel might be expected to stand up about 7.5 per cent longer, under such conditions, than wrought iron.

A short time later a test was carried out under similar circumstances by the American Society of Heating and Ventilating Engineers, using steel and iron pipes supplied by several makers; the report of the trial concludes: "We believe (this test) demonstrates that modern steel pipe of good quality is at least as durable as modern strictly wrought-iron pipe of good quality, and is very much superior to a poor quality of wrought iron in this class of work."

Various other tests carried out by different observers under a variety of conditions have lead to the same general conclusion. Several experiments conducted by the Pittsburgh Coal Co. and the H. C. Frick Coke Co., where the samples were immersed in running mine water containing acid, showed that steel corroded no quicker than wrought iron.

The tests which resulted in favor of steel were one pipe for seven months in hot aerated salt water; another, sixteen months in damp ashes, exposed to sulphuric acid coal-mine water; still another in railroad interlocking signal service; and lastly in locomotive boiler service. Other tests were made by Prof. Woolson on eleven public bath houses in New York. The following typical results show the chemical analysis. The contracts called for wrought iron pipe galvanized, but plumbers do not make any close distinction between iron and steel pipe.

Analyses of Pipe, New York Bath Houses

Per cent manganese	Per cent carbon	Per cent oxide	Classified
0.48	0.09	0.20	Steel
0.32	0.08	0.26	"
0.42	0.08	0.21	"
0.38	0.08	0.30	"
0.50	0.08	0.38	"
Trace	Trace	2.85	Wrought iron
"	"	2.40	"
"	"	2.20	"
"	"	2.50	"
"	"	1.75	"

Bearing in mind that the two kinds of pipe were used indiscriminately and were all exposed to the same conditions, that all samples were tested to destruction, and that probably not more than ten per cent of the welded pipe on the market is wrought iron, it appears that steel gave good results.

Prof. Woolson says: "In my judgment, from the evidence collected, there was absolutely no difference in the corrosion of the two classes of pipe. They appeared to be equally susceptible to the attack."

A similar study was made by Dr. Walker to determine how these materials stood in service when both were used in the same system, separated only from each other by a coupling. The method was to examine a large number of steam and hot-water systems in different conditions, and to collect samples of wrought-iron and steel pipe. Others were obtained from live and exhaust steam lines to make the results of general interest.

The specimens, after service, were split lengthwise and cleaned, then the extent of corrosion was calculated by measuring with a micrometer the ten deepest pits occurring in a length of about 12 ins.

In all, sixty-four comparisons were made and the results may be summed up thus:

Comparative Corrosion of Wrought-iron and Steel Pipe

Instances where iron corroded more than steel	20
Instances where steel corroded more than iron	18
Instances where iron and steel corroded equally	9
Instances where corrosion was negligible	17

In the light of the facts brought out by this work, Dr. Walker concluded that on the average there is no difference in the corrosion of iron and steel pipe.

Immersion in sulphuric acid of a certain strength has been used as a means of determining the comparative resistance to corrosion of different samples of iron and steel, and Dr. Walker conducted some experiments to find out whether this test had any real value. He says: "Although the greatest care was taken to have the specimen the same size, cleaned in the same way, and in the same physical condition, the results show that no reliance can be placed in this accelerated acid test, but that it may be entirely erroneous and very misleading. Not only did the acid test not agree with the service test when steel was compared with iron, but the steels failed to agree among themselves, and the irons showed no agreement when considered by themselves." It may be added that these conclusions have been reached by other investigators, working independently.

Viewing impartially all of the data presented so far, there seems to be little to choose between wrought iron and steel pipe on the whole, as to resistance to corrosion. With steel the rusting takes place more uniformly over the surface. Wrought iron shows a tendency to form deep pits. Dr. Walker brought out the fact that the average depth of pitting for iron was 0.130 of an inch and 0.118 for steel. In samples from the H. C. Frick Coke Co., the average of the deepest pits was 0.112 of an inch and for steel 0.108. Both these sets of twenty-six pipes each were from hot-water boiler-feed lines. The differences are slight, but, if anything, are in favor of steel pipe.

Peat Powder for Locomotives in Sweden

Experiments in the use of peat powder on locomotives of the state railways of Sweden have been made. The statement issued by the Swedish government bureau declares that the powder can technically, as well as economically, take the place of anthracite as fuel for locomotives. The railway has decided to undertake the development of this class of fuel by two different methods for purposes of comparison. Two experts have been requested to give complete estimates of the cost of preparing a certain bog for the manufacture of peat powder, together with estimates of running expenses, by the respective methods. The bog selected is said to be that at Hasthagen, about 1½ miles from the station at Vislanda, with an area of about 500 acres.

Locomotives and Cars for the Lehigh Valley

The Lehigh Valley Railroad announces that it has just placed orders for 1,500 new automobile cars. The new cars will be 40 ft. long with 10-ft. double-staggered doors, which are generally regarded as of approved design for automobile equipment. The cars will have both steel underframes and steel ends. In order to facilitate delivery, the cars were ordered in three lots of 500 each from the Standard Steel Car Company. The Pullman Company and the American Car and Foundry Company.

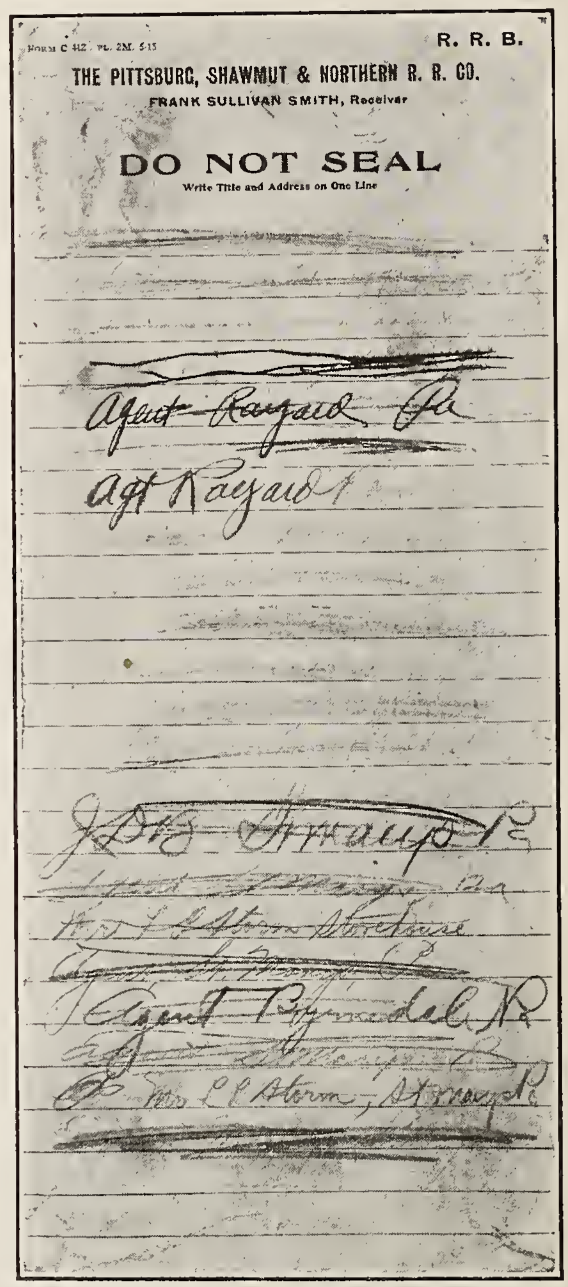
At the same time the Lehigh Valley Railroad announced that it had placed an order with the Baldwin Locomotive Works for ten more new Mikado freight locomotives, to be equipped with superheaters, Walchaerts valve gear, automatic stokers and other new features in locomotive appliances. This order of ten locomotives is in addition to the ten, ordered two months ago. Fifteen new switching engines have also been ordered from the same concern.

The Many-Times Used Envelope

Editor Railway Master Mechanic:

Sir:—Your article on page 7 of the January 1916 issue upon the subject of envelopes was read with considerable interest and the writer thought that your readers might be interested in the method of handling correspondence on the Pittsburgh, Shawmut & Northern Railroad when the letters are not of a personal nature. Enclosed you will find a sample of our "Circulating Envelope" that is supposed to make 48 trips in its life-time and this particular one has made 22 trips and is good for 26 more.

This envelope went to the agent at Hazelhurst, on its first trip, and in turn as follows: Auditor, St. Marys;



Much-Traveled Envelope on the P., S. & N.

Supt. Car Service, St. Marys; Agent, Knoxdale; Agent, Rayard; Agent, Knoxdale; Agent, Rayard; Agent, Knoxdale; Agent, Timblin; Weigh Master, Rayard; Agent, Timblin; Agent, Brookville; Supt., St. Mary's; Agent, St. Marys; Storekeeper, St. Marys; Agent, St. Marys; Agent, Byrnedale; Agent, St. Marys; Storekeeper, St. Marys, and wound up its career in my office.

We are having excellent service from this class of stationery and the envelope we use is usually in fair condition after it has made its 48 trips.

E. F. GIVIN, Mechanical Engineer,
Pittsburgh, Shawmut & Northern Railroad.

St. Marys, Pa.

Principles of Dynamo-Electric Machinery

By REGINALD GORDON

Induction, Magnetic Field, and Electro Motive Force Defined, and Simple Demonstrations Illustrated

In order to clearly understand the action of a dynamo or electric generator and its counterpart, an electric motor, the following experiments with simple apparatus will serve to make the matter plain. In the first illustration, Fig. 1, a coil of wire having an iron core is shown connected with an indicator or galvanometer. The latter is a coil of many turns of fine wire, at the centre of which is a magnetic needle, whose motions

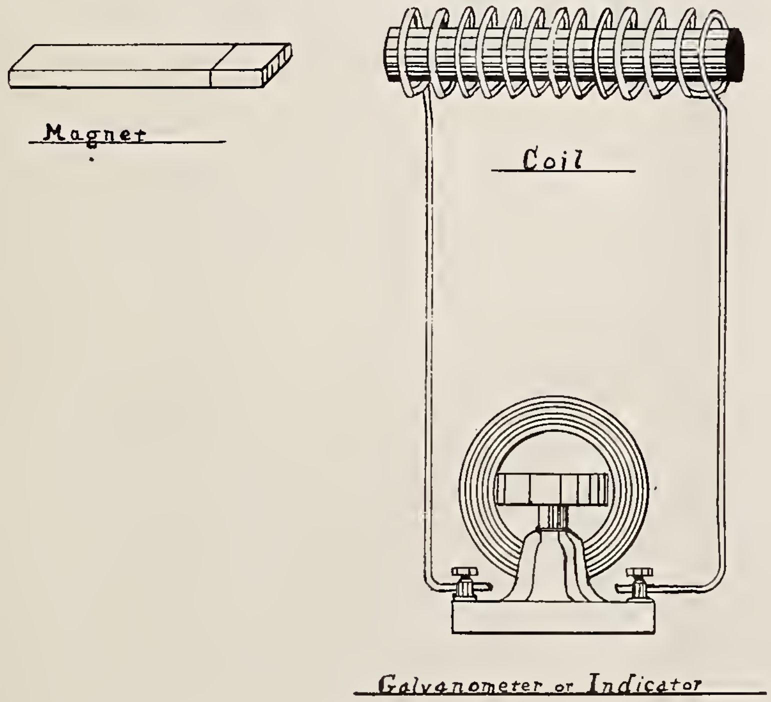


Fig. 1

show the direction and strength of the magnetic field produced by a current in the coil. There is no battery in this circuit, yet when the large magnet shown is brought near or moved away from the end of the coil,

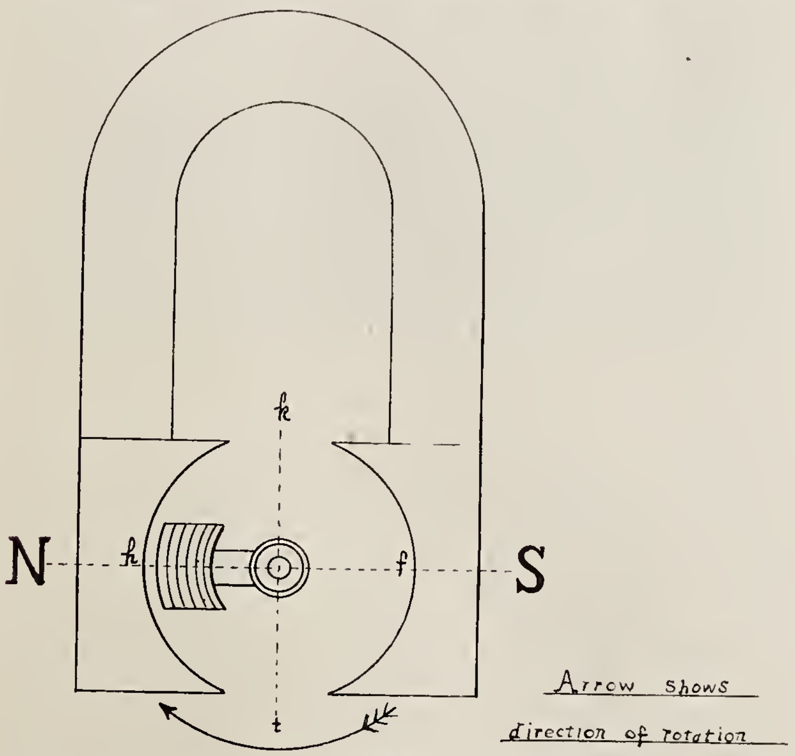


Fig. 2

the indicator shows the existence of an electric current through its windings. The indicator swings one way on the approach of the magnet, and in the opposite direction on its withdrawal. The same effect is produced whether the coil or the magnet is moved.

In the next diagram, Fig. 2, the same principle is shown by representing a coil of wire rotated in the field produced by the two poles of a magnet similar to those of the common type of magneto-generator.

Before going any farther, however, it is necessary to remind the reader that in speaking of energy, whether in large or small amounts, one must distinguish between quantity and pressure. The amount of power developed by a water wheel, for instance, is known definitely only when the number of gallons per minute and the height through which the water falls are known. So with electric energy, the quantity is expressed by the unit Ampere and the height or head or pressure or electromotive force is designated by the unit called the Volt. These are distinctly different ideas or concepts and unless clearly registered in mind may lead to confusion.

Referring again to the second diagram, the coil is shown in the magnetic field in front of the pole N. When the coil is rotated in the direction shown by the arrow, an electro-motive force (abbreviated e.m.f.) is at once set up in it, which decreases in intensity until it is zero when it reaches the position indicated by k, midway between the two poles. As soon as the coil passes the point k, this e.m.f. begins again and becomes stronger in the same sense, as the coil moves around until the latter reaches the point f, where it is a maximum and where it suddenly reverses, decreasing to zero as it moves from f to t and again increasing in the same sense in approaching the pole N at h. In other words, a conductor rotated through a bi-polar field such as that shown in Fig. 2, has a current of electricity generated in it that is reversed in direction twice during each revolution. This is usually shown by the conventional diagram of the third illustration, Fig. 3, where the height of the curve above or below the line N S repre-

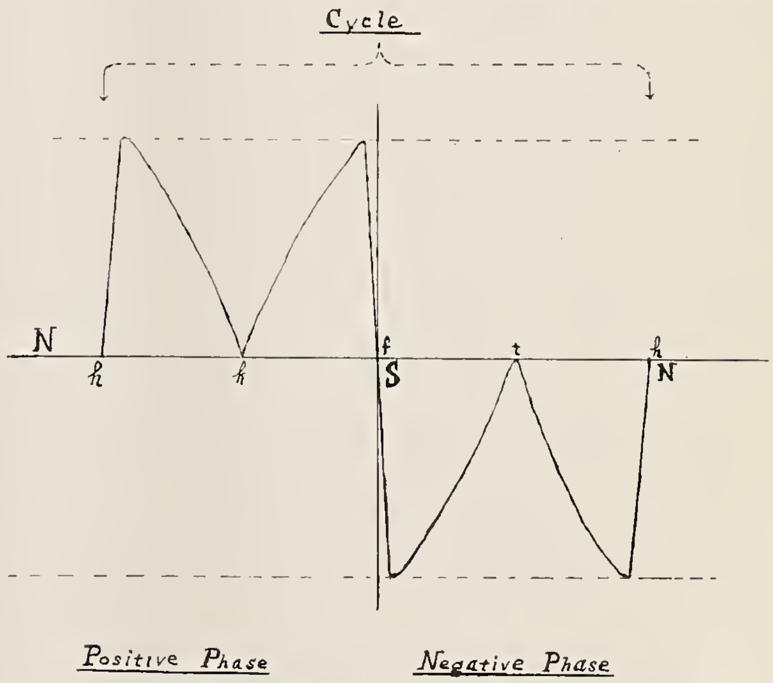


Fig. 3.—Curve Showing Intensity and Direction of Electro-Motive Force

sents the values of the voltage developed at any point during one rotation of the coil from t to t.

The points h and f of the curve indicate the two points of reversal of the e.m.f. in front of the two poles respectively. The point k indicates the zero value of the e.m.f. on passing beyond the influence of pole N and coming nearer the pole S, and the dropping of the curve below the line NS indicates a change in the direction or sense of the e.m.f., but shows its development in the same manner with reference to the poles as in the first half of the revolution. Incidentally, this curve will help to explain the distinction between alternating current and direct or continuous current, as the latter is sometimes called. In the last experiment the electric current is in the same sense in passing through one-half of a revolution of the coil and in the opposite sense in passing through the other half. The rotation of the coil in the magnetic field under these conditions gives rise then to a pulsating or alternating current and the sequence of events during one-half of a complete revolution, and shown by the curve above and below the

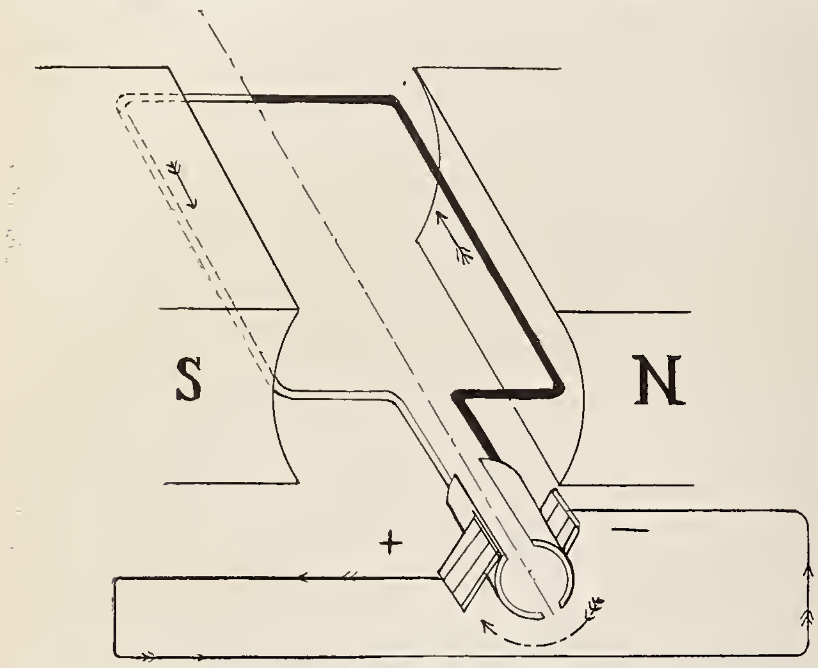


Fig. 4.—Commutator Attached to Rotating Conductor, Generating Direct Current

line NS from h to h constitutes what is called one complete "cycle." Each half of this cycle is called a "phase." The electric current generated in the coil during the first half of the revolution is in one phase and pulsating. The next illustration, Fig. 4, shows a single conductor, for the sake of clearness, in a magnetic field arranged to avoid the reversal of the e.m.f. just described. The commutator shown allows the current generated in one part of the conductor when passing the reversing point in front of a pole, to be disconnected from the terminal or brush to which electricity had been passing. A moment later the same part of the conductor is connected to the other brush, thus sending current in the opposite sense into the external circuit. This arrangement furnishes a pulsating current, but direct in the sense of not suffering reversal. Generators are built with a large number of conducting coils on the armature or rotor so as to give as many impulses as possible for each revolution. In all that has been said, the field has been produced by a permanent magnet, constituting a magneto-electric generator. A dynamo-electric generator is so constructed that the current developed in the armature is wholly or in part utilized to create the magnetic field.

Locomotives at the Centennial

By ARTHUR CURRAN

Early Appearance of the Walschaerts Gear
Automatic Locomotive Bell in Canada

The elaborate exposition held at San Francisco during 1915 recalls the famous one of 1876, called the Centennial; and this affords an excellent occasion for comment on the latter. There have been other exhibitions since then at which locomotives constituted some of the chief attractions, notably the Chicago, World's Fair in 1893; but the Centennial appears to have made a lasting impression on those who visited Philadelphia at the time, and to have now made possible some interesting contrasts between the exhibits and other motive power tendencies of the same general epoch.

One of the most interesting exhibits was a little "bogie" built by William Mason of Taunton, Mass. It was his 554th engine and was completed November 29, 1875. Its cylinders were 12 x 16 ins., and its drivers were 33 ins. in diameter, its total weight being 72,000 lbs. What really attracted attention to this engine, however, was the fact that it had the Walschaerts valve gear, then practically unknown in this country. The gear aroused some interest, but did not seem of any value to those who inspected it. The gear was ridiculed by some and looked upon with good-natured indifference by others, who also volunteered the opinion that the engine's flexible steam connections would leak and make no end of trouble.

The Walschaerts gear has certain well-known and very obvious advantages, in the case of large engines, notably as regards accessibility for inspection and repair, which, however, it fully shares with all the forms of outside gear now used. But the big engine, as we know it today, was a possibility too remote in 1876 to merit consideration.

Mr. Mason appears to have adopted the Walschaerts gear for his "bogies," many of which had their drivers grouped very closely together, as a result of which it was difficult to inspect anything between the frames. Inasmuch, however, as the eight-wheeler was then the favorite type and its links and eccentrics could easily be seen and reached, there was no demand for an outside gear. Even the "bogies" were not, in all cases, equipped with Walschaerts gear, although it was included in Mr. Mason's "recommended practice" for that type.

The "bogie" described here is shown in Fig. 1. It was originally built for the Illinois Midland Railway,

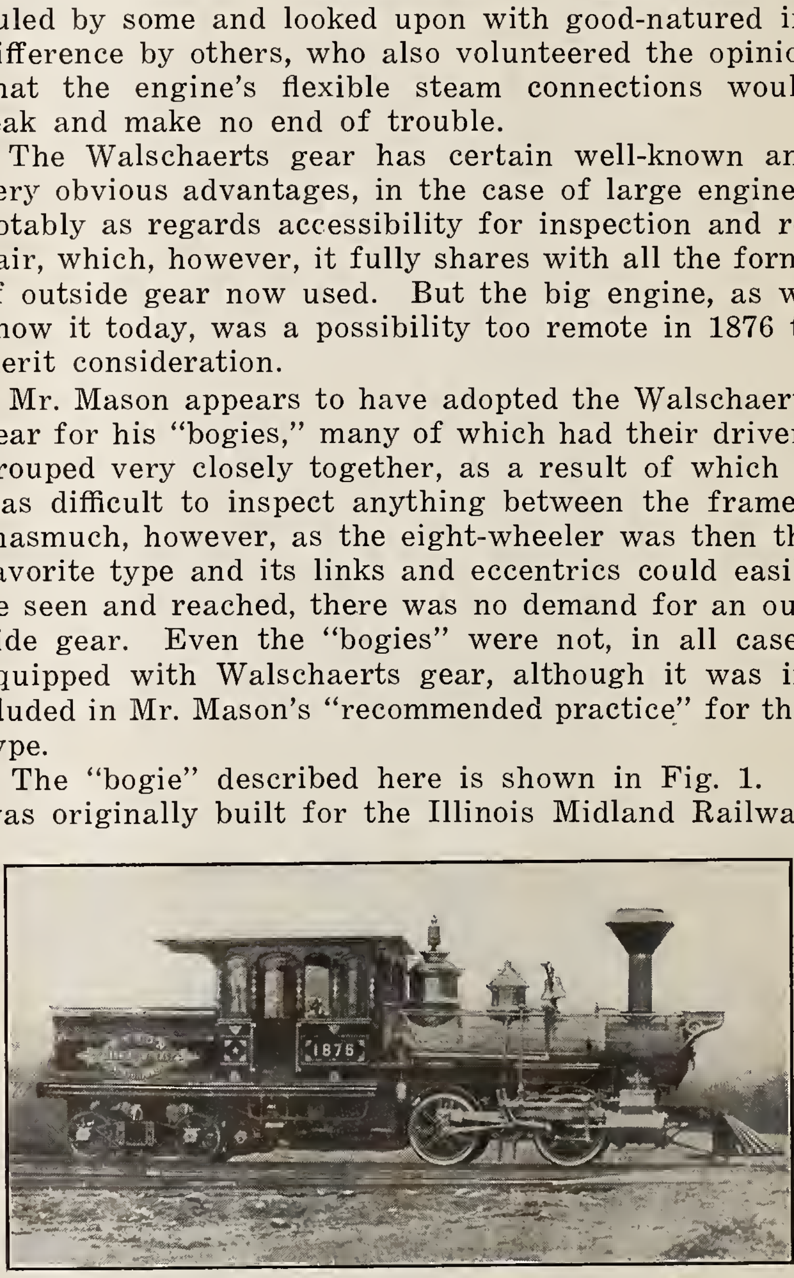


Fig. 1.—Mason Engine at the Centennial, 1876

but delivered to the New York and Manhattan Beach road. Aside from the particulars already given, it should be stated that this engine was very beautifully finished. The scheme of decoration included stars as in harmony with the patriotic nature of the exhibition.

A very neat eight-wheel passenger engine, shown in Fig. 2, was exhibited by the Rhode Island Locomotive Works of Providence, R. I. There was nothing unusual about this engine; in fact, although nicely decorated, its finish was less elaborate than that of many other engines in regular service. To be sure, some roads carried the matter of decoration to an extreme, their engines being literally covered with gold striping and scroll-work. However, it was the style in those days, and any exception to the rule was conspicuous. Even so, this Rhode Island engine presented a very handsome appearance, and included such regulation features as short front, diamond stack and carefully polished machinery. Exact dimensions are not now available, and, although there were a number of other interesting exhibits, the passing of nearly forty years has made photographs and data relating to them difficult to get, as much has been lost or scattered. In any case, they are not obtainable at the present writing.

However, a very interesting engine, of the same general period, is shown in Fig. 3. It is included here as an example of Canadian practice, which, at the time, reflected English influence. This engine was built by the Rhode Island Locomotive Works for the Great Western Railway of Canada, which subsequently became part of the Grand Trunk. An examination of the photograph will reveal the fact that it had English safety valves, which were carried up to the level of the cab roof, so that the steam blown off would not obscure the view of the engineman through the front windows. The tank, though mounted on two four-wheel trucks, was of pronounced English style and fitted with railings above the collar after the manner of British railways. The gangway steps were also English. Perhaps the most curious feature of the engine was the location of the bell, which was on the pilot beam.

It appears that the Canadian laws relating to the necessity of warning persons off the track were very rigorous at the time. In order to keep out of trouble, the Great Western tried the scheme of putting the bell on the pilot beam and operating it by a cam on the leading truck axle, which at each revolution of the wheel struck a rod and knocked it forward. The rod was held in guides and the end of the rod was the knocker of the bell. A coil spring on the rod carried it back from the bell after each blow. This device insured the constant

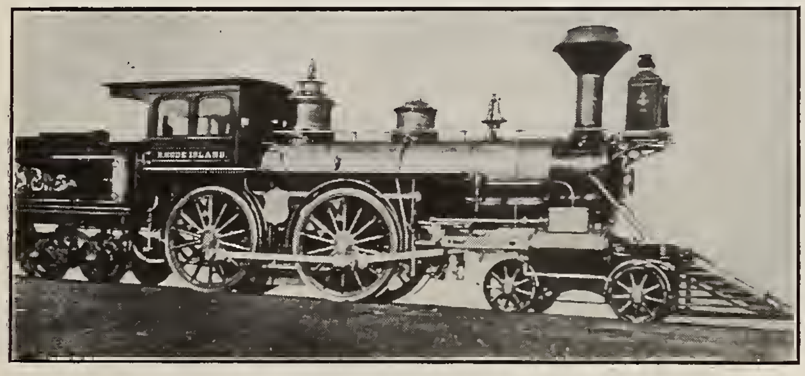


Fig. 2.—Old Rhode Island Engine

and automatic ringing of the bell while the engine was in motion.

From this it also appears that then, as now, the railroads were confronted by a problem created by careless or thoughtless people. How acute this problem has become within recent years, especially in the United States, is known to most railroad officials. Neither a bell nor a whistle will positively prevent an accident. There are, no doubt, many fraudulent cases, and there are people who will state that they did not hear the bell, but the object of the Canadian device on the G. W. R. engines was to enable the railway to establish the fact in court that the bell had been rung, even though the warning had been unheeded.

Other interesting features of the engine shown in Fig. 3 were the large balloon, or hay stack, and it was probably the resemblance to the form in which straw is preserved which introduced the word "stack." The whistle which was perched at the very apex of the dome casing. Altogether, this locomotive is one of the most interesting examples of old-time designing that the writer knows of, and it is of special value on account of the scarcity of photographs of motive power used on Canadian roads long ago. This type often had a hand rail along the running boards and across the pilot beam.

Canadian practice differed from American practice just enough to make comparisons instructive and entertaining to students of locomotive design. Railroad practice in the United States and in Canada is much alike. In fact one may say both are now identical, but the slight differences of days was not only due to individual choice of design, but the influence of the old country, present in both cases, was perhaps a little more strongly marked on the Canadian roads. It is on this account that the writer invites attention to the various features

Fig. 3.—Great Western of Canada with Automatic Bell

of the old Great Western engine, and expresses the hope that an examination of them will be of value to those hitherto unfamiliar with the facts disclosed, and he also hopes it will be a source of pleasure to those who remember them. This, after all, is one of the reasons why the old-time engine should receive recognition, as it incidentally supplies a stimulus to the interest taken by many in the railroading of a past day. It also opens the way for the present day student and young railroad man to see and know what has gone before.

The Result of War in Mexico

On the National Railways of Mexico there were 729 locomotives in service before the troubles began in 1910. Today there are but 19 of them fit to run. Out of more than 18,000 freight cars in use up to the time the revolutions commenced, there are now only 3,400 which are serviceable. As to passenger cars, they have all practically disappeared. The few that are in evidence will have to be completely overhauled. The railway tracks and bridges have almost been demolished. Two-thirds of all the crossties must be renewed, something more than half the rails are worn out and all the bridges throughout the country will have to be rebuilt. Telegraph equipment, as well as buildings of all kinds, seem to have been completely destroyed. Repair shops and other important structures have been burned and all machinery has met complete destruction.

The country's industries which depend largely upon the railways are at a standstill, as a matter of course, and it will take years to remove wreckage and restore affairs generally to their usual condition. It would appear from this showing of destruction that a vast quantity of steel and other materials will be in demand and that the United States will come in for a large share of orders to cover the needed replacements.

In these days, war's doings appear to outclass the results which have heretofore seemed more than awful. There will have to be some more forceful expression invented to put war properly before thinking people than the simple definition, only, that it is "Hell."

Practical Suggestions from Railway Shop Men

Appliances on the St. Louis & San Francisco

By JOHN F. LONG, Springfield, Mo.

I was very much interested in your department of practical suggestions from railway shop men, in your December issue of the RAILWAY MASTER MECHANIC. I submit the following, if you care to use them in your issue.

View No. 1 is a corner in the power plant at North Shop at Springfield, on the St. Louis & San Francisco

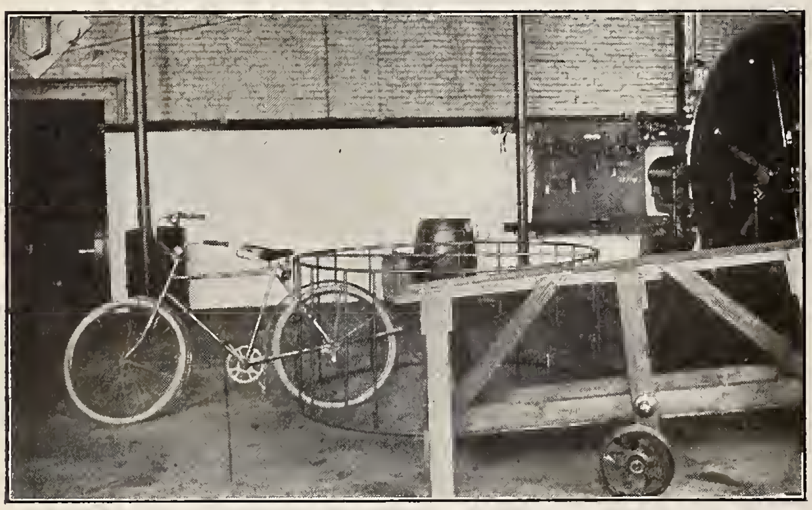


Fig. 1.—Corner of North Springfield Shop

Railroad. It shows a bicycle rack, where all bicycles that are used by the employes of the shop are stored, instead of the bicycles being scattered around the shop, and instead of being in the way of everyone, they are all put in one place, out of the way of the shop force. This view shows, also, a handy portable pipe bench, in position to be moved to any point that a workman may care to move it. When in actual use the wheel is folded down and the bench sets firm on the floor.

View No. 2 shows the wheel shop at this point on the

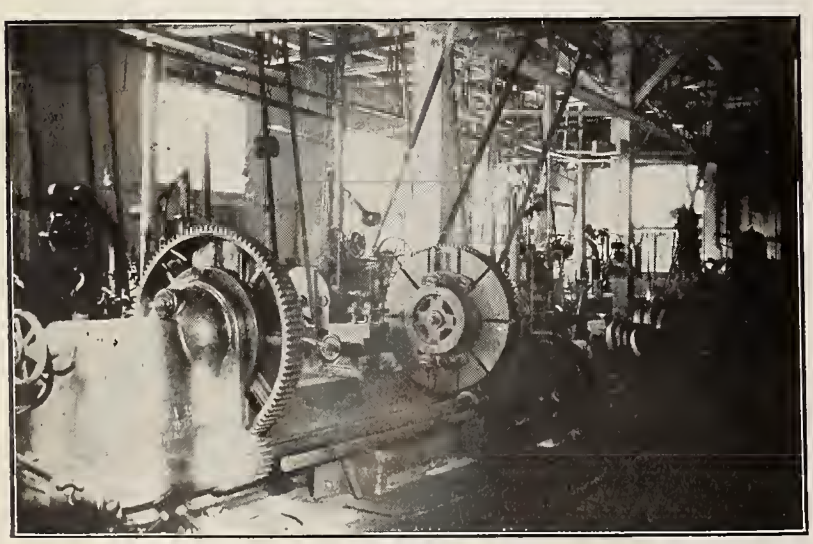


Fig. 2. View of Wheel Shop

St. L. & S. F. View No. 3 shows the wheel yard. View No. 4 shows the car material arrangement in the car yards. View No. 5 shows a metallic rack for the brass in the brass lathe department, the air department in the background.

Fig. 3.—View of Wheel Yard

I also note in this same issue a brake on a boring mill. As soon as I get an opportunity, will take a picture of one I made at this shop, and I believe that mine is a good one.

Foundry operations that influence the properties of physical test specimens of bronze have been investigated by the United States Bureau of Standards. One of the most generally used alloys in government bronze is composed of copper 88 per cent, tin 10 per cent, and zinc 2 per cent. The effects of temperatures of casting, the methods of gating and moulding, the kind of sand and heat treatment on the mechanical properties of the bronze have been studied.

Fig. 4.—Arrangement of Bins for Car Material

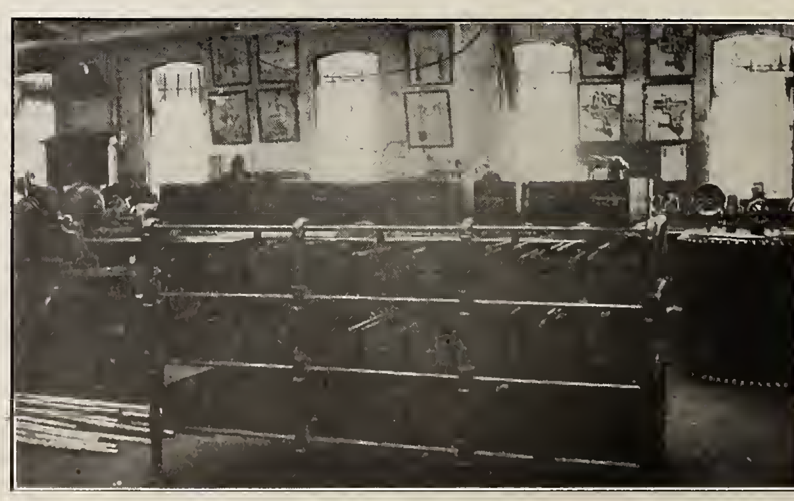


Fig. 5.—Metallic Rack for Brass

Chief Interchange Car Inspectors' and Car Foremen's Assn.

Proceedings of the Special Open Meeting of the Executive Committee, Hotel La Salle, Chicago, Ill., February 21, 1916

Meeting called to order at 9:45 a. m., Chairman F. H. Hanson of the executive committee presiding. The following officers, members and visitors registered:

OFFICERS

President	A. Kipp	G. C. I.	N. Y. O. & W.
Vice-Pres.	W. J. Stoll	C. C. I.	Toledo, Ohio.
Sec'y-Treas.	M. R. McMunn	G. C. I.	N. Y. C. R. R.

EXECUTIVE COMMITTEE

Chairman	F. H. Hanson	A. M. C. B.	N. Y. C. R. R.
	Wm. Hanson	C. I. I.	Denver, Colo.
	M. W. Halbert	C. I. I.	E. St. Louis, Ill.
	Z. B. Wilson	G. F. C. D.	Southern Ry.
	A. Armstrong	C. I. I.	Atlanta, Ga.
	C. J. Stroke	A. G. F.	N. Y. C. R. R.
	J. P. Carney	G. C. I.	M. C. R. R.

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Name	Title	Representing	Location
Gust. Bahr	Foreman	C. B. & Q. R. R.	Chicago, Ill.
W. E. Benham	Car Acct.	C. M. & St. P. Ry.	Chicago, Ill.
W. H. Bettcher	M. C. B.	C. I. & W. R. R.	Indianap'l's, Ind.
G. W. Bill	D. C. I.	Union Tank Line Co.	Whiting, Ind.
H. Boutet	C. I. I.	All lines	Cincinnati, O.
Chas. Bossert	A. C. I. I.	Chi. Car Inter.Bur.	Chicago, Ill.
Geo. Briden	Car Fore.	C. I. & L. R. R.	Hammond, Ind.
Chas. Broo	....	....	....
Chas. Burlingame	Supt.	Wiggins Ferry Co.	St. Louis, Mo.
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C. H. Carey	G. C. I.	E. J. & E. R. R.	Chicago, Ill.
S. W. Caton	G. C. I.	W. M. R. R.	Hagestown, Md.
M. F. Covert	A. M. C. B.	Swift Car Lines	Chicago, Ill.
W. H. Cressey	G. F.	S. Omaha Jt. I. Ass.	So. Omaha, Neb.
D. P. Crillman	G. C. F.	M. C. R. R.	N. Toledo, O.
Wm. Cunningham	C. I. I.	Det. Inter. Assn.	Detroit, Mich.
Joel DeVault	G. F.	T. St. L. & W.	Toledo, O.
John Dixey	M. C. B.	Dairy Shippers' Des.	Chicago, Ill.
C. R. Dobson	G. F. C. D.	C. R. I. & P. Ry.	Cedar R'p'ds, Ia.
J. T. Downs	G. F.	M. C. R. R.	Bay City, Mich.
Joseph Dyer	C. J. I.	Erie & P. & L. E.	Youngstown, O.
H. L. Ebert	M. C. B.	Union Tank Line Co.	So. Chicago, Ill.
W. B. Elliott	F. C. D.	Term. R. R. Assn.	St. Louis, Mo.
J. F. Ewell	G. C. F.	Barrett Mfg. Co.	Chicago, Ill.
F. A. Eyman	Chf. Clerk	E. J. & E. R. R.	Joliet, Ill.
Jos. Forche	G. C. F.	L. E. & W. R. R.	Lima, O.
John Funk	G. C. F.	Soo Line	Kolze, Ill.
J. J. Gainey	G. F. C. D.	C. N. O. & T. P. Ry.	Ludlow, Ky.
W. M. Govert	T. C. I.	E. J. & E. R. R.	Schererville, Ind.
E. H. Hall	G. C. I.	C. G. W. R. R.	Oelwein, Ia.
Harvey Halvoern	M. C. B.	Soo Line	Fond d'Lac, Wis.
Sam Hanson	G. C. F.	P. & P. U. Ry.	Peoria, Ill.
H. H. Harvey	G. C. F.	C. B. & Q. R. R.	Chicago, Ill.
E. H. Harmon	Sec'y.	Am.Assn.R.R.Supts.	St. Louis, Mo.
R. R. Hawk	Sec'y.	Cold Blast Trans.Co.	Chicago, Ill.
A. Herbster	D. G. F.	N. Y. C. R. R.	Englewood, Ill.
O. P. Hiltabiddle	A. G. F.	Wabash R. R.	Chicago, Ill.
Wm. Hogarth	M. C. B.	Cudahy Refg. Line	E. Chicago, Ind.
E. Husband	G. C. F.	Ill. Cent. R. R.	Chicago, Ill.
E. E. Jett	M. C. B.	Morris & Co.	Chicago, Ill.
Adolph Johnson	C. F. A.	S. D.	Chicago, Ill.
J. C. Keene	T. C. I.	Wabash R. R.	Decatur, Ill.
P. F. Kennedy	F. C. I.	A. T. & S. F. Ry.	Kansas City, Mo.
Newman Kline	Supt.	Nor. Pac. Ry.	M'n'p'lis, Minn.
L. J. Koeppen	M. C. B.	C. & I. W. R. R.	Chicago, Ill.
Henry Krush	C. F.	Soo Line	Manitowoc, Wis.
W. K. Lauis	Fore.	C. B. & Q. R. R.	Chicago, Ill.
C. H. Lembke	D. F. C. D.	Mo. Pac. R. R.	Kansas City, Mo.
J. W. Luke	T. C. I.	A. T. & S. F. R. R.	Topeka, Kan.
K. H. Martin	G. E. I.	Southern Ry.	Wash'gt'n, D. C.
J. P. McNally	....	O. F. Jordan Co.	Chicago, Ill.
J. R. Mitchell	....	W. H. Miner	Chicago, Ill.
J. S. Naery	M. C. B.	C. I. & L. Ry.	Lafayette, Ind.
H. E. Nelson	CC-GCF	C. & E. I. R. R.	Yd. Center, Ill.
R. H. Niehaus	F. C. D.	Wabash R. R.	St. Louis, Mo.
J. J. O'Brien	S. C. D.	Term. R. R. Assn.	St. Louis, Mo.
T. J. O'Donnell	Arb.	Niag.Front.C.I.Assn.	Buffalo, N. Y.
C. E. Oliver	G. C. F.	A. T. & S. F. Ry.	Chicago, Ill.
C. W. Osley	....	The Texas Company	Chicago, Ill.
J. W. Peebles	C. I. I.	Un. Pac. R. R.	Kansas C'y, Mo.
Edw. Pendleton	C. I. I.	All lines	Peoria, Ill.
A. K. Plummer	G. C. F.	C. B. & Q. R. R.	Chicago, Ill.
G. C. Pool	....	The Q. & C. Co.	Chicago, Ill.
H. G. Powell	....	Cudahy Refg. Line	E. Chicago. Ind.
E. R. Prindle	Fore. Shg.	Barrett Mfg. Co.	Chicago, Ill.
J. G. Rauen	C. C. I.	C. & E. I. R. R.	Yd. Center, Ill.
Jas. Reed	A. M. C. B.	N. Y. C. R. R.	Englewood, Ill.
L. H. Retan	MCB Clk.	Ann Arbor R. R.	Owosso, Mich.
C. E. Rickey	Supt. Term.	Q. & C. Route	....
W. J. Rourke	Car Fore.	M. C. R. R.	Jackson, Mich.
F. S. Ryan	....	Crystal Car Line	Chicago, Ill.
E. Sande	Car Fore.	C. & N. W. R. R.	Manitowoc, Wis.
F. C. Schultz	C. I. I.	Chi. Car Inter. Bur.	Chicago, Ill.
A. E. Schultz	A. I. I.	Chi. Car Inter. Bur.	Chicago, Ill.
C. Setzekorn	Mech. Supt.	A. R. T. Co.	St. Louis, Mo.
J. A. Shepard	Supt. Term.	Missouri Pac. Ry.	Kansas C'y, Mo.
C. S. Shearman	M. C. B.	Chi. Jct. Ry.	Chicago, Ill.
H. A. Simms	Supt.	Wells Fargo Co.	Chicago, Ill.
A. J. Thrall	....	Atlas Car Co.	Chicago, Ill.
J. E. Vittrum	C. J. I.	All lines	Columbus, O.
B. M. Waldo	C. I. I.	Dallas Car Inter.Br.	Dallas, Tex.
W. G. Wallace	....	Amer. Steel Fdrs.	Chicago, Ill.
C. A. Watler	M. C. B. Clk.	C. I. & W. R. R.	Indianap'l's, Ind.
W. T. Westall	G. F. F. R.	N. Y. C. R. R.	Collinwood, O.
E. H. Wood	G. C. F.	M. C. R. R.	Chicago, Ill.
L. S. Wright	....	Natl. Mall. Cstgs.Co.	Chicago, Ill.
C. J. Wymer	G. C. F.	Belt Ry. of Chicago	Chicago, Ill.
A. Ziebold	G. C. I.	Hocking Valley R.R.	Columbus, O.

There were about ten members who arrvied after the registration who are not included in the above.

A number of invitations which had been received from the various cities would be read, and there were also a few representatives of different cities present who would also be given an opportunity to set forth the advantages to be gained in having the convention held at their city.

It was thought advisable to dispose of the matter of the convention city first, and the secretary read letters from the following:

Manager Convention Bureau, City of Columbus, O. (accompanied by booklet describing the various features of the city); secretary Colorado Springs Chamber of Commerce, Detroit Convention and Tourist Bureau, governor of the State of Indiana (for Indianapolis), mayor city of Buffalo, Chamber of Commerce of Buffalo, manager Convention Bureau, Merchants' Association, City of New York; governor State of Georgia (for Atlanta); Chamber of Commerce, City of Atlanta; Georgia Hotel Men's Association, City of Atlanta; Business Men's Club of Memphis, Chamber of Commerce, City of Cleveland; Cedar Point Resort Co., Cedar Point, Ohio; Charleston, West Virginia, Isle of Palms; Convention Bureau, Chamber of Commerce, San Francisco.

Mr. Hanson advised, for the benefit of those present, that so far as the date was concerned, that could be changed by the executive committee to meet the conditions at the individual city that was finally decided upon.

Indianapolis was selected for the meeting and the dates chosen were October 3, 4 and 5, 1916.

Several members of the American Association of R. R. Supts. were present. Mr. C. E. Rickey, the second vice-president, stated, when called on, that the association was known to his organization as one that was accomplishing very meritorious progress in promoting a more thorough understanding of the rules and methods of handling repairs and interchange, and they were very pleased to have had the opportunity of being able to be present for at least the forenoon session, and if time permitted would again drop in on the meeting later on during the afternoon session providing their meeting adjourned early enough.

Mr. Schultz spoke at length on the meeting recently held by the several chief interchange inspectors at Cincinnati, at which time it developed that something should be done with a view of adopting uniform methods of handling interchange and enforcing the rules at the large terminals throughout the country. For instance, along one of the large trunk lines he knew of, which was all under one management, extending past five or six large terminals, the work at each point was handled differently, although in the main the conditions were similar, and which, of course, resulted in a great deal of confusion, as before any definite action could be taken by the road it was necessary to first go into the different instructions which were in force at each point. There should be no reason for this, and it would not exist if everyone would get together, and decide on a uniform manner that would properly take care of each individual point, and, as well, the various points as a whole.

After considerable discussion by the various chief interchange inspectors, as well as the members, it was decided by the chairman that this was rather a matter to be looked into by the interchange inspectors, and possibly could be taken care of, or some solution of the question offered, by placing the matter in the hands of a committee for investigation and recommendation. It was cited that it was the intent in the meeting of the executive committee, which would take place on the morrow, to appoint a committee to handle work along such lines, and after the committee was formally appointed it would be asked to make this one of their main themes; in other words they should prepare or secure a paper, or papers, on the matter for presentation and discussion at the convention.

Chairman Hanson then called for the taking up of the principal subject of the meeting, namely, the discussion and recommendations for changes in the rules, stating that, as per the arrangement previously mentioned, the secretary would first read the rule as it was at present and it would then be in order to present recommendations, if any, which, after discussion would be voted on by the executive committee, in accordance with the by-laws of the association, and if the motion carried the change would be embodied in the association's recommendations to the M. C. B. Association.

The secretary then read a letter from Mr. F. W. Trapnell, chief interchange inspector of the Kansas City Car Interchange Bureau, under date of the 19th of February.

The secretary was instructed to handle Mr. Trapnell's recommendation by placing them before the association in their proper order, and on their being seconded by a member would be open for discussion and vote the same as the recommendations made verbally by the members present.

Changes in Rules Recommended

The following changes in rules were recommended to the Master Car Builders' Association:

Rule 2, Paragraph 2: Be changed to read as follows:

"Empty cars offered in interchange must be accepted in safe and serviceable condition, the receiving line to be the judge. Owners must accept their own cars, also foreign cars, routing home via their line when offered at any point on their line, and dispose of them in accordance with M. C. B. Rules."

Reason: To make it obligatory for railroads to accept foreign cars routing home via their line the same as their own cars and to keep the cars moving in their proper direction of travel instead of shifting back and forth between the lines and the current of traffic as they are at present being handled, causing endless confusion and controversy.

Rule 3, Paragraph E: Be changed to read as follows:

"Tank cars equipped with safety valves will be accepted in interchange if stenciled on the body of tank to show that safety valves have been tested, adjusted, etc., within the time limit as required by paragraphs 6 and 7 of the M. C. B. specifications for tank cars."

Reason: To eliminate the danger incident to car inspectors getting on top of tank cars with lights of various kinds to ascertain whether or not valves are stamped, which is a violation of the rules of the Bureau of Explosives.

A great deal of discussion arose through a misunderstanding that the safety valve testing and stamping should be protected by the M. C. B. rules in requiring an interchange inspection of the valve to see if stamped. This feature was now covered by the tank car specifications and it was obligatory for the owner to make such test and stencil the body of car to indicate that such test had been made, as well as placing this information on the safety valve itself. It was clearly brought out that by waiving the inspection of the safety valve itself on the part of the inspector and letting him be governed solely by the stencilling on the tank, the matter would be fully protected so far as this feature was concerned in interchange; in other words, it was obligatory on the owner to test the safety valve and stamp thereon the information relative to such test, and at the same time, in addition, stencil the same information on the body of the tank—indicating at what pressure, when, where and by whom the safety valve had been tested, and the inspector could accept car in interchange solely on the tank stencilling.

Rule 3, Paragraph G: Be changed to read as follows:

"After July 1, 1917, cars will not be accepted in interchange unless stenciled showing the year and month originally built. Cars built prior to 1895 may be stencilled 'Built prior to 1895.'"

Reason.—As this is in connection with the safety appliance work and the limit for the compliance with the safety appliance act has been extended to July 1, 1917, by the Interstate Commerce Commission, this rule as well should have the time limit extended accordingly.

Rule 8: The words "or typewritten" be added to rule.

Reason.—As the rule at present reads it leaves it optional with the roads as to whether they will accept typewritten repair cards, which should be made obligatory from the fact that in a large number of cases the individual characteristics in handwriting make the cards very hard to decipher, and, as well, in the typewritten cards it would overcome the tendency of errors in car numbers, initials, etc.

Rule 41: Be changed to read as follows:

"Damaged longitudinal sills, if necessitating replacement or splicing of more than three sills."

Rule 42: Be eliminated, thus placing responsibility for ends broken out on car owner.

Reason.—On a majority of the old cars still in service where this damage occurs it is largely due to decayed tenons and original weak construction of the end, and the handling lines should not be forced to assume the burden of expense on account of the fault lying with the construction or decayed condition of the car. Most of the roads had equipped their cars with steel or reinforced ends and it was not fair, after they had gone to the great expense of placing their cars in condition to meet the present service conditions to also force them to assume the expense of replacing ends on foreign cars which could not withstand ordinary service conditions.

Rule 59: A paragraph be added to this rule to permit the removal of air hose from foreign cars after three years' service.

Reason.—Under the rule as at present the hose are left on until they burst and cause trouble. Recent investigation of accidents caused by burst air hose, as well as hose removed in regular service, developed that the majority of the hose were over three years of age; that is, betwen the period three years and three months, which hose in prior inspection had revealed no indication of being in other than O. K. condition.

Rule 99: Addition to be made to this rule as follows: "When axle is removed by owner account of cut journal on authority of defect card and the journal has additional defects condemnable under rule 85, no material charge shall be made for the axle applied."

Reason.—It has been proven by experience that the lengthening of journal and other wear to same has been the primary cause of the journal heating and cutting, which, under ordinary conditions, could not be detected before the failure and it is felt that owner may take unfair advantage by charging a scrap axle to the delivering line, and, from the general tend of the various M. C. B. Rules to protect the delivering line from paying for a betterment, the recommendation is felt to be fair and just to all concerned.

Rule 103: The following paragraph be added: "Sheet metal parts removed from superstructure of steel cars shall be credited at one-half the weight of material applied."

Reason.—Account of the rapid deterioration of such parts they only weigh half as much as the new material applied.

The chief interchange inspector at Cincinnati called attention to the different instructions issued at various points concerning interchange rules which were not uniform, this having been brought out in the recent meeting of several of the chief joint inspectors at Cincinnati. The methods followed, while they accomplished the same results, were widely different in nature and should be straightened out so that rather than having such a number of special arrangements at the various interchange inspection points, it should be handled uniformly. As an instance he cited the various interpretations of the loading rules—at some points no exceptions were taken to cars unless the doors showed signs of distress; at others, exceptions were taken if it could be ascertained in some manner that the doorways were not protected regardless of whether or not the door was actually in distress at the time. This permitted a car to be received at one point with no door protection and no exceptions taken account of the door not being in distress at such time, but after the car had moved over the road and received a few shocks the lading shifted against the door and placed it in distress, and on receipt by another handling line that road was "stung" for the cost of adjusting lading and applying the necessary door protection. If uniform instructions had existed at all points where this car was handled, namely, a strict interpretation of the loading rules, rather than special arrangements, this would not occur, as they could go back at the initial road.

It was stated that this condition could be overcome if the initial roads were made responsible for the transfer or adjustment of lading due to the doors being bulged on account of lack of door protection.

One of the members called attention to the fact that one of the American Railway Association officials was present and he understood that that body had the question under consideration at the present time and might possibly have something to offer on the subject.

The chairman called on Mr. DeGroot, who addressed the meeting, stating that the work of the Chief Interchange Inspectors' and Car Foremen's Association was becoming recognized in many circles due to the excellent work it had, and was, doing, particularly at the larger interchange points, and he was very glad to be able to be present at the meeting. As to the question under discussion, he could only say that his association and several other organizations now had this same question under consideration but nothing definite had been determined.

An executive session of the executive committee was held February 22, which will be reported in the April issue of the Railway Master Mechanic.

Effect of Vibration of Structures

Recognizing that practically every one is certain that higher speed, better work, and greater human efficiency are possible in a stable as compared with a vibrating building, but that exact data proving this fact are difficult to obtain, the Aberthaw Construction Co. of Boston, Mass., is undertaking an exhaustive investigation in the effort to bring together conclusive evidence. They will greatly appreciate any suggestions or reports of experience that our readers may be able to send to them. These may have to do with any aspect of the case that will assist in the collection of facts or the reaching of conclusions.

Power Plant Costs

To-day power is manufactured, sold and bought just like any other marketed commodity. The cost of production depends on several factors, viz.: cost of fuel, cost of generators, labor cost, amount produced, and this cost is the chief criterion on which the market price depends. Of interest to the power consumer is what his power costs him, what it should cost, and where and why any loss may have occurred.

At a recent meeting of the American Society of Mechanical Engineers, in the Engineering Societies Building, Mr. Walter N. Polakov, superintendent of power of the New York, New Haven and Hartford Railroad, discussed the question of standardization and predetermination of the cost of power. He gave information concerning a simple method by which the owner of a power plant of any kind can, without the necessity of study of technical details, determine just how close the cost of his own plant is to the possible minimum cost of such a plant. In other words, how much more he is paying for power than he should pay, if such is the case.

Mr. Polakov has spent several years in cost standardization work. At one time he was expert consulting engineer to the Board of Estimate and Apportionment of the City of New York. He has been in charge of reorganization work and introduction of scientific management in several large industrial plants in this country. His paper is of value to railroad officials on whose lines electric power is used for machine drive in shops, or for the propulsion of trains.

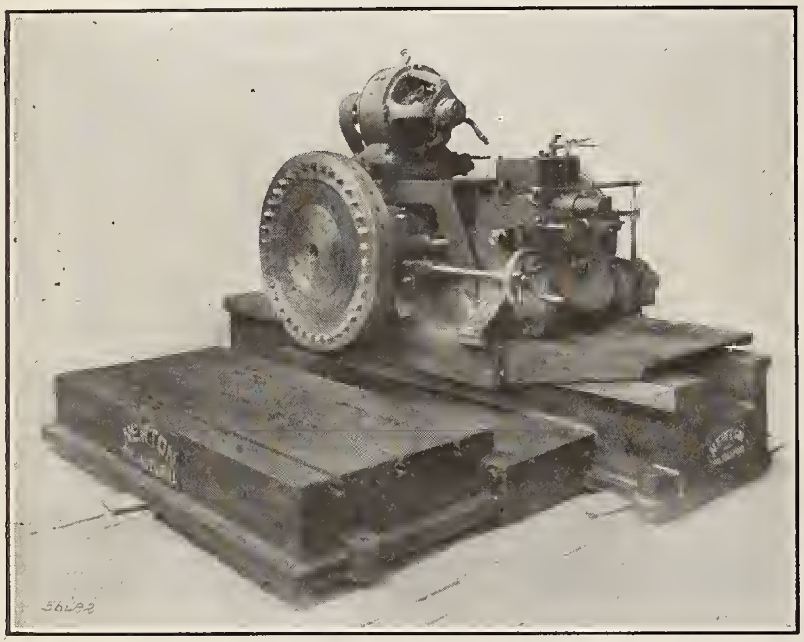
Training Italian Apprentices

The Director-General of the Italian State Railways has furnished United States Consul William F. Kelley, at Rome, with some interesting information as to how railway apprentices are trained in that country. Upon entering the service the young men are given a theoretical course by engineers and receive special training in the machine shops. After six to nine months, the apprentices, having previously had elementary state schooling, must submit to an examination before being accepted as locomotive firemen. The firemen's examination requires some knowledge of the air brake and its working.

New Methods and Appliances

36-in. Head Rotary Planing Machine

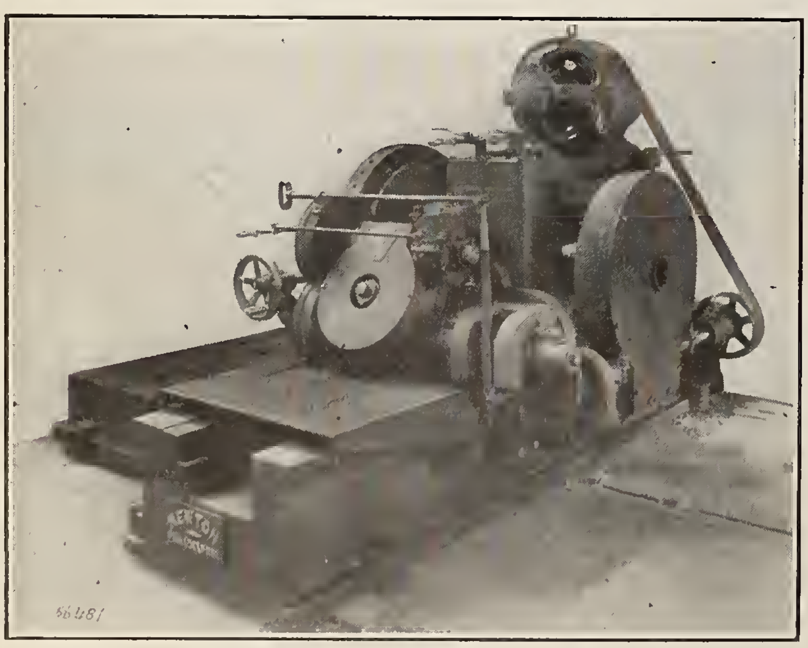
The Newton Machine Tool Works, Inc., Philadelphia, Pa., has recently designed a machine for finishing flat surfaces on steel and iron castings, such as bases of columns or other structural shapes at greater productive rates than were possible with a single tool carried



36-in. Newton Rotary Planer

on a swinging arm, such as was formerly employed, which has even greater capacity than previous models.

In this latest development a belt connection is employed to transmit power from the motor to the driving shaft. The motor is mounted on the saddle and travels with it, an arrangement which is relied upon to eliminate vibration due to torsion in the long feed screws and splined driving shafts of the earlier machines. A machine of this type has been used in the builder's shop on the erecting floor for finishing cast iron surfaces 20 ins. wide. Here it has removed metal to a depth of ¼ in. at a feed of 6 ins. per minute without any appreciable strain on the machine or wear on the cutters.



Back of 36-in. Newton Rotary Planer

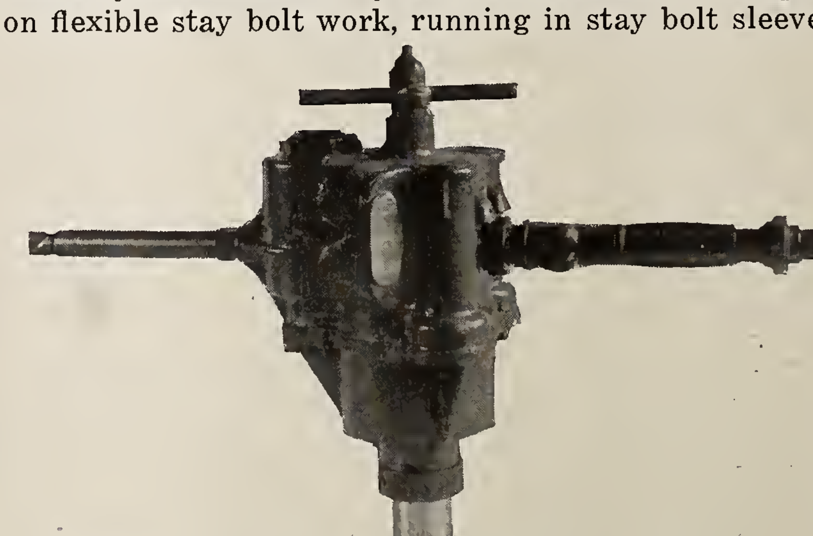
The cutter head used is a steel casting surrounded with a steel band, to which are fitted submerged tool clamping screws to comply with the recent liability laws enacted by the various state legislatures. The drive to the head is transmitted through an internal gear, the teeth of which are cut from a solid casting in the back of the head. A patented feed box renders six changes available. Latch levers control the sliding sleeves, which are incorporated in the construction of the feed box, and each sleeve carries one of several groups of gears, giving feed changes and reversing fast power traverse to the saddle. The work table on the machine is of the fixed type, and the depth of the cut is controlled by an adjustment of the spindle travel. In the design of the machine care was taken to insure flexible and convenient control to secure production at the highest possible rate by reducing as far as possible the time that the machines were idle.

One of the special features of the machine is that there are only three points of control—the top lever regulates the direction of traverse for the feed and fast power motion clutches and is arranged to prevent conflict, while the in and out adjustment of the spindle saddle which gives the depth of cut is controlled by a handwheel.

Portable Pneumatic Drill for Heavy Duty

The Ingersoll-Rand Co., 11 Broadway, New York, have recently added to the "Little David" line of pneumatic drills an exceptionally powerful compound geared model No. 11-SE.

This drill is reversible and is adapted to the heaviest flue rolling, drilling, reaming and tapping. It is particularly recommended by the manufacturer for tapping on flexible stay bolt work, running in stay bolt sleeves,



Powerful Compound Geared "Little David" Drill

locomotive valve setting, and kindred heavy duty operation. It is so constructed that it develops full power on the reverse as well as the forward motion. This is pointed out to be of particular advantage in that, after running a flexible stay bolt sleeve up tight, the No. 11-SE, due to its unusual power on the reverse motion, will unscrew the sleeve cap. This obviates the necessity for the usual cumbersome wrench.

In setting locomotive valves this new "Little David" tool has the same advantage in that it will revolve the drivers in either direction, facilitating the valve setting operation.

This drill has the one piece gear-timed valves and ball and roller bearing crank shaft and connecting rods and general simplicity of construction which have been features of the pneumatic drills of this manufacturer.

This drill is ordinarily furnished with a No. 5 Morse taper socket. It operates at a free spindle speed of 100 R.P.M.

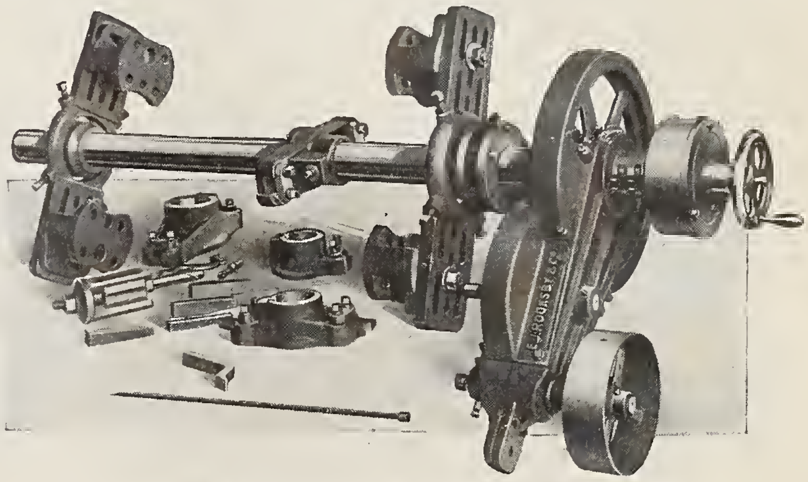
Flue Reclaiming Attachments

The Draper Manufacturing Co., Port Huron, Mich., have recently placed on the market an outfit for welding long ends on boiler tubes, pipes or rods, and for welding splits or flaws in pipes or tubes. These attachments are used in connection with the Draper Improved Pneumatic Flue Welder and an ordinary flue furnace. The flue welder is placed behind the furnace with the end of a long mandrel between the dies of the hammer in line with the center of the furnace. A hole is made through the back of the furnace of such a shape that the operator can view the flue while being heated and welded. Flues are prepared in the ordinary way, scarfed and one piece expanded. The shorter piece is then pushed through the furnace on to the mandrel and the long piece is placed over the lap. A clamp is placed on the tube at a predetermined distance from the weld equal to the distance between the center of the furnace and the center of the welder. When the tube is at the proper heat for welding, it is pushed forward into the flue welder and the clamp on the tube engages a lever operating the flue welder. The flue is welded in a very few seconds after it leaves the fire, which is a great advantage in welding thin flues. The clamp is removed after this operation and the flue pulled out on the tilting table. The heated flue rolls over this table and is straightened and is then allowed to cool until it will support its own weight. By this method the only limit to the length of end that can be welded is the length of the mandrel behind the flue welder.

The illustration shows the outfit in operation, the welder with the reclaiming attachment is behind the furnace, the clamp on the pipe shows between the operator and the furnace and the mandrel can be seen at the right edge of the picture.

Locomotive Cylinder and Valve Chamber Bushing Boring Bar

E. J. Rooksby, 435 N. Eleventh St., Philadelphia, has recently placed on the market a new design of the Rooksby Portable Boring Bar, illustrated herewith, in which the manufacturers have been guided by the very commendable "Safety First" principle of safeguarding all moving parts, and have carefully guarded all exposed gears and moving parts, making the machine



Portable Boring Bar With Gear Guard

compact and of ample strength, yet simple and accessible throughout.

These machines are especially designed for reboring locomotive cylinders and valve chamber bushings. They can be used with one or both cylinder heads removed and are easily and quickly set up. The crosshead blocks are bolted to the cylinder with the cylinder head studs, and the bar revolves in the sleeves supported and centered by set screws in the crossheads. When boring with only one head removed, the expand-

Draper Flue Reclaiming Attachments Arranged to Weld Long Flue Ends ing chuck and pin, having five sets of taper gibs to fit in stuffing boxes of various diameters, is used to support the crank end of the bar.

The power is applied to the bar by means of a back-geared driving power, having a "two-speed, quick-change gear drive." This is a recent improvement of particular advantage where the same bar is used to rebore cylinders and valve chamber bushings of various sizes. The "quick change" is accomplished by simply pulling out a slip pin, shifting the primary pinion out of gear and driving by the intermediate shaft. As the illustration shows, all gears are completely encased.

The tool holder has been re-designed to use high-speed cutters for extra-hard service. The cutterhead is fed by means of an automatic feed case having two changes of feed controlled by a slip pin. This is also completely encased.

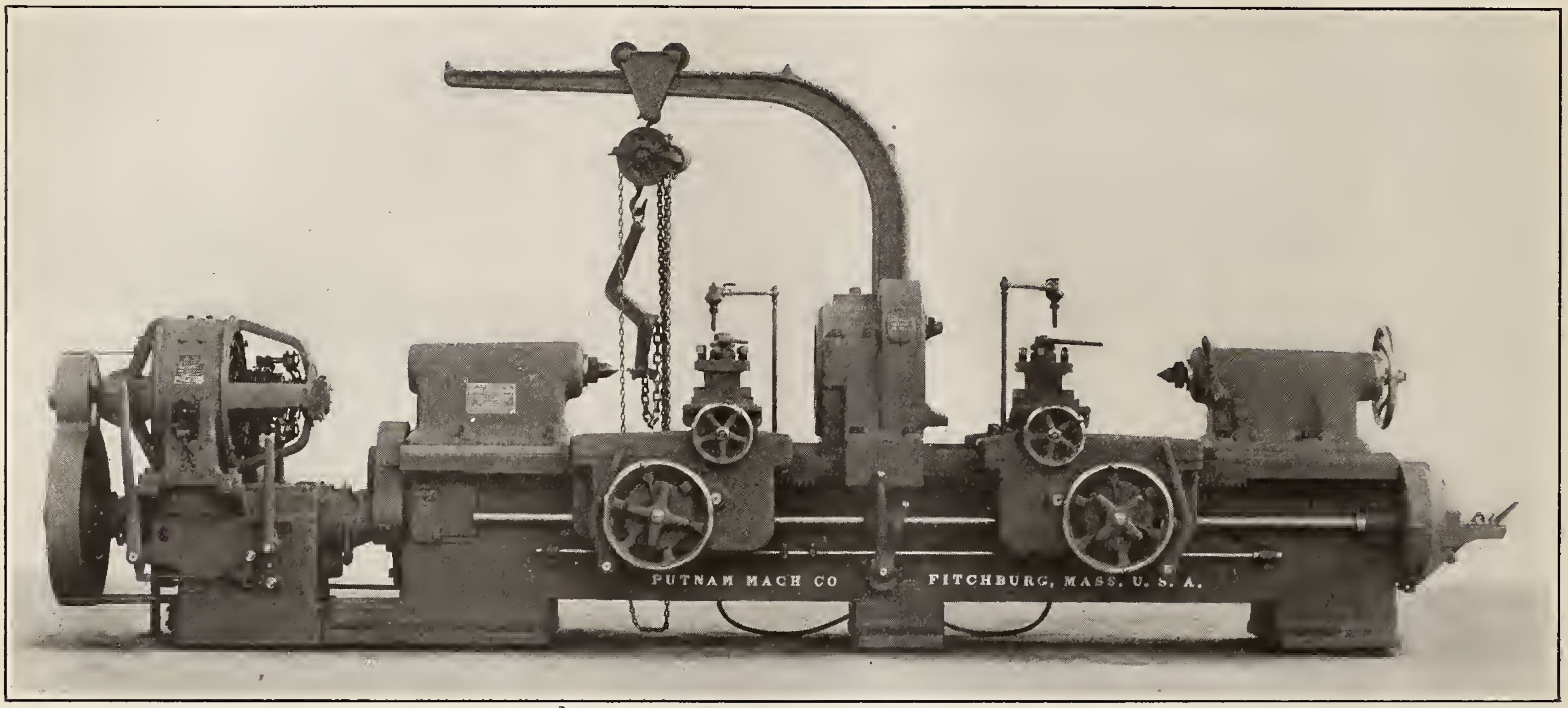
For setting the bar up, in valve chamber bushings, a device is used to enable the operation to be quickly and accurately performed, consisting of a set of tapered cone sleeves in halves, fitting in the counter bore, supporting the bar centrally while bolting up the blocks and crossheads, after which the cones are removed and the bar is ready for re-boring. The sleeves being tapered, one set can be used in bushings of various sizes within their range.

These portable boring bars are made in a number of sizes to rebore cylinders of the smallest simple shifting or contractor's locomotives to the largest low pressure cylinders on the latest types of compound locomotives, and all sizes of valve chamber bushings. Bulletin L, illustrating and describing these tools, will be sent to all interested parties on request.

Putnam Heavy Double Axle Lathe

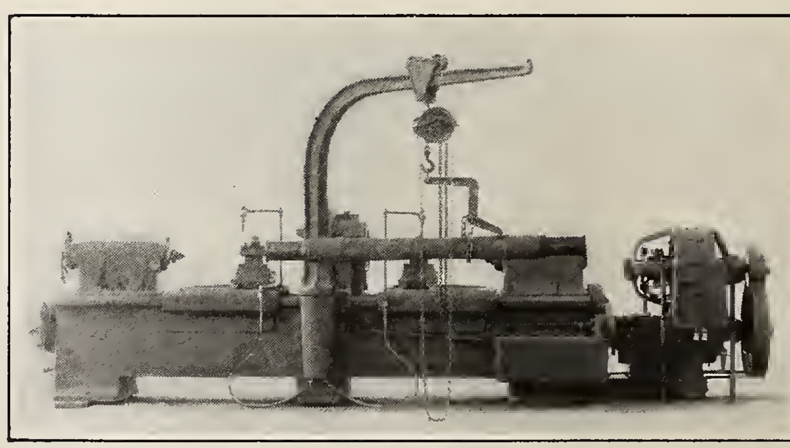
The Putnam Machine Co., Department of Manning, Maxwell & Moore, Fitchburg, Mass., have recently placed on the market a new design of heavy double axle lathe containing several important changes in what has been considered standard practice in the design of tools of this character. One of the most interesting features is the use of four speed selective type gear transmission boxes, in which all gears are of chrome nickle steel, heat treated and hardened. All working elements in this gear box are under constant flood lubrication. Complete and simple interlocking mechanism is provided between shift lever and starting and stopping clutch so that conflicting gear trains cannot be engaged.

The lathe is provided with four-sided turret toolposts, of steel, which are tooled up for all the operations incident to finishing axles from the rough, en-



Front View Putnam Heavy Double Axle Lathe

tirely eliminating tool changes. Carriages have extra large V bearings and broad area flat bearing surfaces directly in line with tool thrust, and are gibbed on both horizontal and vertical bearing surfaces to resist pressure of burnishing tools which is really the severest operation that an axle lathe has to perform. It will be readily recalled by most railroad shop men in the operation of axle lathes of older design, that when the burnishing tools were brought into operation, distortion of the carriage was in many cases very noticeable, and obviously this tended to a high rate of depreciation on the machine as well as to a reduction in output.



Back View Putnam Axle Lathe

Aprons are of unit casting, double wall type, with all-steel gears and carry the necessary mechanism for automatically disengaging feeds at any predetermined point. Practically all bearings throughout machine are of the reservoir self-oiling type, relieving the operator of the necessity of frequent attention and insuring automatically that parts are properly lubricated.

Calculating Machine for Mechanical Officcs

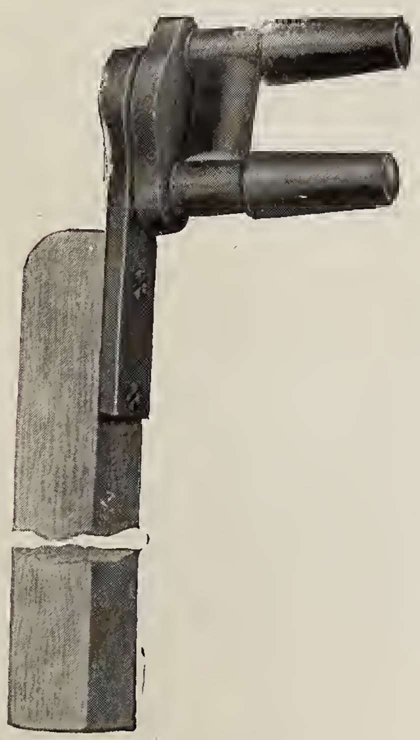
The Monroe Calculating Machine Co., Orange, N. J., has placed on the market a calculating machine specially adapted for handling the payroll distribution in railroad shops, also fuel, oil and locomotive performance reports, especially where percentages are required. Great facility in making these distributions can be attained inasmuch as the percentages can readily be carried to five or more places of decimals, and after the first percentage is reached and set up on the keyboard it is not disturbed until each account is covered, eliminating any danger of error in calculation.

Calculating Machine for Mechanical Department Offices

The machine does not require an expert. Any one can operate it with speed almost immediately. It not only adds, but subtracts, divides and multiplies easily. Problems of the most complicated kind can be handled with remarkable simplicity. Extracting of square root and even cube root can be accomplished with very little practice.

Safety First Belt Shifter

The Ready Tool Co., Bridgeport, Conn., have recently placed on the market a belt stick on which are mounted three rollers, two of which are tapered in such a way that there is no possibility of the shifter getting caught in the belt. The rolls are so designed that there is at all times a tendency for the belt to slip away from the shifter onto the pulley. Accidents so frequently caused by an operator climbing a ladder to put on a belt or by using old-fashioned belt sticks with a pin in the end, are eliminated by the use of this tool. The belt shifter is made in two sizes, for belts 1 inch to 4 inches, and a second size from 4 inches to 6 inches. The operation of the Safety-First Belt Shifter is similar to that of the older-type belt stick with a bolt or pin at the end, but it is much less likely to bind.



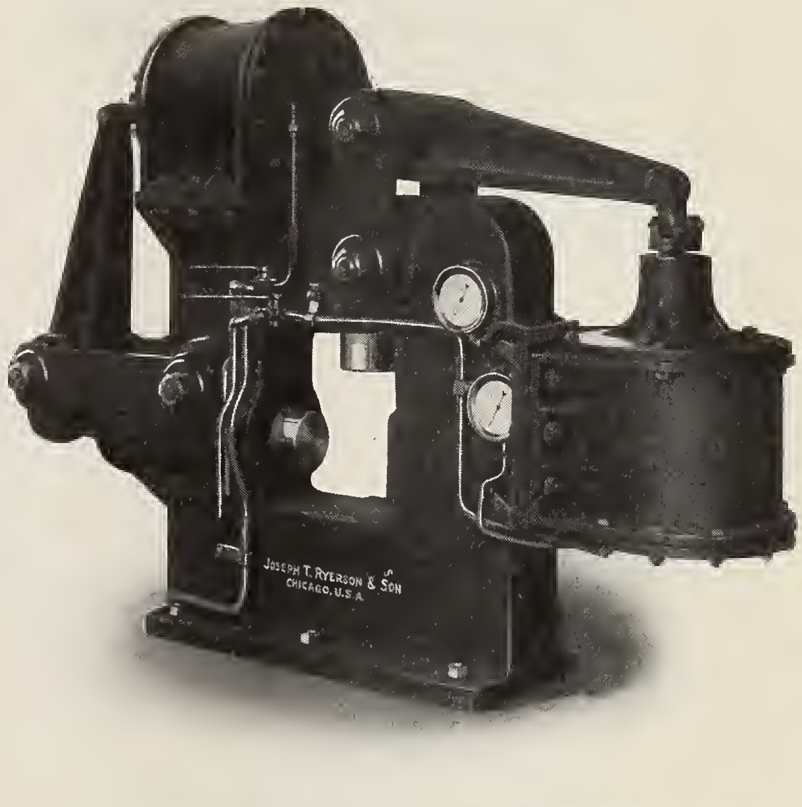
Safety Belt Shifter

Pneumatic Spring Banding Press

Joseph T. Ryerson & Sons, Chicago, have recently placed on the market a pneumatic spring banding press, especially designed for railroad spring manufacturing and repair shops which are not equipped with hydraulic power.

There are a large number of railroad shops throughout the country which have a considerable amount of spring repairing to handle, and a good part of these roads have been performing certain operations of the spring repair work by hand. One of these operations has been to make up the bands, as well as put the band on the finished spring, and on account of the necessity of having an extra power plant where a hydraulic banding machine is used, with the additional cost of operation, the smaller shops could not well afford to have such an expensive installation.

The machine illustrated will handle all the usual run of spring banding work and has a capacity of exerting pressure up to 60 tons. The machine can be operated from the regular shop air line, and on this account, and due to the fact of simple design and construction, the equipment is within the reach of the smallest railroad repair shop. A number of machines in service have demonstrated their value. It has been found that with the use of proper dies the bands themselves can be easily manufactured on these machines.



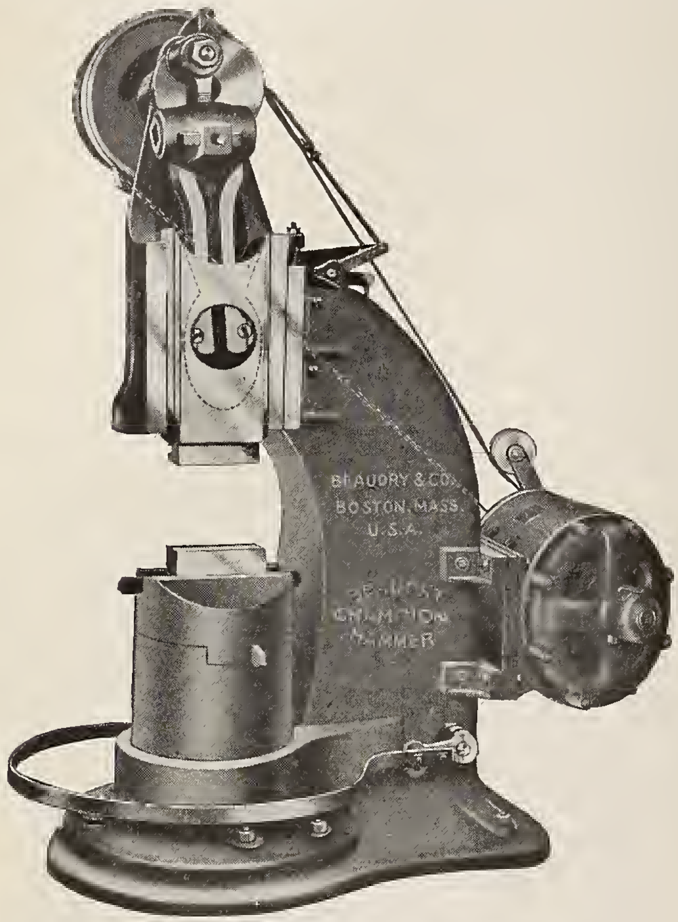
Ryerson Pneumatic Spring Banding Press

The cylinders of this machine are of such a size that with air at 100 lbs. to the square inch, a pressure of 60 tons is exerted on the rams. By means of both horizontal and vertical ram, a positive and known pressure is exerted on the spring band, which insures uniformity and rapid work, and has many other advantages as compared with hand banding. Each machine is furnished complete with three-way hand-operated valves and the necessary pressure gauges. The machine illustrated weighs 6,500 lbs., has cylinders of 16 ins. diameter, and a capacity of 60 tons.

What a piece of work is a man. How noble in reason; how infinite in faculties; in form and moving, how express and admirable; in action, how like an angel; in apprehension, how like a god.—Shakespeare.

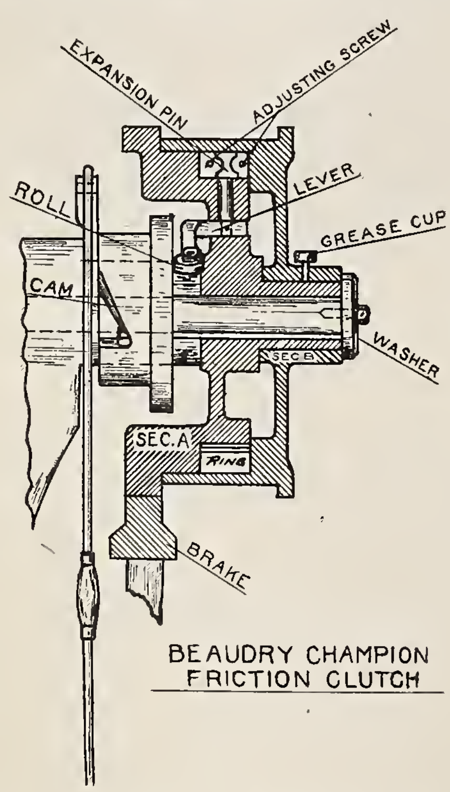
New Motor Drive for Power Hammers

Beaudry & Co., Inc., Boston, Mass., have recently arranged a number of Beaudry Champion Power Hammers for motor drive, permitting a neat and compact equipment where there is an objection to the use of overhead shafting or where the blacksmith shop is too



Motor-Driven Beaudry Power Hammer

far from the main power plant for convenient drive in that form. The motor for such an equipment should have a speed not exceeding 900 r.p.m., and must be

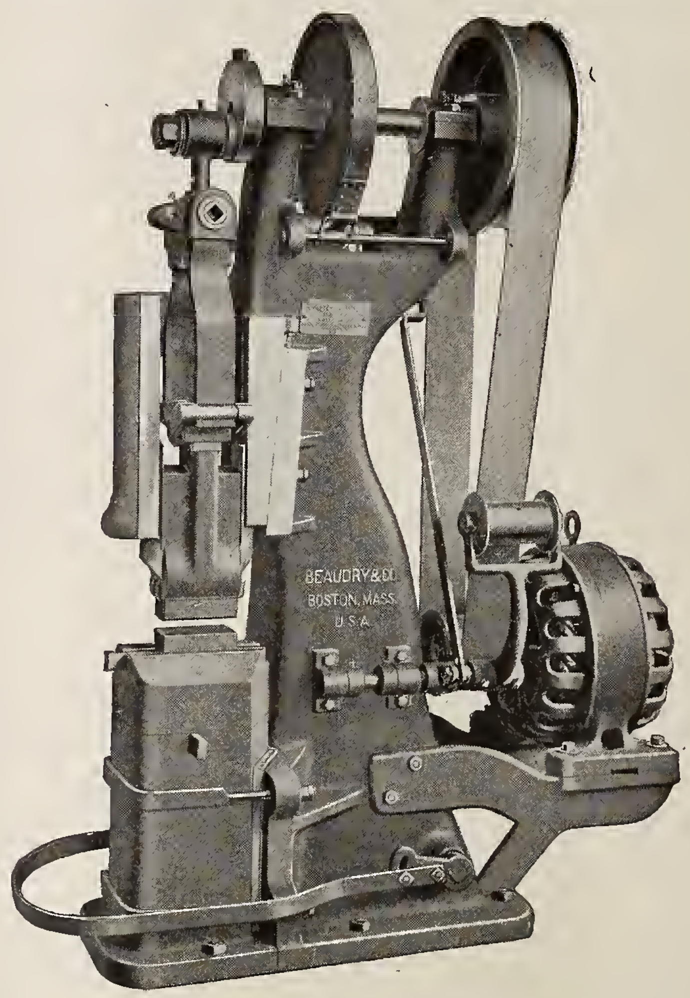


Cross-Section of Beaudry Champion Friction Clutch

fitted with a belt-tightener attachment and a flange metal pulley.

For the operation of these motor-driven hammers a friction clutch pulley is placed on the hammer. Pressure on a foot treadle engages the clutch and starts the hammer with same graduations in the speed and force of blow that are obtained by the use of loose belt and idle pulley on belt-driven hammers.

The friction clutch, which is shown in section, is composed of pulley, ring, brake section, cam, lever, expansion pin, roll and washer. The ring is split to fit the head of the expansion pin, and this slot in the ring has steel faces which make good wearing surfaces. The brake section is keyed to the shaft. The pulley runs loose on the hub of the brake and is lubricated from a grease cup. The cam is made in spiral form and held in neutral position by a spring on the frame. The hardened steel roll is fitted into a slot in the lever. The expansion pin is fitted with adjusting screws and check nuts, making it possible by removing the washer and sliding the pulley back to make all necessary



Motor-Driven Beaudry Power Hammer

adjustments. The operator has the hammer under perfect control, according to the pressure exerted on the treadle. A light pressure allows the pulley to slip, giving a light blow, and by increasing the pressure on the treadle, the maximum blow can be obtained. The brake is automatically released when the hammer is in motion.

These hammers can be supplied complete with motor and belting as illustrated or arranged for motor drive, a 900 r.p.m. motor, motor pulley and belting to be mounted on the hammer when it is installed.

Electric Turbo-Generators

The modern steam turbo-generator makes it possible to concentrate enormous amounts of power generation in one place. This makes possible and advantageous very large individual generating units. The growth in the capacity of generators has been enormous, and it has been made possible by the steam turbine. Electricity can now be transmitted long distances in large or small quantities, and its characteristics changed at will, and all this can be done with small losses and at comparatively low cost.

Supply Trade Notes

J. A. & W. Bird & Co., New York City, manufacturers of Ripolin enamel paint, announce that their New York offices have been changed from 66 Beaver street to the Equitable Building, 20 Broadway, where larger quarters and better facilities have been provided. Owing to the fact that the Ripolin enamel paint is manufactured in Holland, there has been no difficulty in obtaining regular shipments and stock has not been depleted on account of the war.

Frederick Hebert Eaton died on January 27. By it the industrial world has lost one of its foremost captains. He was born in Berwick, Pa., April 15, 1863, and was descended from early Colonial stock.

Mr. Eaton had been for many years a commanding figure in the car manufacturing industry and had been engaged therein practically all his life. He obtained his early experience as chief clerk in the office of the Berwick Rolling Mill Company, then a subsidiary of the old Jackson & Woodin Car Manufacturing Company. From 1892 to 1899 he was successively secretary, vice-president and president of the Jackson & Woodin Company, at Berwick. In 1899 he was an important factor in the formation of the American Car and Foundry Company, a consolidation of many car building companies in the United States, and which is one of the largest industrial organizations in the country today. Mr. Eaton was president and a member of the executive committee of the American Car and Foundry Company from 1901 to the time of his death. In 1906 Mr. Eaton

Frederick Hebert Eaton

was presidential elector on the McKinley-Hobart ticket for his native state of Pennsylvania.

Mr. Eaton was a director of the American Agricultural Chemical Company, American Beet Sugar Company, Columbia Trust Company, Hoyt & Woodin Manufacturing Company, National Surety Company, Seaboard National Bank, and Sligo & Eastern Railroad Company; chairman of the board of directors of American Car and Foundry Export Company, and was a trustee of the Mutual Life Insurance Company of New York.

He was also a member of the New York Chamber of Commerce, the Pennsylavnia Society in New York, the Society of Colonial Wars, Sons of the Revolution, Economic Club, American Geographical Society, American Society of Political and Social Science, Academy of Political Science, Peace Society of New York, Navy League of U. S., New York Geneological and Biographical Society.

Mr. Eaton was also a member of many clubs. He is survived by his widow, Elizabeth Furman Eaton, and a daughter, Mae Eaton Crispin of Berwick. His city residence was Alwyn Court, 182 West 58th street, and his country place "Maibenfritz," Allenhurst, N. J.

The Electric Storage Battery Co., Philadelphia, Pa., have recently announced that George R. Murphy, Rialto building, San Francisco, Cal., will hereafter represent them on the Pacific Coast. Mr. Murphy will make use of the stock carried at the Exide Battery depot, San Francisco, to insure prompt shipments.

The International Acheson Graphite Co. of Niagara Falls, N. Y., has changed its name and hereafter will be known as Acheson Graphite Co. It will be noted that the word "International" has been dropped and that the company name now begins with the name of the noted inventor of the process for making graphite artificially in the electric furnace. The change was brought about through the conception that the word "International" had no significance in the company's business and only served to conceal the identity of the company when indexes and other references were examined for the name and address.

The J. C. Russell Shovel Co., Pittsburgh, Pa., announces that they have made an arrangement with R. L. Mason, 1501 Oliver Bldg., Pittsburgh, Pa., to act as special representative in the railway field. Mr. Mason will have charge of railroad sales on track shovels and locomotive scoops and his broad experience in the last fourteen years especially qualifies him to be of servive.

Westinghouse Electric and Manufacturing Co., East Pittsburgh Works, have announced the appointment of R. L. Wilson, manager of the railway department of the East Pittsburgh works, as assistant general superintendent, looking directly after trade apprentices, employment, working conditions and other matters of similar nature. Mr. Wilson entered the employ of that company in 1893 as student draughtsman and subsequently became inspector, engineer of construction, and later superintendent of construction, at one time being in charge of erection work in the New York district. Later Mr. Wilson was made superintendent of the railway division, which position he continues to hold.

He is chairman of the joint committee appointed by the company and the employes for the settlement of differences in opinion arising between the employes and the company, and is also trustee of the Veteran Employes' Association of the Westinghouse Electric Co.

The Westinghouse Electric and Manufacturing Co. Veteran Employes' Association, at its third annual banquet, held recently in Pittsburgh, presented to the company a handsome bronze memorial tablet of the late George Westinghouse, founder of the numerous industries bearing his name.

This organization, though only three years old and composed of those who have been in the employ of the company for twenty or more years, is one of the most active of the numerous Westinghouse organizations. About 450 veterans were present. President I. DeKaiser of the association made the opening address.

Bronze Tablet Dedicated to George Westinghouse

The memorial tablet is approximately 4 x 3 ft., made of solid cast bronze and weighs about 300 lbs. It shows a true bas-relief likeness of Mr. Westinghouse taken from one of his best photographic poses seated in an armchair. It bears the inscription, "George Westinghouse, Master Workman, Inventor, Founder, Organizer, 1846-1914." It will be placed in the reception room of the East Pittsburgh works of the electric company.

The model for this tablet was made by Lorado Taft, one of America's famous sculptors. It was cast in bronze and placed in position by the James H. Matthews & Co. of Pittsburgh, Pa.

Addresses were made by a number of veterans, former associates of Mr. Westinghouse, including E. M. Herr, president; L. A. Osborne, vice-president; N. S. Storer, general engineer; B. Kupferberg of the storeroom office; Charles F. Scott, consulting engineer, and Guy E. Tripp, chairman of the board of directors. Each speaker referred to some different phase of the great inventor's life which had particularly impressed him.

The tablet was presented on behalf of the veterans by Charles F. Scott, consulting engineer, and was unveiled by Miss Rose Kennedy, one of the four women members of the Veteran Association. The tablet was accepted on behalf of the company by Guy E. Tripp, chairman of the board.

William H. Woodin has recently been elected by the directors of the American Car & Foundry Company, president, to succeed the late Frederick H. Eaton. Since 1902 he has been a director and assistant to the president, in which capacity he had general direction, under Mr. Eaton, of the company's affairs. Mr. Woodin is a car builder by inheritance, his father and grandfather having both been leading figures in that industry. He received his training in the old Jackson & Woodin Manufacturing Co., which was established by his grandfather in 1842 at Berwick, Pa., and which was one of the companies amalgamated with the American Car & Foundry Company. Mr. Woodin received his technical education and his degree at Columbia University School of Mines, and then worked his way through the shops. In 1892 he was general superintendent of the Jackson & Woodin Manufacturing Company, and continued as such until 1895; from 1895 to 1899 he was vice-president of that company; in 1899, when the American Car & Foundry Company was formed, he became district manager in charge of the Berwick plant, which is the largest car building plant in the country.

New Trade Literature

The Columbia Nut & Bolt Co., Bridgeport, Conn., have recently issued a 24-page illustrated booklet describing in addition to their original Columbia Lock Nut and improved Columbia Lock Nut, their new Columbia Jib Nut Lock and Kling bolt. The jib nut lock is a 3-thread nut with bent edge on each side, made either square or hexagon. The cling bolt has a divided head which permits the head to be put through a hole the size of the bolt and lock, where only one side of a sheet to which something must be bolted is accessible.

The Monarch Engineering and Manufacturing Co., Baltimore, Md., have recently issued a 28-page illustrated booklet describing the Monarch line of metal melting furnaces, core ovens, burners, ladle heaters, blowers, etc., using oil or gas or air.

The Putnam Machine Co., department of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., have recently issued an 8-page illustrated bulletin on the Putnam Heavy Double Axle Lathe, which is built for maximum duty, and is proportioned throughout to successfully absorb all strains and vibrations incident to heavy cutting.

Strauss & Buegeleisen, 489 5th ave., New York City, have recently issued a folder on the Micalite and Allwon eye shields. The material is similar to celluloid, but will not support combustion. The Allwon eye shield has two shades of color, affording a variation in production from light.

The Vanadium-Alloys Steel Co., Pittsburgh, Pa., have recently issued a circular dealing frankly with the high-speed steel situation, as regards stock on hand, specifications for future delivery, raw material and manufacturing conditions.

Personal Items for Railroad Men

A. J. Allen, recently apointed general foreman of the Hayne shops of the Southern Railway at Spartanburg, S. C., entered the service of the Southern Railway in 1898 and served for nine years as machinist and roundhouse foreman. In 1907 he was employed as machinist by the Charleston & West Carolina at Augusta, Ga., and in 1915 he returned to the Southern Railway at Columbia, S. C., where he remained until his recent appointment, in which he succeeds R. F. Harril, promoted to general foreman at Charleston, S. C.

James W. Brookhart, recently appointed master mechanic of the Thornton & Alexandria Ry. at Thornton, Ark., entered the service of the Lima Locomotive Works in 1902, and in 1907 was appointed erecting foreman. In 1914 he became master mechanic of the Cotton Belt Lumber Co., and in his recent appointment succeeds W. M. Taylor, who has left the service.

W. J. Brooks, recently appointed locomotive foreman for the Chicago & Alton in their Glenn Yards, Chicago, served his apprenticeship with the Pennsylvania R. R. at Dennison, Ohio, and in 1900 was appointed assistant roundhouse foreman on the Alton. In 1911 he was appointed general foreman at Venice, Ill., and in 1914 he was made general roundhouse foreman at Bloomington. He succeeds in the Glenn Yards J. W. Brewer, who has resigned to accept service with the Lima Locomotive Works, at Lima, Ohio.

J. D. W. Dellinger, recently appointed general foreman of the Detroit, Toledo & Ironton Railway, at Lima, Ohio, entered the employ of that road at Lima in 1896 as car inspector and general foreman. In 1909 he was appointed car foreman for the St. Louis, Iron Mountain & Southern, at Monroe, La. In 1911 he returned to the Detroit, Toledo & Ironton as general foreman at Lima In 1913 he was appointed car foreman on the Missouri, Kansas & Texas, at Smithville, Tex., and now returns to his position on the Detroit, Toledo & Ironton, succeeding A. Stoll, transferred to Delray, Mich.

J. C. Dunham, recently appointed general foreman in the Southern Railway shops at Greenville, S. C., entered the service of that road at Spencer, N. C., in 1901 as machinist's helper, and when he completed his apprenticeship in 1907, he was appointed assistant foreman of freight repairs. In 1913 he was made general foreman at Charleston, S. C., where he remained until in his present appointment he succeeds C. E. Keever, appointed trainmaster at Greenville.

D. B. Graham, recently appointed foreman of shops of the Chicago Northwestern at Deadwood, S. D., entered the employ of that road in 1910 as apprentice at Missouri Valley, Iowa, and remained in the motive power department there until his recent appointment, where he succeeds Walter Smith, apointed foreman of shops at Chadrane, Nebr.

H. E. Greenwood, recently appointed master mechanic of the Indiana division of the Baltimore & Ohio Southwestern at Seymour, Ind., served his apprenticeship and was for a number of years roundhouse foreman for the New York Central at Brightwood, Ind. He was later erecting foreman of their shops at Beach Grove, Ind., and later was made general foreman of the Cincinnati, Hamilton & Dayton at Indianapolis. In 1915 he was appointed master mechanic of the Baltimore & Ohio Southewestern at Flora, Ill., where he remained until his recent appointment, in which he succeeds E. A. McMillen, promoted.

R. F. Harrill, reecntly appointed general foreman for the Southern Railway at Greenville, S. C., has been transferred from a similar position at Charleston, S. C. He succeeds J. C. Dunham.

Louis D. Moore, recently appointed electrical engineer of the Missouri Pacific at St. Louis, has been serving since 1910 as general assistant to the electrical engineer. Previous to this he had been engaged in miscellaneous electrical work since 1906. In his new position he succeeds C. Garner, who has retired on account of ill health.

John S. Naery, recently appointed master car builder of the Chicago, Indianapolis & Louisville at Lafayette, Ind., entered the service of that road as apprentice, and has held successively positions of foreman, general foreman, mechanical engineer, and has now been appointed to the newly created office of master car builder.

J. E. Quigley, recently appointed master mechanic of the Baltimore & Ohio Southwestern at Flora, Ill., entered railroad service in 1893 as machinist's apprentice on the C. N. O. & T. P. at Chattanooga, Tenn. In 1897 he was appointed machinist; in 1900 engine house foreman; in 1904 general foreman at Somerset, Ky., and in 1907 he was made master mechanic at Chattanooga. In 1910 he was made master mechanic of the Alabama Great Southern at Birmingham, Ala., and in 1911 master mechanic of the C. N. O. & T. P. at Somerset. In 1914 he was appointed engine house foreman of the Baltimore & Ohio at Parkersburg, and in 1915 engine house foreman at Holloway. January 1, 1916, he was appointed general foreman of the Ohio & Southwestern at East St. Louis, and he has since been appointed master mechanic at Flora, Ill.

J. T. Sullivan, recently appointed road foreman of engines on the Buffalo, Rochester & Pittsburgh at Punxsutawney, Pa., entered the service of that road in 1902 as fireman; was appointed engineman in 1906, and now fills the newly created position of assistant road foreman of engines.

Obituary

Thomas James Hennessy, formerly division master mechanic on the Michigan Central R. R., died recently.

Mr. Hennessy was born at London, Ont., January 1, 1845, and entered railroad service as a fireman on the Michigan Central in 1872. In 1874 he was promoted to engineman and in 1889 became traveling engineer. In

1893 he was appointed division master mechanic at Detroit and in 1896 at Jackson, Mich. In 1902 he was transferred to Bay City as division master mechanic and February 1, 1915, was retired from service, having reached the age limit.

Mr. Hennessy leaves behind a host of friends, not only on the Michigan Central, but among all railroad men with whom he has come into contact in his long and useful career.

J. W. Hogsett, late chief joint inspector, Fort Worth, Tex., was born November 13, 1861, in Platte County, Mo., near Barry, and died after a very short illness December 24, 1915, at Fort Worth, Tex.

Mr. Hogsett left his native town in 1884, taking up residence in Watrous, Lamy, Los Vegas, Wagonmound, N. Mex., until 1889. In the fall of that year he became identified with the Sante Fe Railroad, subsequently moving to Fort Worth, where he became a car inspector, and on January 31, 1893, was promoted to the position of chief joint inspector, all lines.

Mr. Hogsett became identified with the Chief Interchange Car Inspectors' and Car Foremen's Association a great many years ago and has always taken a very active interest in the association. His death will be keenly felt, as he was well and favorably known among its members. He was of a kindly disposition, treating all with whom he came in contact with the utmost courtesy and was known far and wide for his thorough knowledge of car interchange work. His standard of business ideals was high and he more than lived up to that standard. In his death the railroads at Fort Worth have lost an efficient officer and his associates a loyal friend.

Book Reviews

Scientific Management and Labor, by Robert Franklin Hoxie, Associate Professor of Political Economy, University of Chicago. Published by D. Appleton & Co. New York: Price, $1.50.

This book is one in which a comprehensive study of the labor conditions and problems connected with, and resulting from, the introduction and practice of scientific management, is discussed, from the standpoint of the individual shop and the industrial and social outcome generally. The book is based on extensive investigations made for the Commission on Industrial Relations. Mr. Hoxie presents a summary of statements for and against scientific management, on which both employers and employes have agreed, it is said, accurate and exhaustive.

The book begins with a careful analysis of the claims of scientific managers relative to labor and labor methods, the objections of organized labor to scientific management, and the possible benefits to labor. It presents a number of interesting and valuable suggestions and criticisms based on the actual methods employed in the shops and studied and results achieved. These cover: the installation of the systems; functional foremanship, as it affects labor; the selection and hiring of workmen; adaptation, instruction and training of workers; time study and task setting, their purposes, methods and results; methods of payment and their operation; the protection of the workers from over-exertion and exhaustion; the methods of advancement and promotion, discipline and discharge of employes, the resulting labor turn-over, etc.

It gives also the results of investigation with respect to the general relationships of employers and workers in shops where scientific management prevails, and the general effects of the system on labor together with labor's attitude toward them and the causes involved. In the appendix, a full statement is made of the vital points at issue between scientific management and organized labor, and an analysis of the fundamental and specific facts which are required as a basis of judgment with regard to the labor standards of any shop, and the means necessary to raise these standards.

Oxy-Acetylene Welding and Cutting, including the operation and care of acetylene generating plants and the oxygen process for removal of carbon, by Calvin F. Swingle, M. E. Published by Frederick J. Drake & Co., Chicago, 1916. Price, cloth, $1.00; leather, $1.50.

This book contains thirteen chapters which cover the following subjects: Welding, Welding Flames, Oxygen, Acetylene, Acetylene Gas Purification and Handling, Oxy-Acetylene Torches, Characteristics of Welding Torches, Welding Installations, Preheating and Annealing, Operating a Welding Installation, Metal Welding Practice, Oxy-Acetylene Cutting, Oxygen Carbon Removal, and an Index.

It was originally pointed out by Mr. Chatelier that the oxy-acetylene flame results from the combustion of a mixture of oxygen and acetylene in equal volumes. Theoretically, it requires 2½ volumes of oxygen to completely burn one volume of acetylene, and this is actually what takes place, if the oxygen of the air is taken into account. In practice the volumes are in the ratio of 1.28 to 1.13 of oxygen to one of acetylene.

These and similar facts of theoretical value are brought out, as well as those of more practical import. The management and regulation of the apparatus has to be considered in the light of whether it is to be used by experts or inexperienced men, and how this is to be done, and what and how adjustments are to be made, as all apparatus does not give precisely similar results.

The book is a valuable contribution to the subject, and will be found useful to those who have the handling and manipulation of apparatus. It is in pocket size, convenient to carry and easy of undestanding.

Valves and Valve Gears, Volume I. By Franklin De Ronde Furman, M.E., Professor of Mechanism and Machine Design at Stevens Institute of Technology. This is a second edition, reset and enlarged, and treats of Steam Engines and Steam Turbines. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London. Price, $2.00.

This volume discusses elementary reciprocating engines, valve diagrams for steam engines, fundamental valve forms, fundamental valve gear mechanisms, practical types of valves, eccentrics and shaft governors, practical steam engine valves and steam turbine valve gears. The work treats of mechanism rather than power and tells in particular just how an engine or motor is regulated. Volume one before us is complete and interesting and cannot help to be of great value to any one who is engaged in the field which the book covers.

Standard Car Truck Co., Chicago, Ill., has recently issued a 25-page illustrated catalogue giving information concerning Barber trucks, centre plates, side bearings, tilting brake staffs and special four-point bearing underframes. In the Barber arrangement the truck sides are each cast in one piece, the bolster is steel, as is the truck frame, and the spring "board" is made of two steel angles. The rollers above the truck springs, which permit the lateral motion of the bolster are made of steel and lie in a hollow curve the deepest portion of which brings the rollers to the central position.

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Supplies, Scrap and Reclamation

In the early days of railroad operations economies were exercised, as a matter of course, but as mileage increased and general conditions changed, the idea of thrift became more pronounced, and to-day we have a picture set in a somewhat different frame, with a phase of what is now termed efficiency, resulting in economies and methods of operation based upon science. It cannot be said yet that railroad operations in every particular are founded upon a science that is exact, but they are working that way rapidly; in fact, on some railroads it is so absolutely, and the examples set are being followed by degrees on all railroads.

Among interesting experiences are conditions which prevailed on one of the large railroad systems some years ago. A long receivership had left the property in bad repute financially and suffering, at the same time, from a series of careless operations. A new president promptly called into service experts in different fields of railroading to adjust affairs so that the machinery of the organization might work to the best advantage. The methods then adopted resulted finally in an institution of the first class. To-day it is one of the stable high dividend paying railroads of the country and its prosperity is established for all time.

No order prevailed in the supply department. Heads of departments sent requisitions to the Purchasing Agent directly, and in turn supplies were delivered directly to these various departments. This resulted in an excessive accumulation of all sorts of not properly accounted for supplies, while old material lay along the line in haphazard clusters and was seldom disposed of. Following a two months' investigation a report was submitted to the board of directors to the effect that under a proper system $1,000,000 could be saved in the then next twelve months. This report—regarded as a joke—furnished ground for a good laugh; but instructions were given, nevertheless, to act on the lines suggested, with the hope of some good results at all events. A reorganization was promptly begun, and the results showed a saving of more than $1,000,000 that year. A general store house, with convenient sub-store houses, was established and put under the charge of a competent storekeeper, who took careful account of all supplies and material received, distributing the same on approved orders and making the necessary and appropriate charges therefor.

All old material was picked up, shipped to headquarters and sold. At that time prices for old railroad scrap of all kinds were fairly high. Old oil barrels by the thousands, wrought and cast iron scrap, old rails, old car wheels and other varieties of old material had been accumulating for many months and, together, made up a valuable collection of saleable articles, the returns from which netted more than $300,000. A lumber yard of several acres was found containing oak car timber, bridge timbers and track material, while requisitions for the same sizes and dimensions were coming in daily, under the claim that there were none on hand. The same state of affairs prevailed as to general supplies. Altogether it was an interesting exhibit of what a railroad carelessly handled could do. The oil account ran into enormous figures, and economy exercised in the purchase and consumption of this all important product resulted in a saving of more than $100,000. The car timber, lumber and other material which was brought to light in the lumber yard were sufficient to furnish such needs for five years! It would not be possible to find an instance similar to this to-day; but it is safe to say that on many railroads much less care is paid to the supply department than should be. A spirit of reclamation, however, is abroad in these times, making use of old material, where possible, and rehabilitating this, that and the other thing by judicious use of the available parts of one to make good the missing parts of another. The thrift now exercised is worthy of the highest commendation, while the results are almost astounding. There are excellent examples of this sort of tidiness to-day on the Baltimore & Ohio and other large systems. This good work helps to meet interest; assists at pay-roll time, and is the means, indirectly, of partially providing dividend money. It all goes toward establishing credit as well as securing results which are both surprising and satisfactory.

Spontaneous Combustion

The spontaneous ignition of coal or other substances was for a long time regarded as a mysterious occurrence, and it was apt to be classed among those natural destructive agencies for which mankind had not provided and had therefore conveniently described them each as an act of God. Spontaneous combustion, like other natural phenomena, is now easily referred to as a specific cause and the prevention of a fire so produced is well within the range of the practical knowledge and the common sense of the community. Charles Dickens, in "Bleak House," details the death of an unfortunate victim of spontaneous combustion and gives references to scientific and medical testimony as to the existence of such cases, though happily they are few and far between.

A heap of rags, waste, wool, clothing, paper, etc., more or less saturated with oil, has long been regarded as a menace to railway shops, and these accumulations of rubbish are now regularly cleared away. The cause of the fire in a heap of oily rags, however, is due to the oxidation of the oil, and this takes place so rapidly that the temperature of the mass is raised to the point of ignition without the application of external heat. Oil alone will not burst into flame, and clean bits of cotton or wool, though rich in carbon, will not ignite of themselves. The combination such as is found in a pile of these things, where the heat is not radiated away as fast as it is formed, causes the mass to become hotter and hotter, and the oxidation, always rapid, is now rendered still more rapid, until the mass bursts into flame and sets fire to surrounding objects.

In the case of coal, spontaneous combustion is usually the result of the rapid oxidation of the iron pyrites which occurs as an impurity in the coal. Iron pyrites is the di-sulphide of iron, FeS_2, where two atoms of sulphur are combined with one of iron. This substance very readily takes up oxygen from the air, and the chemical combination results in a rise of temperature, which, in confined space, where the radiation of heat is not active, soon brings the pyrites up to the igniting temperature and flame is the result, which sets fire to the coal.

A mechanical method of preventing the spontaneous combustion of coal where iron pyrites is present is to cool the whole mass as far as possible. One prominent railroad, which kept a large stock of coal in a hugh heap on the ground at each of its various locomotive stations, tried the experiment of driving ¾- or 1-in. round iron bars deep down into the coal and having the iron rods turned round or lifted up and pushed down each day. The moving of the rods was intended to prevent damp coal from adhering to them and so enabling the rods, which are good conductors of heat, to be kept clear of a heat-absorbing mass of fine coal. The object in the use of the rods was to afford a means of carrying off the heat as fast as it was generated by the process of oxidation of the iron pyrites, and so keeping the mass below the igniting temperature. Thus constant care is required where large masses of coal are stored.

Whether or not spontaneous combustion takes place, coal stored in the air gradually deteriorates. The effect of weathering is to lessen the quantity of carbon and disposable hydrogen, while it sometimes increases the total weight of the whole. It increases the amount of oxygen and the indisposable hydrogen and reduces its heat-producing power. An experiment by Richters proved that three samples of coal at a temperature of 158 to 180 deg. Fahr., lost in fourteen days an average of 3.6 per cent of calorific value.

Extra Professional Duties of an Engineer

As a definition of the word mechanical engineer it has been said that he is a man who has helped to bring about many wonderful developments in utilizing the forces of Nature and by so doing he has increased the efficiency of each worker many fold. It might be added that he has added to the material comfort of millions and has given to life a wider and more satisfying outlook. It has been said that an engineer is a "dreamer whose dreams come true."

In presenting a paper to the A. S. M. E. not long ago, Mr. F. H. Newall drew the generally accepted and conventional picture of the engineer when he described him as one who, to the ordinary public, appears as a man seated in his office, perhaps removed from interruption, absorbed in abstruse calculations, and unaware of the changes going on outside in other lines of endeavor. If this is true, as no doubt it is, in part at least, the engineer fails to receive the recognition from the public to which he is justly entitled. He is a conscientious worker and usually possesses a great deal of modesty, so much so that he does not concern himself with the task of enlightening the public. He may regard that as the legitimate work of others, but by not telling his own story a lack of recognition is his meed.

The mechanical man, unlike those in other professions, has to deal with elemental physical conditions. His success does not depend on convincing an audience, nor on directing or even leading the thoughts of his fellow men, whose opinions and beliefs are transitory. The mechanical engineer's work must be judged by higher and more rigidly exacting standards, for he deals with forces of nature, which do not lie and cannot be deceived; he may not flatter, and he would browbeat them but in vain.

It has been said that the work of an engineer should speak for itself, but much of his best work is not visible, and even if it is conspicuous, it is often unobserved and seldom understood. From the very circumstances of the case much of his work is unseen, but its quality is of the highest. That which is essential is not necessarily apparent. The information concerning his work may be read in the technical press or in the transactions of professional societies and clubs, but the man in the street does not read these accounts. Mr. Newell further charges that much that appears in the periodic press of the professions is highly technical, and is often only within the mental grasp of a few experts. Many of the technical papers read at society meetings are not presented so as to be readily taken in by the practical railway man, on whom rests the bulk of the actual performance of railway work.

It is true that to the technically educated man it is easier to write so as to reach the trained and well-informed few, but the necessity for simplication exists if the profession is to do all that is expected of it. Years ago Huxley, who was a trained and expert biologist, took up the cause of organic evolution as set forth by Darwin, and brought the subject to the level of the ordinary intelligence, so that in the end his devotees practically embraced all who could read or think. Indeed, so completely was the difficult task of reaching so vast an audience accomplished that at the twenty-first anniversary of Darwin's book Huxley said that the theory of evolution had been so widely and completely accepted that a little healthy opposition would do it good.

Mr. Newell very rightly advocates the formation of local societies of engineers, and the vigorous prosecution of the work supposed to be done by them. In the railway world we have special societies, associations and clubs each of which publish proceedings, and the technical press of the country is doing much good work in spreading abroad the information gathered by experts in the various engineering lines.

It is not, however, only the presentation of ascertained facts, good as they are, that is all important. Facts pure and simple are like the tempting viands on the table, their enjoyment is another thing, but their assimilation produces the results upon which growth depend. The exchange of ideas, and the comments of an experimenter or worker, on the experience of another is one of the most potent factors in the progress of railroad men. Meetings such as are held at Atlantic City in June, with the exhibition of railroad appliances and the demonstration of their utility, must occupy a high place in the estimation of the railroad man as a means of acquainting himself with the most recent progress which has been made in the science of transportation, in which he is vitally interested and with the success of which he himself is intimately concerned. He does not have to study behind closed doors, but may mingle with his fellows and in the open; see, observe and make the labors and the industry of others his own.

Rolled Steel Pistons

Of late years the increasing size of locomotives and the size of their reciprocating parts has been in evidence. Increase of size has of course meant increase of weight as well, and incidentally this has run up the cost as each successive type of heavy locomotive has made its appearance. The weight of reciprocating parts has affected the counterbalancing and if things had kept on going in the direction in which they started a point would one day have been reached when the tendency to leave the track at high speed might have become a serious matter.

Some years ago experiments on what was poetically called the "footprints of the locomotive" showed that at high speeds the counterpoise on the driving wheels exhibited a tendency to deliver a severe hammer blow on the track as the weight struck down and an equally pronounced tendency to bound upwards when the counterweight swung up to its highest point. The proof of these facts was gained by passing a wire between wheel and rail and noting the heavy and light depressions on the wire as it passed along.

In order to have lighter counterweights and thus diminish what has been called the dynamic augment, it becomes necessary to make the reciprocating parts comparatively light and yet have them strong enough to stand the increased work on modern steam locomotives. Steel of various kinds and alloy steels forced their way into the realm of serious consideration and very beneficial results soon became apparent. The use of the Walschaerts valve gear also contributed to the same result.

Some time ago Mr. W. W. Scott, Jr., in a paper read to the Railway Club of Pittsburgh, advocated the use of forged and rolled steel pistons for modern locomotives as a means to this end. Not only is there a decrease of weight where forged and rolled steel is used, but there is a reducing of cylinder wear. Observation of the locomotive cylinder shows that a fair percentage of this cylinder wear is on the top. A good deal of this is due to poor lining of the guides, loose crossheads, and the fact that when working the steam tends to lift the piston, by working under the piston rings.

A suggested remedy for this state of affairs was, of course, more careful lining of the guides, keeping the piston tight on the rod and further the use of forged and rolled steel pistons, made solid and cut with one or more dovetail grooves in the face with an inserted segment of malleable bearing metal, which is very solidly hammered into a dovetail groove. This, it is claimed, would have the advantage of forming an oil groove between the metal bearing face and the piston rings. Another suggestion was made by Mr. Scott that the solid rolled steel pistons be made with two steel rings of bearing metal. Solid steel rolled pistons used on the P. R. R. have extended hollow piston rods, which reduces uneven cylinder wear and simplifies lubrication. The lighter weight of the piston, of course, has an advantage which is obvious.

British East African Railway System

The general manager of the Uganda Railway, in his last annual report, shows a total capital expenditure up to that date, of $31,181,739. Gross receipts were, for the fiscal year, 1914-1915, $2,510,744. Operating expenditures amounted to $1,631,854, leaving net earnings of $878,890, or 2.81 per cent to apply on the capital invested, against 3.39 per cent and 3.52 per cent for the two previous years, respectively. Since 20 per cent of the gross income was cut off by reason of the European war, on account of the German East African trade, it seriously affected the net results. Many improvements were added to the property in spite of this, all of which had the approval of the Imperial authorities. It would appear that all workshops, as well as roadway and structures, are maintained in excellent order.

I believe there are quiet victories and struggles, great sacrifices of self and noble acts of heroism done every day in nooks and corners, and in little households, and in men's and women's hearts.—The Battle of Life.

American-Built Locomotives in Foreign Lands

Belgian and Russian Railways Using the Product of Our Shops. American Designs Adapted to Suit Climatic Conditions. Prompt Delivery a Prominent Factor

Belgian State Railway

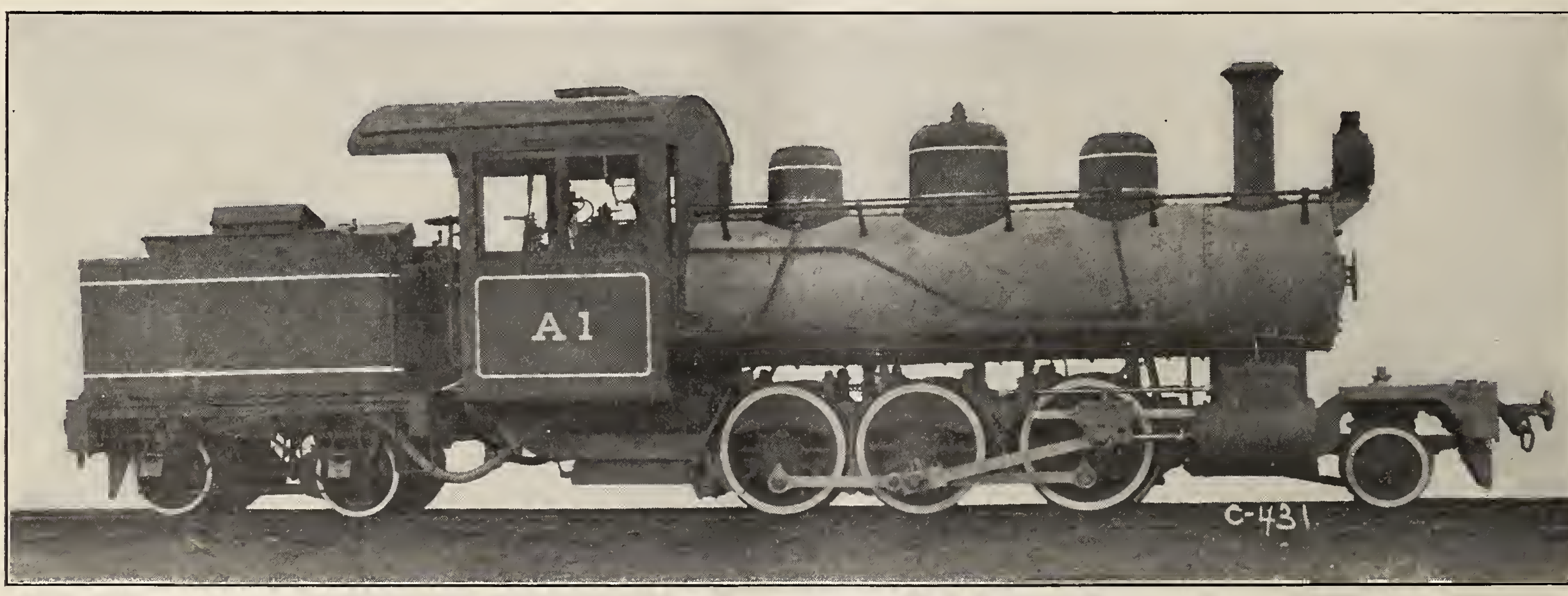
Twenty 2-6-0 type locomotives of unique design were ordered, and the first engine was shipped two and a half months later. In Belgium overhead trolley wires are not allowed. While electricity is used in the cities, all interurban traffic is handled by small steam engines. These engines haul passengers and produce to the distributing centers in the large cities where the tracks connect with the electric lines.

As the soil is of a very sandy nature it is necessary to enclose all running gear so as to exclude dust. Having outside frames, the enclosing sheet metal runs from the bottom of the frames to the bottom of the side tanks. Five swinging doors on each side allow access to the moving parts. These engines are also arranged for operation from either end. The throttle and reverse lever handles are fitted with a steel link, which holds the latch levers in an open position when engine is being operated from the opposite end.

The gauge of the track is 39⅜ ins. The engines have a total weight of 58,900 lbs. in running order. Having cylinders 11½ ins. in diameter and 16 ins. in stroke, driving wheels 34 ins. in diameter, and a steam pressure of 180 lbs. They thus have a tractive effort of 9,520 lbs. The boiler is of the Belpaire type, 42 ins. in diameter at the front end, and is designed to burn coal briquettes. It is fitted with 144 tubes, 1½ ins. in diameter and 6 ft. 4 ins. long. The firebox is 42 ins. long by 28¼ ins. wide, and is designed so as to drop down between the frames for repairs. Ten engines have steel tubes and steel fireboxes and the other ten have brass tubes, copper fireboxes and copper staybolts. A hand operated automobile horn is installed on each end.

Belgian State Railways, 2-6-0 Type

Track gauge, 3 ft. 3⅜ ins. Fuel, briquette coal. Cylinder, diam., 11½ ins.; stroke, 16 ins. slide valves. Tractive power, simple, 7,300 lbs. Factor of adhesion, simple, 6.6. Wheel base driving, 6 ft. 6 ins.; rigid, 6 ft. 6 ins.; total, 6 ft. 6 ins. Weight in working order, 58,500 lbs.; on drivers, 58,500 lbs. Boiler, type, Belpaire; O. D. first ring, 42 ins.; working pressure, 180 lbs. Firebox, type, narrow; length, 42 ins.; width, 28¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; back, ⅜ in.; water space front, 3 ins.; side, 2¼ ins.; back, 2¼ ins.; depth (top of grate to center of lowest tube), 13¾ ins. Crown staying, radial. Tubes, material, brass, C. D. S. S. for ten engines; number, 144; diam., 1½ ins. Thickness tubes, No. 13 B. W. G. Tube, length, 6 ft. 4 ins.; spacing, ⅝ in. Heating surface, tubes and flues, 354 sq. ft.; firebox, 39 sq. ft.; total, 393 sq. ft. Grate area, 8.2 sq. ft. Wheels, driving diam. outside tire, 865 m. m. (34 ins.); center diam., 745 m. m. (29¼ ins.). Wheels, driving material, main, C. S.; others, C. S. Axles, driving, journals main, 6 ins. by 7 ins.; other, 6 ins. by 7 ins. Boxes, driving, main, C. S.; others, C. S. Brake, driver, A. L. Co. West.; pump, 1 8-in. West.; reservoir, 1 16 ins. by 48 ins. Exhaust pipe, single; nozzles, 2¾ ins.; 2⅞ ins. Grate, style, rocking. Piston, rod diam., 2¼ ins.; piston packing, C. I. rings. Smoke stack, diam., 9¼ ins.; top above rail, 10 ft. 6 ins. Tank, style, one on each side of engine; capacity, 528 gals.; fuel, 1,100 lbs. coal. Valves, type, Richardson balanced; travel, 4 ins.; steam lap, ⅝ in.; ex. lap, line and line; setting, 1/16 in. lead.



American Locomotive Company 2-6-0 Type for the Belgian State Railways

Russian Government

An order for one hundred 2-10-0 type locomotives for the Russian State Railways was received. The design was entirely new, and as delivery was an important factor the work was pushed with the utmost speed.

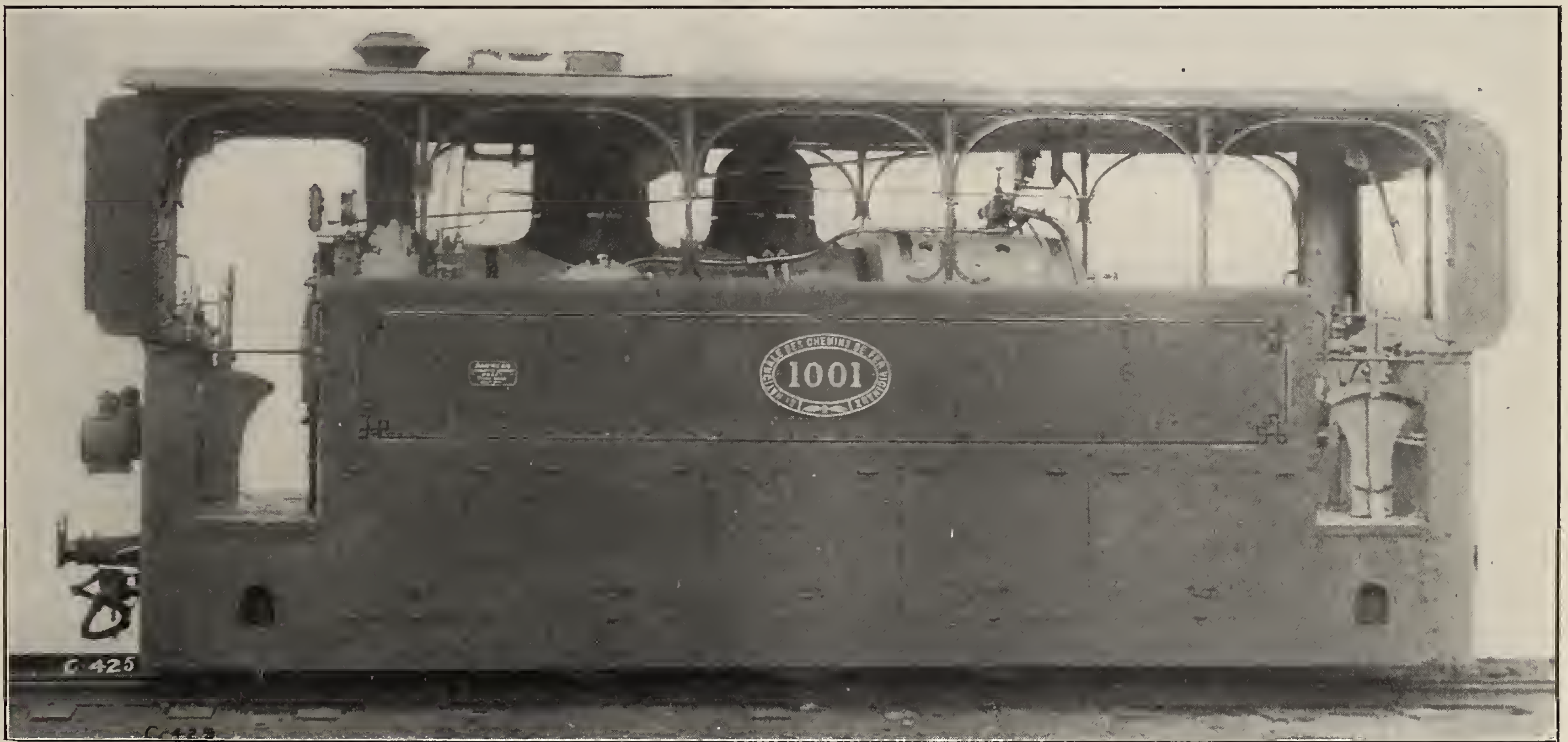
These engines operate on the main lines of the Russian State Railways, which have a gauge of track of 5 ft. They are guaranteed to haul, under favorable conditions, on an 0.8 per cent grade, without curves, a train of 1,000 tons in fully loaded cars at a speed of 12 to 15 versts (7.96 to 9.95 miles) an hour. The design in general follows American practice with the exception of the proportion between weight and tractive power; these engines having exceptional power for the weight limitations imposed. The total weight of engine is 195,000 lbs. and the weight on drivers is 174,000 lbs. Cylinders being 25 by 28 ins., driving wheel diameter 52 ins., and steam pressure 180 lbs., gives a tractive power of 51,500 lbs. and a factor of adhesion of 3.39. This factor of adhesion is less than what would be considered good American practice, but European engines do not work at the same cut-offs as is used in this country. This reduces their figure for tractive power and necessarily increases the factor of adhesion.

The boiler is of the straight top, radial stay type. It is $70\frac{1}{4}$ ins. outside diameter at the front end and contains one hundred and ninety-five 2-in. tubes 17 ft. long. It is also fitted with a 28-unit Schmidt superheater. The firebox is of copper and is $107\frac{3}{4}$ ins. long by $85\frac{3}{4}$ ins. wide and has copper water space stays, with tell-tale holes drilled in both ends. A Security fire brick arch supported on tubes was also included.

An interesting feature is an arrangement whereby the by-pass valves are operated by the superheater-damper cylinder. Ordinarily, the damper cylinder receives steam from the steam pipe and therefore operates a short time after the throttle is opened. The by-pass valve have to close immediately when the throttle is opened. This necessitated changing the steam connection for the damper cylinder and connecting it to the turret in the cab with an intervening control valve connected to the throttle. By this change steam is instantaneously admitted to the damper cylinder when the throttle is opened and the by-pass valves are at once closed. In a similar way the by-pass valves open when the throttle is closed.

A very neatly constructed link bracket is used. This link bracket is unique in that it forms by being a small and light casting, a support for the link, at the back end of guides, and also carries the bearing for the reversing shaft. Connections on front and back knuckle pins are made by ball joints. This eliminates the bending strain on side rods when engine is on curve. Lateral motion on first and fifth drivers allows the engines to operate on curves up to 700 ft. radius on main line, with a possibility of entering curves of 300 ft. radius occasionally and with care. Other features included are I-section guides, outside steam pipes, extension piston rods, Rushton air operated screw reversing gear, Zara throttle, pyrometer, radial buffer, Franklin firedoor, Le Chatelier water brakes on fifty engines, and Russian Westinghouse brakes.

American Locomotive Company, 2-10-0 Type for the Russian Government Railways



American Locomotive Company, 2-6-0 for Peter the Great Fortress, Reval, Russia

Fifteen 2-6-0 type locomotives were ordered for the Peter the Great Fortress Reval. This was an entirely new design but followed American practice. These engines have a gauge of track of 750 m. m. (29.53 ins.).

Having cylinders 11 ins. in diameter by 16 ins. in stroke, a boiler pressure of 165 lbs. and a driving wheel 33½ ins. in diameter they have a tractive power of 8,100 lbs. The boiler is of the straight top type, is 36⅝ ins. outside diameter at the front end and contains 85 2-in. tubes, 10 ft. 6 ins. long. The firebox is 40½ ins. long and 33 ins. wide, and burns soft coal. The tender is of the four-wheel rigid pedestal type and has a capacity of 700 gals. of water and 1½ tons of coal. Dimensions of this and the other engines are here appended for reference.

Russian Government Railways, 2-10-0 Type

Track gauge, 5 ft. Fuel, soft coal. Cylinder, diam., 25 ins.; stroke, 28 ins. piston valves. Tractive power, simple, 51,500 lbs. Factor of adhesion, simple, 3.4. Wheel base driving, 18 ft. 8 ins.; rigid, 18 ft. 8 ins.; total, 27 ft. 10 ins.; total, engine and tender, 60 ft. 1½ ins. Weight in working order, 195,000 lbs.; on drivers, 174,000 lbs.; on engine truck, 21,000 lbs.; engine and tender, 330,332 lbs. Boiler, type, straight top radial stay; O. D. first ring, 70¼ ins.; working pressure, 180 lbs. Firebox, type, wide, length, 107⅞ ins. first 50 and 107⅝ ins. last 50; width, 86 ins.; thickness of crown, ⅝ in.; tube, 1 in. and ⅝ in.; sides, ½ in. and ⅝ in.; back, ½ in. first 50 and ⅜ in. last 50; water space front, 4 ins.; sides, 3½ ins.; back, 3½ ins.; depth (top of grade to center of lowest tube), 21 ins. Crown staying, radial. Tubes, material, cold drawn seamless steel; number, 195; diam., 2 ins.; flues, material, cold drawn S. S. for 75 engines, hot rolled S. S. for 25 engines; number, 28; diam., 5⅜ ins. Thickness tubes, No. 12 B. W. G.; flues, No. 9 B. W. G. Tube, length, 17 ft.; spacing, ¾ in. E.; 11/16 in. B. Heating surface, tubes and flues, 2,386 sq. ft.; firebox, 176 sq. ft.; arch tubes, 24 sq. ft.; total, 2,586 sq. ft. Superheater surface, 553 sq. ft. Grate area, 64.4 sq. ft. Wheels, driving diam. outside tire, 52 ins.; center diam., 46 ins. Wheels, driving material, main, cast steel; others, cast steel. Wheels, engine truck, diam., 30 ins.; kind, C. S. spoke; tender truck diam., 36 ins.; kind, solid forged steel. Axles, driving journals main, 10½ ins. by 12 ins.; other, 8½ ins. by 12 ins.; engine truck journals, 5½ ins. by 10 ins; tender truck journals, 5½ ins. by 10 ins. Boxes, driving, main, cast steel; others, cast steel. Brake, driver, Russian West.; tender, Russian West.; pump, Ry. Co.'s std.; reservoir, 30½ ins. by 96 ins. Engine truck, two-wheel radial. Exhaust pipe, single; nozzles, 5½ ins., 5⅝ ins., 5¾ ins. Grate, style, rocking. Piston rod diam., 4¼ ins.; piston packing, 2 C. I. rings. Smoke stack, diam., 17¾ ins.; top above rail, 14 ft. 11 9/16 ins. Tender frame, A. L. Co.'s std. Tank, style, water bottom; capacity, 7,400 gals.; fuel, 8 metric tons of coal. Valves, type, piston, 12 ins.; travel, 6½ ins.; steam lap, 1¼ ins.; ex. lap, line and line; setting, ⅛ in. lead.

Peter the Great Fortress Reval, 2-6-0 Type

Track gauge, 750 m. m. Fuel, soft coal. Cylinder, diam., 11 ins.; stroke, 16 ins. slide valves. Tractive power, simple, 8,100. Factor of adhesion, simple, 4.1. Wheel base driving, 6 ft. 6 ins.; rigid, 6 ft. 6 ins.; total, 12 ft. 6 ins.; total, engine and tender, 26 ft. 9 ins. Weight in working order, 37,265 lbs.; on drivers, 33,376 lbs.; on engine truck, 3,889; engine and tender, 54,705. Boiler type, straight top; O. D. first ring, 35⅝ ins.; working pressure, 165 lbs. Firebox, type, narrow; length, 40½ ins.; width, 33 ins.; thickness of crown, 5/16 in.; tube, ⅜ in.; sides, 5/16 in.; back, 5/16 in.; water space front, 2¼ ins.; sides, 2¼ ins.; back, 2¼ ins.; depth (top of grade to center of lowest tube), 15 27/32 ins. Crown staying, radial. Tubes, material, steel; number, 85; diam., 2 ins. Thickness tubes, No. 12. Tube, length, 10 ft. 6in.; spacing, 9/16 in. Heating surface, tubes and flues, 463 sq. ft; firebox, 41 sq. ft.; total, 504 sq. ft. Grate area, 9.3 sq. ft. Wheels, driving diam. outside tire, 33½ ins.; center diam., 29 ins. Wheels, driving material, main, C. I.; others, C. I.; Wheels, engine truck, diam., 20 ins.; kind, C. I. plate; tender truck diam., 24 ins.; kind, C. I. plate. Axles, driving journals main, 5 ins. by 6 ins.; others, 5 ins. by 6 ins.; engine truck journals, 3½ ins. by 6 ins.; tender truck journals, 3¼ ins. by 6 ins. Boxes, driving, main, C. I.; others, C. I. Brake, driver, A. L. Co. steam; tender, hand. Engine truck, radial. Exhaust pipe, single; nozzles, 2¼ ins. and 2½ ins. Grate, style, C. I. rockers. Piston, rod diam., 2 ins.; piston packing, C. I. ring. Tender frame, steel channel. Tank, style, "U" shaped level top; capacity, 700 gals.; fuel, 1½ tons. Valves, type, plain "D"; travel, 3¾ ins.; steam lap, 7/16 in.; setting 1/16 in. lead in full gear.

American Master Mechanics' Association

Report of the Proceedings of the Forty-eight Annual Convention, June, 1915

The report of the meeting of the Master Mechanics' Association, held at Atlantic City last June, has recently been issued by the secretary, Joseph W. Taylor, Karpen Bldg., Chicago. The illustrations and folders are numerous and furnish many important details on improved construction. This book shows the earnest work of the various committees in securing valuable information on the various subjects, and the discussions bear out the conclusions arrived at by the committees. The committee on locomotive counterbalancing sets forth very clearly that many of the reciprocating parts of the locomotive can be made much lighter than formerly, on account of the marked improvement in alloy steels; the recommended amount of saving in weight being almost one-third, so that the parts referred to might be reduced to 1/240 part of the total weight of the locomotive, instead of 1/160 part, as in present practice, with the result that more of the weight of the locomotive could be used in pulling the train. Copies of the report, which contains 736 pages, may be had from the secretary.

Master Car Builders' Association

Proceedings of the Forty-ninth Annual Convention, June, 1915

The proceedings of the Master Car Builders' Association have recently been issued in two bulky volumes comprising 1,072 pages, with numerous illustrations and folders. Many of the reports are remarkable for the fulness with which the subjects were treated. The discussions also appear in complete detail, and the result unquestionably is that a considerable advance has been made toward standardization and improvement in designs of many of the details of car construction. Many recommendations of value appear, an instance being that wheels of the recommended size should be used, as the failure of car wheels, especially under refrigerator cars, were out of all proportion to the service. The failures were chiefly under cars of a gross weight of 105,000 lbs. or more, considerably in excess of what is supposed to be carried by the ordinary 625-lb. type of car wheel, 63 per cent of such overloaded wheels were found among all the car wheels reported cracked. Applications for copies of the report should be made to the secretary, Joseph W. Taylor, Karpen Bldg., Chicago, Ill.

The Life of a Steel Freight Car

Effort to get Maximum Service out of Steel Cars. Estimate of Life in Years not Always Accurate. Steel of Better Quality Used in Recent Years

"There is quite a diversity of opinion as to the life of a modern steel car," said Mr. Samuel Lynn, master car builder, P. & L. E. R. R., at a recent meeting of the Railway Club of Pittsburgh. "I will have to say that I was told by some, that a steel car will last anywhere from eight to fifty years." These are some of the expressions received in answed to letters of inquiry. Nearly all have formed opinions regarding the probable life of certain classes of steel cars, and these opinions are based on experience and conditions that have come directly under observation. "Therefore, instead of confining the subject strictly to 'The Life of a Steel Car,' I would suggest that the subject for discussion be 'What Maintenance is Necessary to Get the Maximum Service from a Steel Car.' "

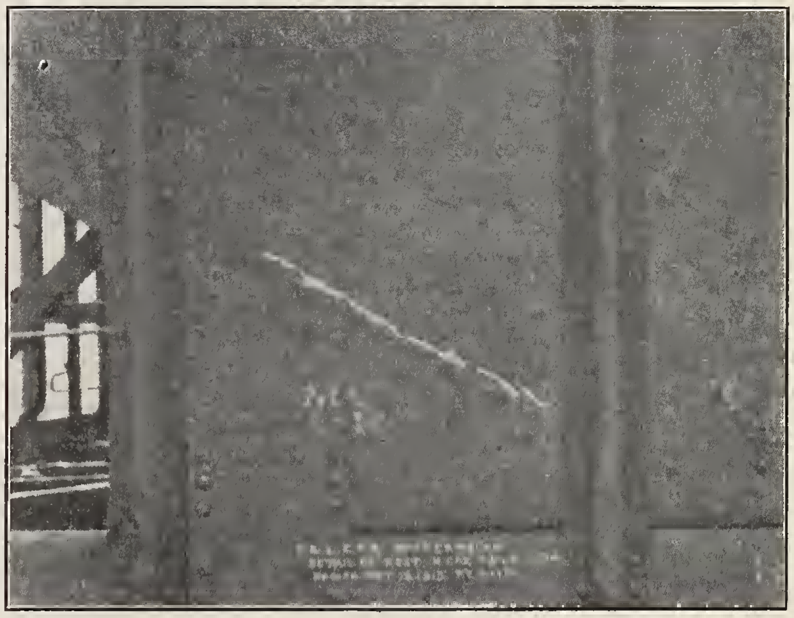
There are some car officials who apparently think that the steel car does not require much attention. This theory is not now given consideration, as any one responsible for steel car maintenance realizes that while the steel car, with its larger carrying capacity, increases the earnings of a road, yet after the car reaches a certain age its maintenance cost increases over that of the old wooden car.

One thing of most importance is the design of the car. Care must be taken to get the required strength in the underframe in order that the car may withstand the shocks incident to present-day handling. In addition to a good solid underframe, the draft sills and draw gear must be equally strong in order to do their work. There have been new cars turned out, and after the first or second loading the draw sills, or center sills from end sill to body bolster, were so badly buckled that they had to be removed and replaced and reinforcement added to strengthen the weak members. These cars, although practically new, were useless until this repair work had been done to take care of oversight or poor design.

The commodities with which a car is loaded and the climatic conditions in the territory through which it travels are important factors in the life of a steel car. The cars in this region carry coal, coke, and ore and are subject to very severe service, as they are usually hauled in heavy tonnage trains, and the acids in the coal and coke eat through the floor sheets very rapidly. In addition to the injurious effects of the acids on the inside of the car, the varying weather conditions, rain, snow and heavy damp atmosphere, help in the deterioration of the car.

In early days even car inspectors looked over a car primarily for safety appliance defects, hot boxes, etc., and took it for granted that because the car was made of steel it was all right, and for some reason, the steel car from the time it first appeared did not seem to have a friend. At the industrial plants where the cars were unloaded the men took frequent cracks at them with a sledge, and as a result the side and hopper sheets soon became bent out of shape. During the winter season when ore becomes frozen in the cars, some of the plants use dynamite to loosen up the ore, and in addition they frequently loosen up the floor and side sheets at the rivets. If the steel car was given reasonable treatment and repairs made when needed, and repainted when the steel became exposed, the renewing of some of the parts would not become necessary for a longer period than it is now.

From observation it has been found that the original painting of the steel car is usually faulty. Owing to the hurry-up methods of the contracting builder the required quality of paint is liable to be 'dryer-sacrificed,' or made to fit the building time of the car, without having the required protective qualities of the paint. Paint will not cure all the ills of the steel car, but if a liberal quantity of good paint was used to protect outside parts, the life of the car would be lengthened considerably. Occasionally we may hear of some railway official using the expression that 'a steel car will run and earn just as much money without paint.' This may be true, but the question arises, how long will the car run? Part of the expense of steel equipment maintenance is due to paint neglect. Painting



Ravages of Rust on Sloping Floor of Hopper

the inside parts of any steel car is unnecessary—the first loading cuts and mars the paint so that moisture can get under it and so do damage—but keeping the outside parts painted, the corrosion of the outside of the sheets would be counteracted to a considerable extent.

Some pictures shown on a screen made plain the effects of corrosion on the steel sheets on the sides of the cars, and also the effects of acids. Our illustration shows one of them. Along the floor seams near the hopper at each end of the car, the side sheets are entirely eaten through. A photograph was taken of a particular car when it came into the shop before the repairs were started on it, and after the car had been repaired and turned out, and loaded at one of the mines, another photograph was taken. The car is under load and appeared as if able to continue to earn money for some years to come. In order to keep this hopper type of car in service, it has been found that after the first 10 or 12 years, the floor and hopper sheets have deteriorated from ¼ in. in thickness to a very light gauge. In fact, along the seams and sides of the cars where the floor sheets are riveted to the sides, in some cases the steel is completely rusted through, and in order to get any further service from the car it is necessary to renew the floors and hoppers.

This has been done on a large number of steel hopper cars at an approximate cost of $225 a car.

After this class of repairs have been made and the cars have been in service for about 4 years, the car sides, which were in fairly good condition when the new floors were applied, have deteriorated to such an extent that it is necessary to renew the sides of the cars. This work can be done at an approximate cost of $130 a car, making a total approximate expense of $355 a car, on the car body, outside of various light repairs necessary at different times.

While this class of repairs was being made, it was found in a few cases that the center sills had deteriorated to some extent from corrosion. They had buckled due to shocks, making the application of new sills necessary. On such cars where new sills were applied an additional cost of $45 was necessary, making the total amount spent on the car body approximately $400. On a very large percentage of the cars on which this class of repairs is being made it is not necessary to renew the center sills. These sills, in most cases, have been reinforced between the body bolsters and the hopper sheets by a tie plate or channel section riveted to the sills, the cost of this application being included in the figures just given.

From all this it would seem that the bodies of the majority of the first steel cars built, or cars that have been in service 16 or 17 years, will require repairs amounting practically to the rebuilding of the car body. This rebuilding process, however, occurs at different stated periods, whereas if all the parts of any unit of equipment deteriorated at the same rate, there would be no question but that the average depreciation could be fixed very closely, as every part of the unit would then become worn out at the same time and the whole body of the car would probably be scrapped or rebuilt as a new unit. The present policy of maintaing the steel car as different parts fail is practically the same method as was employed in the maintenance of the wooden car equipment.

It has been the custom to estimate the life of the wooden car of either box or gondola at 20 years. The old wooden car, during the 20-year period, received at different times repairs such as two or more longitudinal sills, the renewal of the top side plank, new floors, and other repairs which amounted practically to the rebuilding of the car, yet for general purposes 20 years was considered the average life of the wooden car. Allowing the same treatment for a steel car, that is, giving it general repairs when necessary and properly maintaining the car so as to get maximum service from it, the steel car is still in serviceable condition after it has been running 16 or 17 years.

There are some who think that it is more economical to prolong the life of the car by repairs, while there are others who say that from an economical standpoint, it is better to run the car until it requires repairs such as have already been described as necessary, after it has been in service about 12 years, and then scrap the body and place a new body on the trucks. They believe that when the floors and hoppers are worn out, the rest of the car has deteriorated to such an extent that it is cheaper to scrap the body than to try to maintain it, and it would appear not to be good policy to scrap these cars.

One P. & L. E. car, excepting short periods when it was in the shop for class repairs, has been in continuous service since June, 1897, and is therefore over 18 years old. It is an 80,000 lbs. capacity car of the hopper type; it has a cubical capacity of 1,286 cu. ft.; weight, new, 35,700 lbs. The last time it was weighed, in June of this year, it was 35,200 lbs. The car was built of wrought iron by the Youngstown Bridge Company, and is in good condition today. The original sills, bolsters, end sills and draw members, as well as the sides, are still on the car. The car received heavy repairs in the years 1912 and 1915 at an approximate total cost of $450. The appearance of this car does not indicate that it should go to the scrap pile.

The first steel car of the B. & L. E. is over 19 years old, having been built in 1896, and from the information received from Mr. Dickinson, M. C. B. of the Bessemer & Lake Erie, this car has received at different times class repairs. Mr. Dickinson states that all the cars in this series are in almost as good condition as when first built. This will show that the Bessemer & Lake Erie Railroad is one of the pioneers in the use of steel cars.

It has been stated that opinions have ranged from eight to fifty years as the average life of a steel car, but as long as this type of car meets the requirements as to carrying capacity and stands up while rendering the service for which it was intended, justice would not be done to the steel car if a limit is placed on its life.

There is one other reason why no definite limit should be placed on the life of the steel car, and that is steel that is now being purchased and used for repair parts is inferior to the steel that went into the first cars built. Steel plates that are being purchased and used for repairs today are deteriorating faster than the original sheets of the cars. If this same grade of steel is being used by car builders today on new equipment, and an estimated average life was placed on cars based on the lasting qualities of the material used when steel cars were first built, the steel in the cars that are now being built and put in service might not last more than half the time of the cars first built, and we would be doing the steel car an injustice to say that at the end of any stated period it should be relegated to the scrap heap. The steel car can be maintained as long as the owner desires to run that particular type of car."

Present Unsatisfactory Conditions

Since the beginning of the year down to March 1st a larger number of locomotives and cars have been ordered than for a like period in the past nine years. It is safe to say that the railroads have just begun to replace equipment which has already been run to its limit; but in view of the overwhelming demand for all sorts of material and the high prices prevailing, these belated purchases are made at a great disadvantage.

Twelve months or more ago prices for materials generally were extremely low compared with present figures. Unfortunately, as is often the case, the railroads were in such financial straits that the low cost of everything which goes into railroad maintenance and construction could not tempt them to buy. In addition to the high prices, at present, deliveries are slow and uncertain and needs are pressing. While it is more than gratifying to observe the marked increase in railroad traffic the conditions offer little hope for the railroads to secure all the benefits they are entitled to; the public suffers at the same time, and anxious security holders are obliged to see full returns on their investments denied. These matters will of course adjust themselves eventually, when substantial good times are actually in vogue.

Chattering Slip of Electric Driving Wheels

Abstract of Paper Presented to the American Institute of Electrical Engineers by G. M. Eaton

Sufficient steam pressure in the cylinders of a steam engine to start slipping of driving wheels produces a sustained load on the piston adequate to insure fairly uniform acceleration of the driving wheels. With electric equipment the acceleration after slipping starts, is likely to be irregular in that aside from the method of transmitting the tractive effort of the rotors to the wheels, the acceleration is dependent upon the distribution of rotating masses and on the co-efficient of friction between the wheel and the rail.

An analysis of the forces at work in the electric locomotive in starting acceleration is necessary to appreciate the reasons for these conditions. When current is supplied to the motor the rotor or armature starts to turn. Clearance and lost motion in the transmission mechanism are at once eliminated. As the torque is increased the metal of the transmission is placed under strain and is bent, twisted or otherwise deflected by this strain. This stressed metal accumulates energy until finally the tractive effort becomes sufficient to overcome the existing adhesion of the wheel to the rail and the wheel starts to slip. The instant that relative movement occurs between the wheel and the rail, the co-efficient of friction drops from that of repose to that of relative motion, and an opportunity is presented for the stressed metal to discharge its stored energy as soon as part of the resisting force has disappeared.

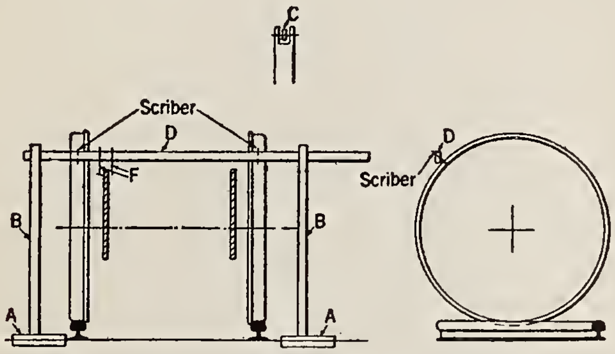


Fig 1

This energy accelerates the wheels ahead of the angular position relative to the rotor at the instant slipping began. The fact that the wheels are being accelerated ahead of the rotors causes the rotors to lose their load and to tend to speed up. This reaction is true both of series motors and of induction motors when running below the speed of synchronism. The adhesion of the wheel to the rail decreases as the velocity of the wheel tread relative to the rail increases. The effort necessary to turn the wheel therefore decreases very rapidly, due to the expenditure of the energy stored in the stressed metal of the transmission system, and as soon as the effort tending to accelerate the wheels becomes less than the adhesion at the rail which tends to retard the wheels, the wheels will start to slow down.

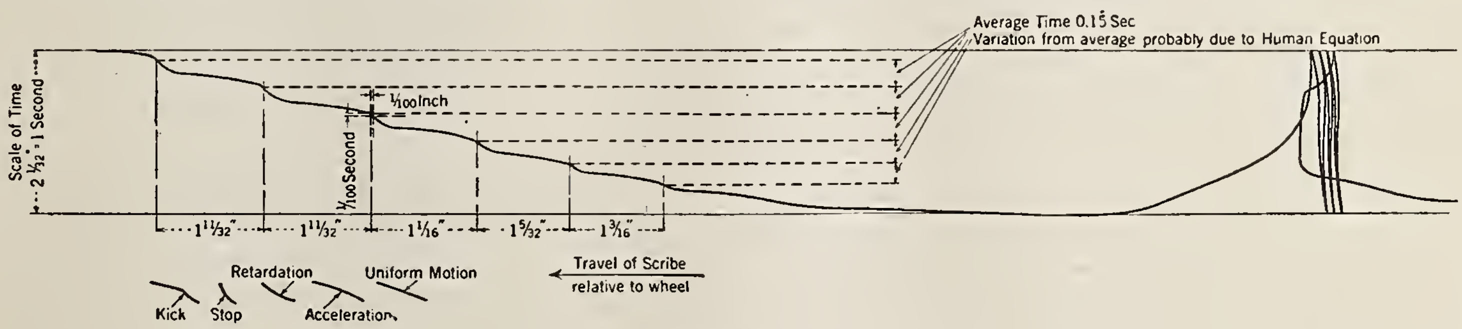


Fig 2

There is then first an effort of the rotors to turn the wheels in which the rotors are attempting to move faster than the wheels and as soon as this effort of the rotors overcomes the adhesion between the wheel and the rail, this tendency of the rotors to move more rapidly than the wheels instantly expends itself, and the momentum gathered by the turning wheel tends to accelerate the rotor. The clearances in the transmission which mechanically couple the rotating masses are first taken up in one direction and then the other and the shock and recoil resulting from their being taken up gives the setting for the chattering action which has been experienced in practically every type of electrically driven rolling stock where the motors are sufficiently powerful to slip the wheels at high adhesion.

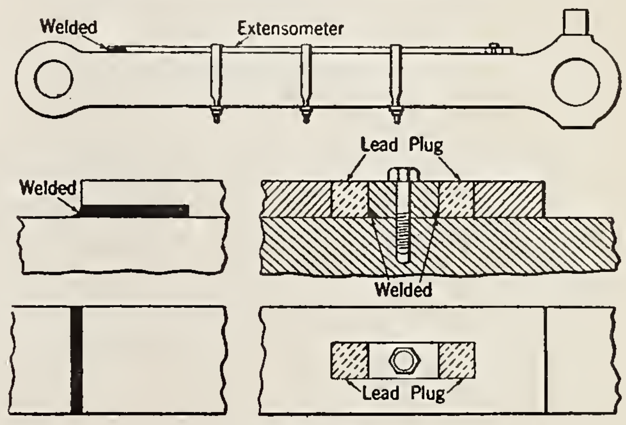


Fig. 3

The immediate harm traceable to this chattering lies in the breaking of parts of the transmission system which cannot withstand the instantaneous overloads produced. In one case quill spring arms struck the wheel spokes at a point near the tire and more or less breakage of these arms occurred. Inspection showed that the arms which broke had blow-holes in the interior of the castings and after defective castings were eliminated the construction was strong enough to put an end to failures at this point. In later locomotives in the same service two motors were mounted on each axle, and the change in rotor inertia eliminated this striking. Chattering slip could not be eliminated, but the capacity of the quill springs were sufficient to limit the amplitude of spring to a distance less than the existing clearances.

Chattering slip can be occasionally observed in City and Interurban cars although less frequently than in heavy electric locomotives due to the greater tractive power in proportion to the weight of the latter, which increases the chances of the wheels slipping.

In arriving at the approximate forces necessary to produce the acceleration and retardation which occur in chattering slip and the resultant stress in the rods and pins of the transmission mechanism, a rough oscillograph can be constructed as shown in Fig. 1. The brakes are set on all trucks of the locomotives save one, and the oscillograph frame set up on the remaining truck. The wheel tread is chalked and the oscillograph frame turned on its supporting points A, the amplitude of oscillation being two inches and the time of completing oscillograph two seconds. The scribers are pressed against the wheel tread, and the wheel treads are then slipped. A characteristic diagram is shown in Fig. 2 and the analysis of the figure is self-explanatory.

To check the figures obtained in this manner extensometers can be arranged as shown in Fig. 3, and the stresses resulting in the expansion and compression of connecting rods can be recorded by means of the compression of blocks of lead. The two methods should check within a very few per cent, and from the figures obtainable rods, pins, etc., can be designed which will prove adequate to withstand the instantaneous shocks caused by the chattering slip.

In all heavy hauling electric motive power this problem must be considered with every type of drive. The great number of variables are affecting the results, and the wide fluctuation to certain of these variables renders broad judgment necessary in securing a successful solution of any given problem.

Welding by the Electric Arc

Description of the Method of Applying the Process to Boiler and Other Kinds of Work

A description of electric welding given by Lieutenant C. S. McDowell in the Journal of the American Society of Naval Engineers is full of interest. Among other things he says: Welding is the joining of two pieces of metal, like or unlike, by fusion, while they are in a plastic state. The former definition of welding was stated as the process of uniting two pieces of metal by hammering them together while hot. Modern methods of obtaining high temperatures by means of electricity has broadened the definition of welding and brought in use additional processes, to which the term "welding" has been applied. The process is applicable to reclaiming castings, repairing broken machinery of all kinds, building up of worn parts, welding seams in boilers, tanks, making high-speed tools, repairing boilers, etc. The essential characteristics of a successful weld are: That the metal in the welded joint shall be free from impurities, slag and defects of all sorts; that it shall possess a sufficient amount of elongation, flexibility and tensile strength; and that the process of welding shall be such as to reduce to a minimum disturbances in the texture of the surrounding metal.

There are two methods of electric arc welding: One in which a carbon electrode is used, and the other in which a metallic electrode is used. As a result of the tests which have been conducted in electric arc welding, it is believed that the carbon electrode process is not suited for general work, some of the reasons being that much greater difficulty is experienced in maintaining the proper temperature, and there are more chances of getting an excess of carbon in the weld. In the other process, which is extensively used, it is necessary to have the metal electrodes of such material that the deposited metal in the weld shall have practically the same characteristics as the rest of the metal in the object worked on. It is necessary to have the electrode contain an excess of certain materials over what is desired in the finished weld. The amount of loss of metal electrode depends on the temperature, and it has been found necessary to have a constant temperature at the weld.

A certain amount of skill and experience is required on the part of the operator, as some types of apparatus require much more skill and closer attention than others. A system which depends primarily on the skill of the operator cannot turn out work uniformly good. some persons believe that a flux is necessary, but in the tests conducted all sorts of material have been welded, and the best results have been obtained where no flux is used. The claims in favor of flux are: that it blankets the weld by forming a glass around the material which prevents oxygen reaching it and so prevents oxidation; this has been proved not to be necessary, by making similar welds where oxygen was entirely excluded, and then other welds in the air, and no difference in strength or structure of the weld was to be found in either case. It has therefore been considered that in a good electrical welding system a flux is not a necessity.

While it is recognized that it is desirable to have as simple an equipment as possible, it is considered necessary to have an automatic control of the input energy to the weld, so that when the proper amount of energy has been determined for a particular job it will remain constant regardless of the varying of the arc length. It should be possible for the operator to set the current controller at the desired amount, as well as at the panel board; the controller should automatically keep the current approximately at the fixed value. A variation of less than 5 per cent can be obtained with a well-designed equipment. The electric arc has been found suitable for cutting, but a carbon electrode must be used; no automatic current-control is necessary, although a choke coil is advisable to prevent large inrushes of current. The amount of current varies with the size of the material to be cut.

The material to be welded should be cleaned with a scraper or wire brush to remove oxides and prevent forming of slag, and it is also necessary to bevel the edge sufficiently so that the distance from the electrode to bottom of the weld is less than that of the electrode to any other part of the article, so that the arc will not stray. In thick plates, where possible, and especially in castings, it is usual to weld from both sides, and in this case the original material is pointed by beveling on both sides.

A large saving in cost on repair work has been made on boiler jobs, in addition to a saving in time. A specific application of arc welding is in the making of high-speed tools, a piece of the tool being made out of ordinary steel, and high-speed tool steel is welded on for the cutting edge only. Some other applications are: Building up of worn wearing parts, pins, rollers, bearings, etc.; welding of plates instead of riveting, or where seams are leaking; building up of rivets, building up stripped gears, repair of cracked castings, making of high-speed tools, filling blow holes. In manufacturing work: Welding of heads on tanks, welding of tubes in tube sheets, welding of broken feet on castings. Brass, bronzes and aluminium, as well as steel, cast steel, wrought iron and cast iron, can be welded by this process.

The Chilled Iron Car Wheel

The Origin of the Flat Spot and Seams in Wheel Treads, Both in Steel and Chilled Iron Wheels; Remedies That May Be Applied. Record of Performance in Winter

Looking further into the paper on the "Chilled Iron Wheel" read before the Richmond Club by Mr. F. K. Vial, chief engineer of the Griffin Wheel Co., of Chicago, we find that in dealing with characteristics which develop in service, Mr. Vial spoke substantially as follows. Without quoting his actual words, we may give our reads the results of his observations.

Leaving out of consideration the laboratory tests and the composition of the metal, which have been already dealt with in these pages, we turn to the M. C. B. Code of interchange rules, and the first thing to be considered is Rule 68, which deals with "Flat Sliding Cast Iron or Cast Steel Wheels," and which calls for the re-

Fig. 1. Typical Flat Spot Chilled Iron Wheel

moval of all wheels having a flat spot 2½ ins. or over in length. Fig 1 exhibits a typical flat spot in the chilled iron wheel. The length of the flat spot is definite; its borders are clearly defined and are not pounded out, nor are they smoothed away in service. The noise caused by such a spot as the wheel rolls is characterisitc. The intensity of the blow on the rail for a flat spot up to 2½ ins. is not great. The intensity of the blow increases as the spot becomes larger until a maximum is reached at a certain speed, after which the intensity of the blow diminishes. The longer the spot, the higher the speed at which the maximum blow is produced.

The conditions affecting the steel wheel are different because its malleability allows the edges of the flat

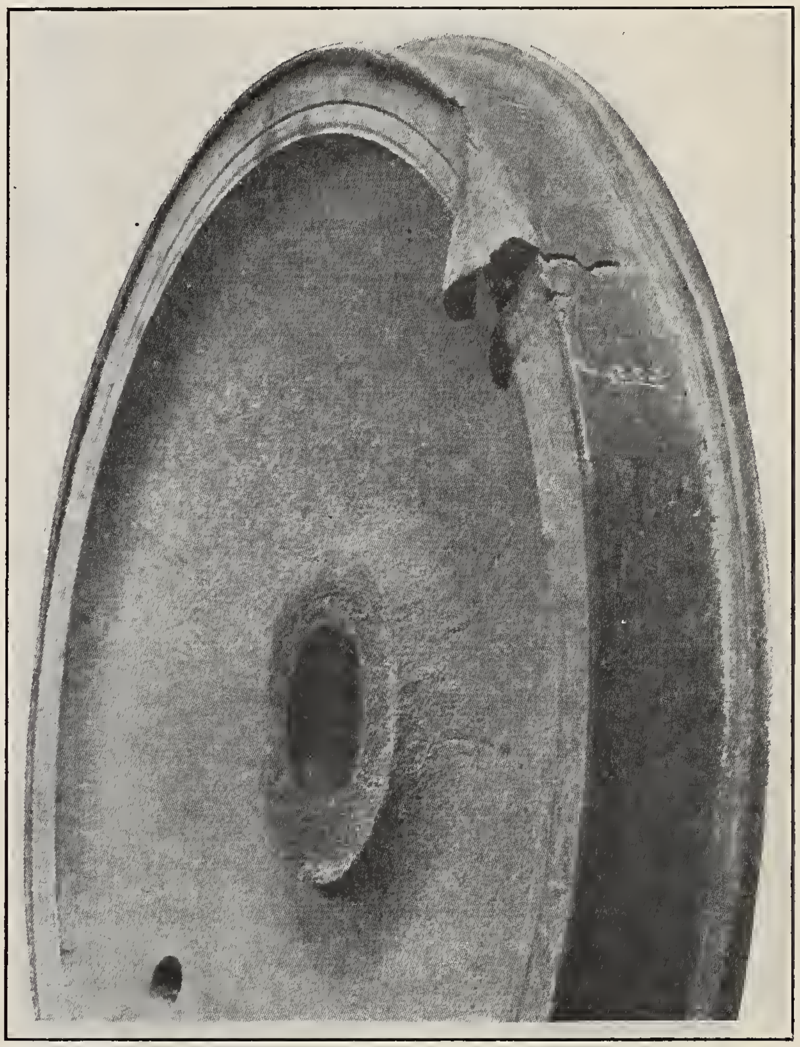


Fig. 2. Flat Spot on a Steel Wheel

spot to be pounded out and lengthened until finally there is practically an eccentric wheel produced. The long rounded spot in a steel wheel does not produce a distinctive noise, and often remains in service until a very considerable eccentricity has been developed. This constitutes a serious danger, especially in winter and in very cold weather, and when the track is covered with ice, as the constant pounding tends to loosen rivets, break truck parts, and to seriously damage and fracture rails. Fig. 2 shows the flat spot on a steel wheel, and how its development and action differs from that shown on the chilled wheel, Fig. 1.

During the winter of 1912-13 there is record of 29 flat steel wheels under a mail train of 6 cars. In this season 66,000 rails were broken upon the railways of the United States. No such record has ever been charged against the flat spot on the chilled iron wheel. The only occasion where a chilled iron wheel may develop eccentricity is when it has been worn through the chill. This is a condition which is not likely to happen if the M. C. B. rules for minimum chill are observed, and when it does occur it is easily recognized and the wheel removed before eccentricity is developed, because this defect is of slow growth. A metal which

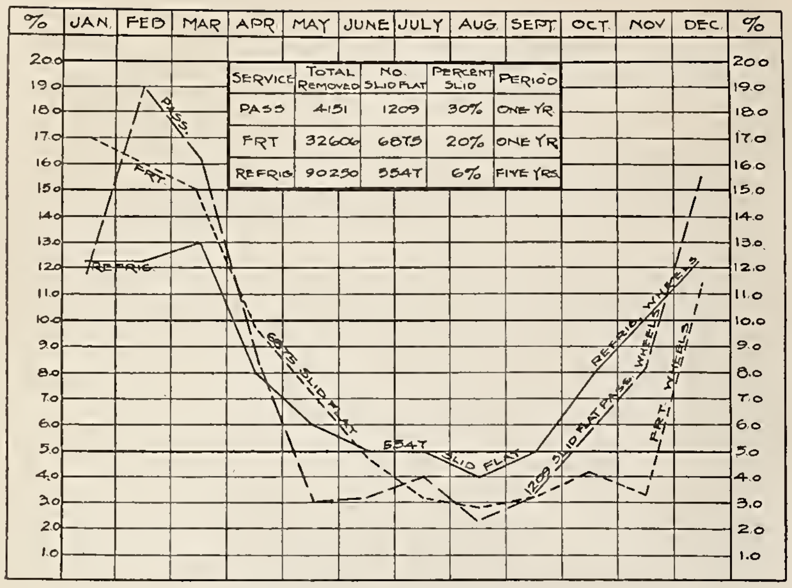


Fig. 3. Weather Effects on Flat Wheels

has any degree of malleability is in a condition where flat spots will grow rapidly, because at each revolution a blow is struck at the same spot on the wheel, whereas the rail receives a blow at intervals of about 8 ft. Yet it is possible that the causes for flat spots in the chilled iron wheel, though numerous, are capable of a material reduction in number. Fig. 3 shows the effect of weather upon a number of flat wheels. Statistics show that three times as many flat spots are developed in winter as in summer, especially in the colder climates.

In dealing with what are called broken flanges, it is at once apparent that a very important item with refer-

Fig. 4. Chilled Iron Wheels With Vertical Flange and With Shoulder Worn Close to Flange

ence to safety in transportation, is the reliability of the flange. The object of the flange is to guide the truck, and one flange or the other is constantly in contact with the rail and subject to rubbing or grinding, always under pressure. When traversing a curve, the flange pressure amounts to from 10,000 to 20,000 lbs. under ordinary circumstances, and impacts may momentarily be much greater than these amounts, but the continuous grind, without lubricant, results in flange wear. This is more pronounced in the case of the steel wheel than in the chilled iron wheel for two reasons, because steel is softer than chilled iron, and because the material of the steel wheel and the rail are identical, being fibrous rather than crystalline. The surfaces of flange and rail are roughened and there is greater rapidity of abrasion.

Fig. 4 shows various conditions of wear on chilled iron wheels. In one case a shoulder is worn on the

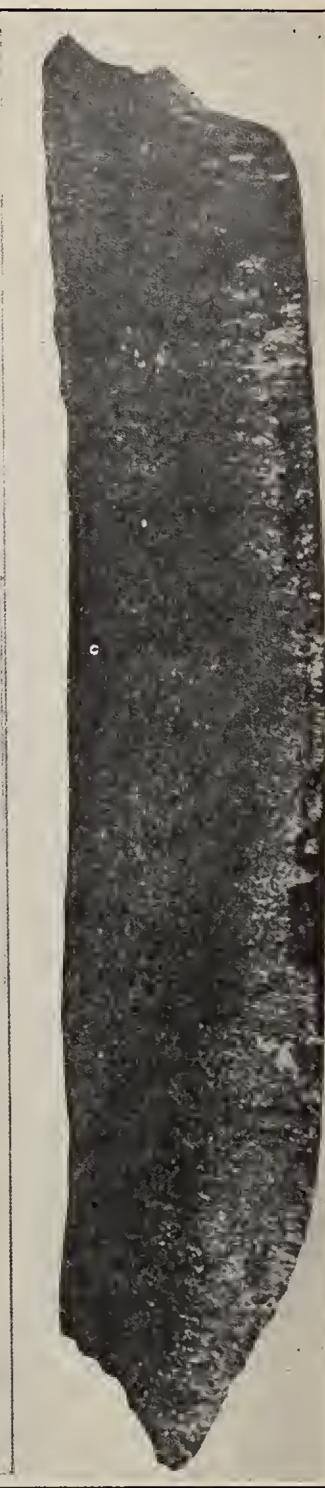


Fig. 5. Seam Below Surface —Blue Fracture

Fig. 6. Seam, Progressive Type.

throat of the chilled iron wheel on account of its mate being sharp flanged, while it exhibits a typical vertical flange shown with the M. C. B. defect gauge applied, so as to indicate that the vertical flange has reached the limit and should be removed. A broken flange through solid metal is of rare occurrence on a chilled iron wheel, although there has never been any increase in the thickness of the flange from the time when the 10-ton car was standard on the railways of this country.

In the matter of what are called seams, it is true that a seam in the throat is responsible for a certain number of broken flanges. Figs. 5 and 6 make two classes of seams apparent, one of which develops below the surface of the metal and is known as a blue fracture, and the other, occurring in wheels of low chill, is of what may be called the progressive type, as it starts in small cracks in the throat, which eventually unite and form one line, which gradually grows to be a crack through the chill. This may work through the grey iron and result in a broken flange. This type of seam can be eliminated by avoiding low chill. The blue fracture cannot be detected until the surface metal, usually about one-eighth of an inch thick, is broken through, so as to show the seam below. This blemish is a foundry defect and can be avoided by pouring iron at the proper temperature. It is true that seams in the throat of the chilled iron wheel are less prevalent than they were some years ago. Fig. 7 shows a seam in the throat after the surface metal has been broken through near the flange, and is marked B, and also a seam at the rim, marked A. As the cause for these seams is known, and is under the control of the foundry, they should eventually be eliminated. There is little or in fact no excuse for seams in the throat or in the rim under present foundry practice. Fig. 8 shows a section of a mold in which a wheel is cast. When the iron is poured into the mold first it fills the lower part of the hub and then passes through the bottom plate and the brackets, and fills up the flange. The section of the mold forming the flange is thin and the upper part is formed by the metal chill. From this it is evident that the metal in the flange would be partially cooled by passing over the cold sand of the mold before reaching the chill. This metal is also not stirred or mixed by the metal subsequently entering the mold, as it flows on top of that which forms the flange.

It is evident that the metal in the flange has already set solid and has begun to contract while the metal above the throat is still in a soft and pasty condition,

A — Fig. 7. Seam at Rim B — Seam at Throat

with the exception of a thin layer of surface metal which has been cooled by the chill.

The more rapid cooling and contraction of the metal forming the flange, as compared with that in the tread, tends to cause a separation of metal, which produces the seam, as shown in our illustrations. This is only true where the iron, when poured, was not at a sufficiently high temperature to set homogeneously throughout the tread and flange portion of the mold. Where seams of this kind occur, it is almost always found that the tread is chilled nearly through, and the iron, mottled in appearance, contains large flakes of graphite, which are widely separated. Chill having this appearance occurs most frequently in wheels poured from fresh ladles, also where the iron was at too low a temperature from any cause. Modern foundry practice re-

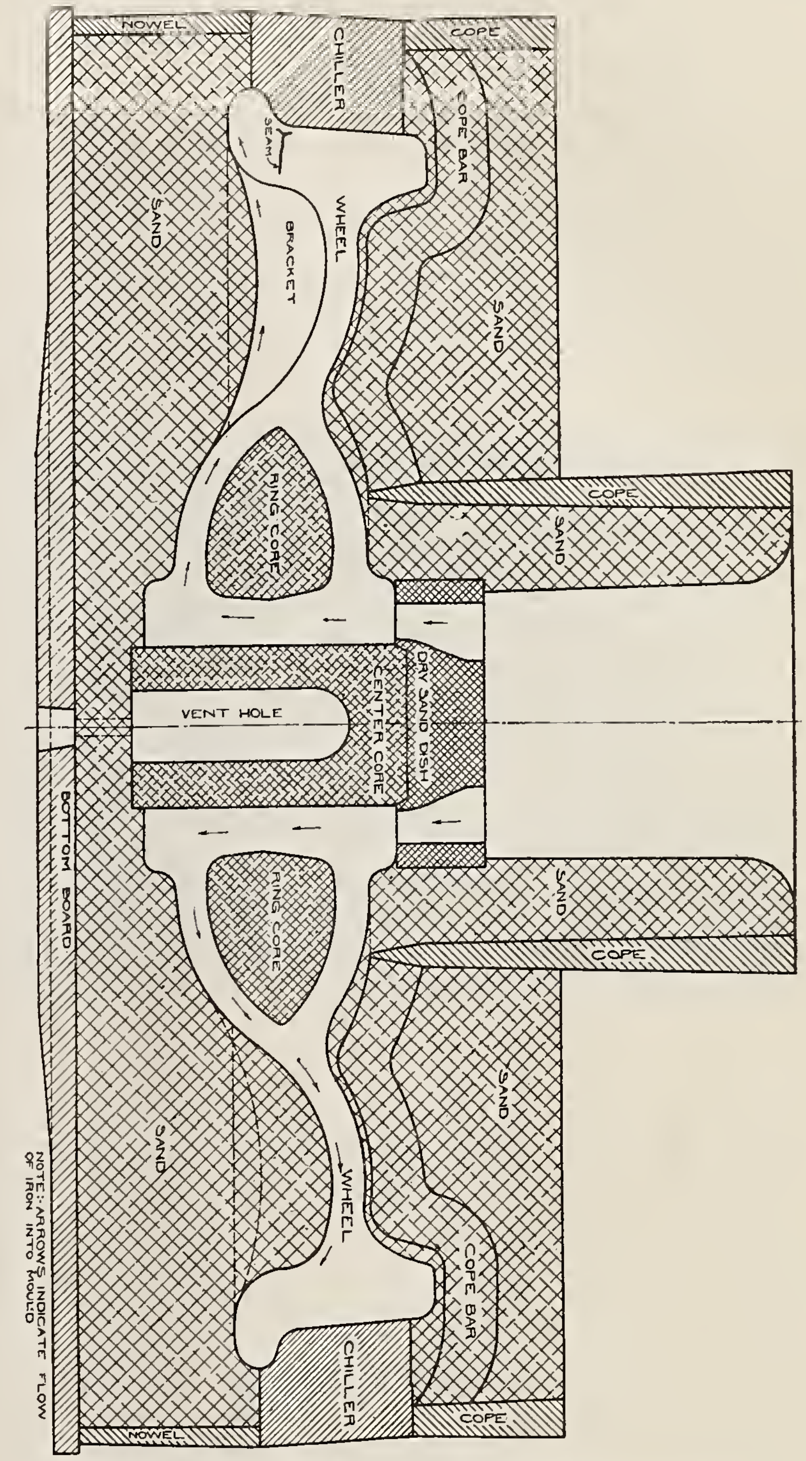


Fig. 8. Section of Mould for Chilled Iron Wheel

quires that ladles shall be heated before being poured, so that the molten metal will keep hot for longer time and arrangements are made to insure rapid pouring into the molds. Seams are not confined to chilled iron wheels, they are also to be found in steel wheels.

A Busy Supply Department

The Purchasing Department of the Pennsylvania Railroad handled on an average last year 737 requisitions daily; 287,206 orders for supplies and material were sent out, and 365,219 bills or invoices covering these purchases were passed upon.

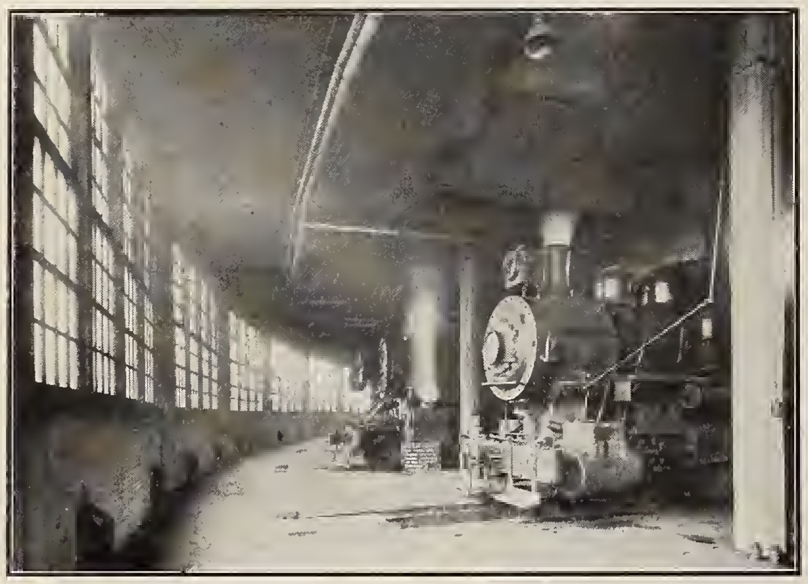
During the year this department's mail—incoming and outgoing—amounted to nearly 1,000,000 pieces, or a letter on the average for every $100.00 expended. The incoming mail amounted to 480,126 pieces, on the outbound 466,405 pieces.

Lehigh Valley Round House at Sayre, Pa.

Typical Well-Appointed Round House. Provision by which Case of Accidental Destruction of Wall Opposite a Track, Does Not Cause Extensive Damage

The work of construction of a wheel and axle shop, a 46-stall reinforced concrete round house, the foundation for a 75-ft. transfer table, the center foundation and ring wall for a 100-ft. turn-table, oil house, locker room and tool room, together with a small office building, was put through by the Lehigh Valley Railroad as an extension of their facilities at Sayre, Pa.

The 46-stall reinforced concrete round house was designed and built with concrete foundations, structural steel colmns for the front and interior columns, the structural steel being incased in concrete. The



Interior of Sayre Round House, L. V. R. R.

rear-wall columns are of reinforced concrete, built wide, in the form of pilasters. The building is 13 ft. 6 ins. center to center of front-door posts, and 95 ft. deep. The overhead clearance for the front door is 17 ft. The roof construction is composed of main reinforced concrete girders which run over the tops of the columns from the front of the building to the back. These girders vary in size from 1 ft. 2 ins. wide by 1 ft. 10 ins. deep to 1 ft. 2 ins. wide by 2 ft. 6 ins. deep, depending on the span. The construction between the girders is made by narrow reinforced concrete beams with hollow tile between, with a concrete slab above. The depth of the beams and tile used varies from 8 ft. to 12 ins., depending on the span. This form of construction gives a smooth surface for the underside of the roof, allowing a better escape of smoke.

Paul Dickinson & Co. cast-iron smoke stacks are installed. They are long and narrow and allow some movement of an engine without carrying the smoke stack out from under the jack. The roof is waterproofed with the Standard Paint Company's 4-ply built-up roofing, flashed with 16-oz. copper flashing. The rear wall of the building is built with 8-in. brick, panel wall, with a wooden window above. This panel wall and window is independent of the re-inforced concrete pilasters. This prevents any damage to the framework of the building in case an engine accidently went through the back wall. The floor is 1½-in. mastic on 6-in. concrete sub-base. The building is equipped with engine pits 74 ft. long, 2 ft. 6 ins. deep at one end and 3 ft. at the other, thus allowing for drainage. A drainage sump is arranged at one end, with a grating. The pits are all drained by being linked together with 8-in. tile pipe, and the same are brought outside the building to a manhole connecting with the general sewer system. We may say that the rain water leaders for the front of the building are taken into the same drainage system.

The pit walls are made wide enough to allow for jacking. Two tracks are arranged with a pony drop pit and two tracks are arranged for a trailer drop pit. These pits are 5 ft. wide by 7 ft. 8 ins. deep, and 6 ft. wide by 7 ft. 8 ins. deep, respectively. The heating of the building is accomplished by two 190-in. engine-driven fans set in two seperate buildings, put up as a lean-to on the main round house, the hot air being led to the pits and into the building through concrete and tile ducts. The electric lighting is by means of overhead illumination, all wires being protected by being in a conduit laid in the concrete roof. The building is supplied with the usual steam, air and water piping. A Millers boiler-washing system is installed, twenty tracks being piped for this system. Our illustration shows in a general way the construction of the building.

The construction of the building was carried out under considerable difficulties, owing to the fact that an old round house, which had to be kept in operation until the new round house was ready, occupied the space covered by stalls 41 to 46 and 1 to 5. Considerable difficulty was also experienced in removing the foundations of this old round house, which were built of heavy masonry and required extensive blasting to get them out. We would say that the construction work on this job occupied about five months. In other words, in five months the first engine was housed. The entire superstructure above the foundation for 40½ bays was "poured" in 33 working days, making an average of 1 23-100 bays per day. The method of "pouring" this building was by a comparatively low Insley tower and spouting, which was mounted on a track on the inner circle of the building. This tower was moved around

L. V. R. R. Round House and Turn Table

as the building was "poured." The material, such as sand, gravel and cement, was brought in on cars on a track just inside the building and moved along parallel with the tower. This made a very effective method of handling this material.

The wheel and axle shop building is 50 ft. by 65 ft., with concrete foundation, brick walls, steel columns, and trusses covered with wood sheathing on wood purlins. The roof has been waterproofed with the Standard Paint Company's built-up waterproofing. Steel sash glazed with plain glass has been used in the building, and a mastic floor was put in. In connection with this building, a depressed track was built for loading wheels in and out.

The oil house is a combination building, used for an oil house, engineers' tool room, engineers' locker room, with over-all dimensions of 40 ft. by 100 ft. The oil house is provided with a basement 40 ft. by 40 ft., in which are stored two 5,350-gallon tanks, one 1,900-gallon tank, one 190 gallon tank, and seven tanks having a capacity of 10,000 gallons. The building is made of concrete from the basement floor of the oil room up to 4 ft. above grade. Higher than this point it is of brick, with reinforced concrete beam-and-slab roof. The roof has been waterproofed with Standard Paint Company's waterproofing. The windows of the oil room are of steel sash glazed with wire glass. All oil room doors

L. V. R. R. Round House at Sayre, Pa.

are fireproofed. The remainder of the building has wooden window sash glazed with ordinary glass. Ordinary wooden doors are used.

Four Wayne Oil Tank and Pump Company's long-distance self-measuring oil pumps are installed, together with a battery of seven Bowser tanks, with Bowser self-measuring pumps mounted on them. A separate room is provided with fireproof wall and doors for the storage of waste. The waste is handled by means of a monorail. In connection with the 75-ft. transfer table, the foundations of which were installed by the L. V. R. R., it was necessary to cut off an old flue shop and cab shop and demolish an old wheel and axle shop. The work was carried out by Westinghouse, Church, Kerr & Co., in co-operation with and under the direction of Mr. E. B. Ashby, chief engineer of the Lehigh Valley Railroad.

Dynamo-Electric Machinery for Railroads

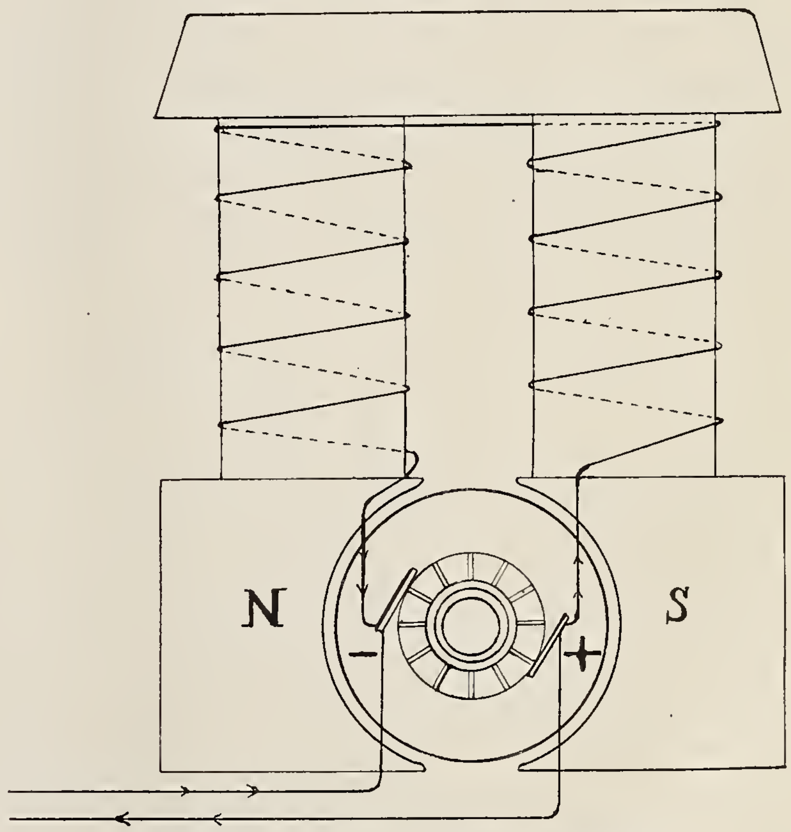
By REGINALD GORDON

Generating and Transforming Units Described and their Operation Explained

The art of designing electric generating machinery has advanced so rapidly and so far that units of 30,000 kilowatts, equivalent to 40,000 horse power, are becoming common in railway generating stations. The term "generating unit" is applied to any combination of steam engine, or steam turbine, or water wheel that drives a dynamo; prime mover and generator commonly being set on the same base, or foundation. Generators in railway power houses are usually built to furnish alternating current, abbreviated to the letters A. C. Sometimes direct current, abbreviated, D. C., machines are used, but chiefly for shop motors and lights, or for street and interurban railways where the energy is not transmitted more than a few miles. In railway substations, a type of machine called a rotary converter is installed, which runs as a motor driven by A. C. power, and at the same time generates D. C. power which is fed into the third rail or trolley wire.

Generally speaking, generators may be classed either as self-excited or separately-excited. The diagrams used here show this distinction for machines having only two poles in the field, but the principle can be extended to include any number of poles. Alternating current generators supplying power to railways are almost always separately excited. The exciting generator or "exciter" as it is called, is sometimes belt-driven from a pulley on the shaft of the main generator, or mounted directly on that shaft. Its output is D. C. energy that goes through the coils of the field magnets of the large machine, and is regulated in amount according to the demand for power from the latter. All D. C. generators must have a commutator, or device for collecting all the positive currents in the armature circuits, and connecting them with the positive terminal; and collecting all the negative currents, and connecting them with the negative terminal of the machine, whence they are distributed by the leads or bus-bars to the switchboard. This commutator is made up of a large number of segments or narrow pieces of copper, each insulated from those next it by narrow strips of mica, bakelite or other approved insulation. This fact limits the voltage or electro-motive force that can be generated in one D. C. dynamo; so, when power must be transmitted at high voltages, it is almost always done with alternating, and not with direct current. If D. C. power must be obtained for lomotives or for shop motors from a distant power plant, the A. C. current must be transformed to D. C., at points where it is to be used or locally distributed.

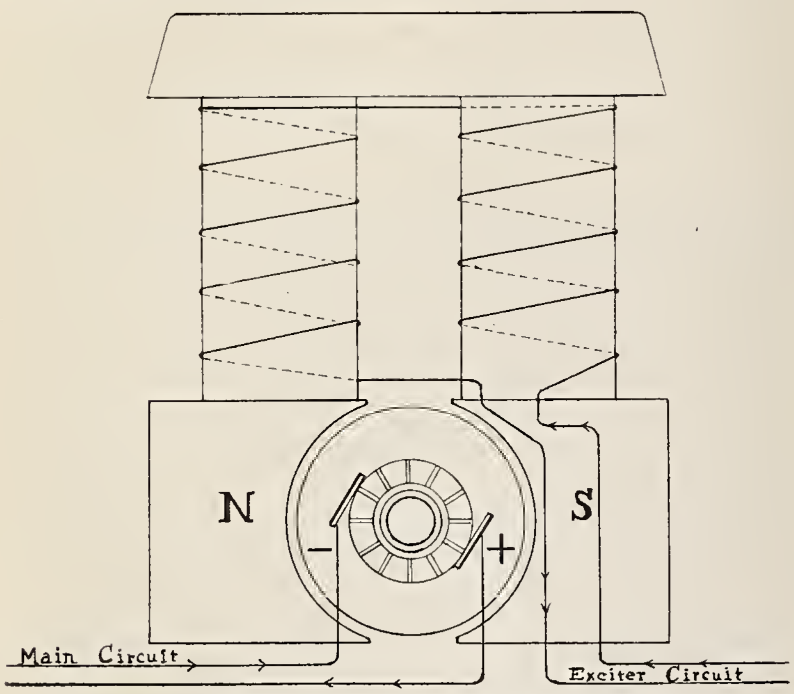
For electric locomotives or motor cars either direct or alternating curent may be used. It has never yet



Self-Excited Direct Current Generator

been definitely settled by electrical engineers which is the better system for railway work under all conditions of distance, grades, speed, train load, density of traffic, etc. The two systems are being used about equally. The Pennsylvania Railroad has both, employing 600 volt D. C. locomotives for its New York terminal electric service, and 11,000-volt A. C. for the motor coaches used on the Philadelphia-Paoli electrification described in the January, 1916, issue of Railway Engineering and Maintenance of Way. Both systems are alike in one respect. They both generate alternating current energy in the power houses and transmit it at high tension to various points on the electrified division. On the roads using D. C. this alternating current must be transformed to direct, and thence transmitted to the third rail or overhead conductor. On the other hand, roads equipped for A. C. operation with the energy transmitted from the power station may be fed directly into the conductor from which locomotives and cars draw their supply.

Where power must be transmitted long distances, A. C. energy must be supplied, not only because the amount



Separately-Excited Direct Current Generator

of power that can be distributed through a wire circuit increases almost in proportion to the rise in voltage at the source, but also because, as before mentioned, it is not practicable to build D. C. generators so well insulated as to stand the strain of high tension between adjoining commutator bars and armature circuits. For these reasons the common practice is to install steam turbine-driven A. C. generators, transmit the 13,200-volt A. C. energy to sub-stations located 12 to 20 miles apart along the road, and at each sub-station convert A. C. power into low tension D. C. power at 650 volts.

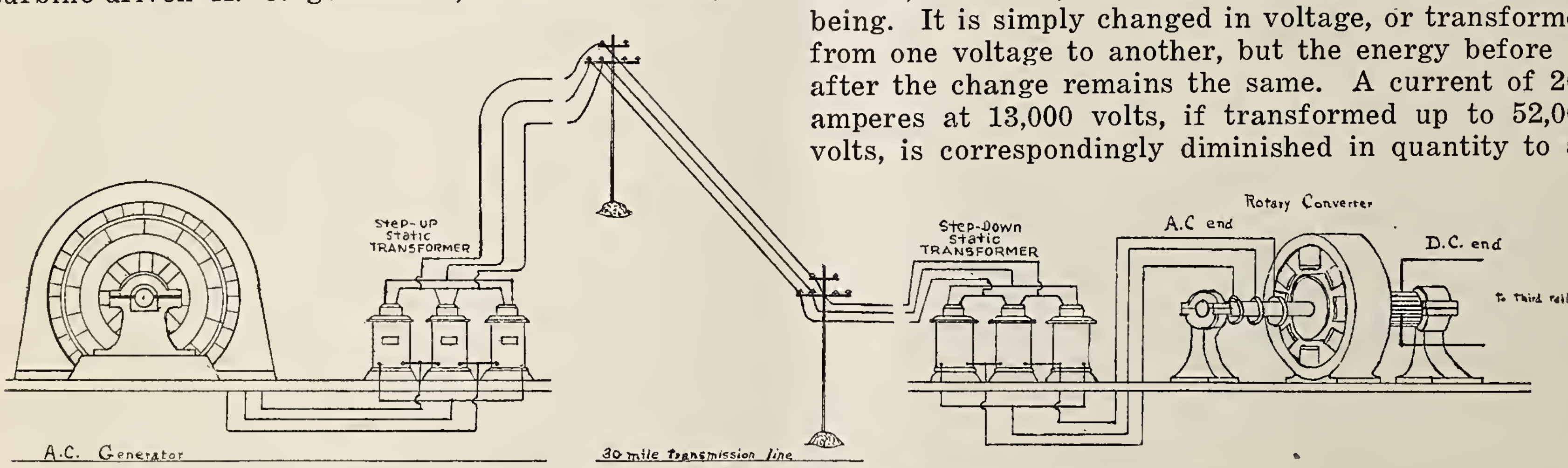


Diagram of Typical Power House, Transmission Line, and Sub-Station

Where A. C. energy is to be transmitted at a voltage higher than that for which it is practicable to design a generator, the output of the latter is raised by a transformer to the desired value, and lowered at the sub-station in a similar manner.

A transformer (called also a static transformer, because it is stationary and does not move, nor has it any moving parts) is an electro-magnetic device for alternating current, consisting of an iron core, or frame, on which is wound two circuits. One of these consists of a few turns of thick wire, and the other of a large number of turns of fine wire wound close together, but insulated from each other; the thick wire being connected to the generator and the fine wire to the line. Every alternation of current through the winding connected to the generator induces a current in that connected to the line; but the voltage in the line coil, or secondary, is higher than that in the primary, in proportion as the number of turns of the fine wire is greater than that of the thick wire.

Thus a dynamo giving alternating current at 13,200 volts is conected to a transformer that "steps up" the voltage to 44,000 volts, at which pressure it is transmitted along the railroad to a sub-station where another transformer is situated, by which the pressure is "stepped down" to 11,000 volts. At this voltage it is fed into the overhead conductor for use with A. C. locomotives and motor cars. If these, on the other hand, are designed for D. C. power, the transformer at the receiving station must be supplemented by a rotary converter, referred to in the first part of this article. Rotary converters usually have an armature, or rotor, having two entirely separate systems of circuits, one of which connects with collector rings on the A. C. side and the other with a commutator and brushes, from which direct current power is taken off for the third rail or overhead wire.

According to local governing conditions, some roads use one system and some the other. Thus the New York Central and Pennsylvania distribute A. C. energy from the power stations at 13,200 volts and convert it at sub-stations to 650 volts D. C. The New Haven distributes A. C. at 22,000 volts, and by the use of special transformers supplies it at 11,000 volts to the locomotives.

The Chicago, Milwaukee & St. Paul receives A. C. energy at 100,000 volts at the sub-stations, which then distributes it as D. C. current at 3,000 volts to the overhead wire. It must be remembered that in every transformer of energy, say from 13,000 volts to 44,000, or from 2,200 to 110, no energy is created or brought into being. It is simply changed in voltage, or transformed from one voltage to another, but the energy before or after the change remains the same. A current of 200 amperes at 13,000 volts, if transformed up to 52,000 volts, is correspondingly diminished in quantity to 50 amperes, or less. This latter quantity, however, can be distributed by a smaller wire than the former in the ratio of 1 to 4. This smaller wire is the secret of success of high-tension A. C. transmission.

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High art consists neither in altering nor in improving nature; but in seeking throughout nature for "whatsoever things are lovely, and whatsoever things are pure."—Modern Painters.

Factors Causing Variable Tractive Effort of Electric Motors

By A. J. MANSEN

Difference Between the Constant Tractive Effort of a Steam Locomotive and the Variable Tractive Effort of an Electric Motor

Electricity is being introduced here and there as a motive power on steam railroads, and since the electric locomotive is entirely different in principle from the steam locomotive, a few remarks as to the calculation of tractive effort developed by electric locomotives, and a few words comparing the electric locomotive and the steam locomotive, should be of interest.

The tractive effort of the electric locomotives, as for the steam locomotives, is the power developed at the rim of the drivers. The tractive effort of the steam locomotive is obtained from the following formula:

$$T = \frac{d^2 \times s \times 85\% \ P}{D}$$

Where T = Tractive Effort
d = diameter of cylinder in inches
s = stroke in inches
P = boiler pressure in pounds
D = diameter of drivers in inches

From this formula it is noted that the only variable part is the boiler pressure, and since the boiler has its limits in size, due to the design and railroad conditions, there is a maximum tractive effort which can be obtained from the steam locomotive, and this maximum tractive effort is at the point when the boiler is delivering its maximum pressure and maximum output of steam.

In the case of the electric locomotives, there are certain fixed conditions, namely, the diameter of the drivers and also the mechanical connection between the electric motors and the drivers. This connection may be a one to one ratio as in the case of the Pennsylvania Railroad electric locomotive, which is driven by a jackshaft and side rod, the drivers revolving one revolution for each revolution of the motor, or the motors may actuate the drivers through gearing where the motor revolves usually about four to six times for each revolution of the driver.

The tractive effort at the rims of the drivers, therefore, bears a fixed relation to the power given out by the electric motor. However, the power given out by the motor is not a maximum fixed value, as in the case of the steam locomotive, which depends on the boiler pressure admitted to the cylinder, but covers a wide range, and is only limited by the amount of electric current which it is safe to put through the motor. The power developed by the motor, or as known to electrical engineers as torque, is directly, and approximately, as the value of current fed to the motor, i. e., the torque from the motor with 500 amperes, will be only one-half of the torque if 1,000 amperes were fed through the motor. Since the electric locomotive receives power for the motors from an outside source, such as a third rail or overhead wire, this source of supply being practically unlimited, compared with the capacity of the locomotive, a tractive effort of any amount can be obtained from the electric locomotive, and is not limited to a maximum value as in the case of the steam locomotive where the boiler pressure is fixed.

Therefore, in calculating the tractive effort for electric locomotives, it is necessary to know the characteristics of the motor. For this purpose, characteristic curves are always drawn up for the motor under consideration, these characteristic curves showing the relation between the revolutions, torque and the electric current taken by the motor. When this motor is applied to an electric locomotive, with certain fixed mechanical relations between the motor and the drivers, i. e., either by side rods, gearing or a combination of each, a set of curves, known as the characteristic curve of the electric locomotive, would be drawn up with the torque of the motor shown in terms of tractive effort at the drivers. A set of these curves is shown by Fig. 1, which is the curve for one motor.

On the locomotive in operation on one of the large steam railroads, there are four of these motors per locomotive, so that the tractive effort for these locomotives under any particular consideration will be four times that as shown on the curves.

The characteristic curves illustrated in Fig. 1 are used in two ways. For instance, it is easily calculated, or rather the result is easily obtained, as to the amount

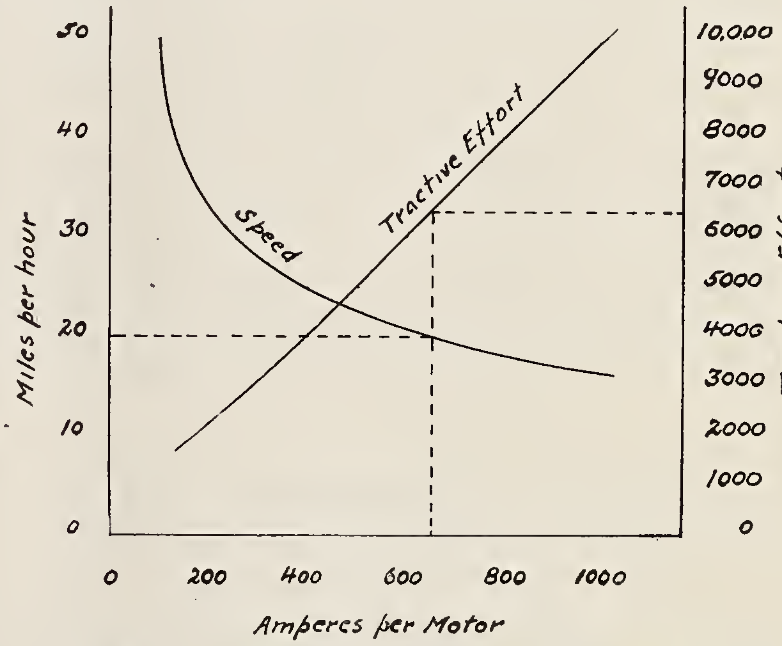


Fig. 1. Diagram of Speed and Tractive Effort

of current taken by the electric locomotives when developing a certain tractive effort. As an illustration: the locomotive may be called upon to move a certain weight of train up a certain grade. We know from tests the resistance required to pull the locomotive itself and also the trailing load up this known per cent grade, and thus we can obtain the tractive effort required of the electric locomotive. This will then be so much tractice effort per motor, and, for instance, under particular conditions this amounts to 6,500 lbs. Referring to the curve, the tractive effort scale is shown at the left. Projecting this value to the tractive effort, curve "B," it is noted that 650 amperes are taken per motor and the locomotive will run at a speed of 20 miles an hour.

Working in the other direction, a certain current can be selected and the tractive effort and speed for this current can be obtained from these curves. As mentioned above, the electric locomotive has no fixed maximum tractive effort, it all depends on the amount of current being put through the motor. Of course, there is a maximum current which each motor can stand, but this amount of current depends wholly on the time in which it is fed to the motor, and the larger amount of current, the shorter time it can safely be kept on the motor.

With these characteristics, the electric locomotive has, therefore, a great advantage in being able to exert a large maximum tractive effort, but it is not able to maintain this tractive effort continuously on account of the damage which would result to the motors. This then brings out the point that the motor has, or the locomotive in this case has, a continuous and an hourly rating which does not enter into the calculation with the steam locomotive, as the latter is able to maintain its maximum tractive effort at slow speed as long as desired.

As we have seen, the amount of current passing through the motor gives the amount of torque and in turn the tractive effort available. The coils and windings of the electric motor are made up of copper wires or bars covered with special tape or other 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 radiation and by the iron which makes up the motor, and thus a certain constant temperature will be reached when a certain constant current is flowing through the motor continuously. The tractive effort, determined as in above explanation, for this amount of current determines the continuous tractive effort of the electric locomotive. A much larger current can be used providing that the same is not kept on the motor more than one hour, and this, calculated in terms of tractive effort of the locomotive, would be the hourly tractive effort rating of the electric locomotive.

From the above, it can be clearly seen why in specifying an electric locomotive, the work this locomotive will have to do must be studied very carefully so that it will be equipped with motors of such size that the locomotive will handle the work required without overheating.

Maintenance of Foundation Brakes

Things Seemingly Unimportant, are Found to be Essential when Intelligently Examined by the Expert

The most vital parts of a brake are the rods, levers, brake-beams and attachments, through which the power, no matter how perfect, passes. No matter how perfect the brake shaft and its connections, and the triple valve brake cylinders may be, the best work of the brake is not realized unless the parts which transmit the power to the wheels are all in good condition and are in their proper positions.

This idea thus expressed forms the opening words of the address given by Mr. Charles Page, Air Brake Inspector on the N. Y. C., at a recent meeting of the Niagara Frontier Car Men's Association. He continued by pointing out there are no rules prescribed governing the lengths of brake rods, neither is there any information given out generally outlining the proper proportion of brake levers and it appears to be a matter that inspectors and repairmen are not generally familiar with. Cars are placed on repair tracks and receive brake repairs, and when completed there is a possibility under present conditions of having a different brake pressure on each pair of wheels.

It is the practice to remove the triple valve for test where sliding occurs and if found all right it is replaced, but there are times when the leverage governing the braking power is not checked to see that the power is evenly distributed. It is acknowledged that the greatest defect on hand brakes today, is the uneven amount of slack in brake chains and until the brake rigging is properly applied and adjusted, it will continue to give trouble.

There is another thing, which is often wrongly done, and that is the use the dead lever guide is put to. Its purpose is to take up the slack caused by brake shoe wear, but most repairmen utilize it to take up the slack existing on the levers, instead of adjusting the brakes at the bottom connection, and this leaves no room to take up the brake shoe wear. When applying a top rod, care should be taken to see that the push rod is forced back into the cylinder as far as it will go, and the cylinder lever should be at right angles. The push rod should be up against the piston head; if not, it is too short. If the cylinder lever cannot be placed at the proper angle, on account of the push rod striking piston head, the push rod is too long.

Regarding the matter of levers to determine the dimensions of levers to be used on a freight car, we should take 60 per cent of the light weight, assumed 32,000 lbs. This gives a total braking power of 19,200 lbs., and divided by 4, which is the number of brake beams, it shows a strain of 4,800 lbs. on each beam. The truck lever dimensions usually employed are 8 x 24 ins. Next multiply 4,800 by 8, which is the weight of arm of truck lever, and divide by the total length, which is 32 ins., which is power arm of truck lever, this gives a pull of 1,200 lbs. on the top rod; and this, multiplied by the total length of cylinder lever, which we assume to be 25 ins., and divide by 3,700 lbs., which includes 1,200 lbs., the pull on top rod, and 2.500 lbs., the force exerted on piston, gives 8, 4/37 ins., or the length of the power arm of cylinder lever. Substracting 8, 4/37 ins., the length of power arm, from the total length, or 25 ins., leaves 16, 33/37 ins., which is the length of the weight arm.

This may seem to be a big problem, but no car can be poperly tested and adjusted if it is equipped with improper rods and levers, and when once a carman is acquainted with these requirements, the matter of proper foundation brake gear will be realized; it will be interesting to carmen, to figure out or compute this leverage, as everyone wishes to learn the finer points of his vocation and to become thoroughly efficient in his work.

What I have dealt with thus far might be termed the scientific feature of the brake arrangement, but we should not lose sight of the fact that careful attention should be given to the brake lever key bolts to see if they are worn, and also to brake levers, to determine if holes in them are elongated, in which event, they should be replaced. There are other things that cause too much slack in the brake rigging, such as worn brake heads, long body rods, short truck brake connections, loose cylinder and reservoir brackets. Careful attention should be given to detect these conditions and, of course, the matter of brake adjustment should be followed up at all times.

It may interest some of our readers to know that the National railways of Chile have asked for bids covering the construction of central workshops in San Bernardo. The plans and specifications may be obtained on application at the office of the railway company at Santiago. The bids will be opened on May 4 next.

Electric Lighting of Railway Passenger Cars

The Various Systems in Use Today. What They Aim to Accomplish, how They do it. How the Systems are Cared for

In presenting a paper on the methods employed at the present day for lighting railway passenger cars, Mr. E. S. M. Macnab, engineer of electric car lighting on the C. P. R., to the Canadian Railway Club at a recent meeting said, among other things, that he did not desire to go into technicalities too deeply. The demand for electric lighting had increased for several reasons; among them was safety, the possibility of fire from a wreck was practically nil where electricity was used.

Comfort was represented by the possibility of berth lights, and fans could be used in hot weather. The electric light was cool and clean and used up no air, and these lights could be placed where required and could be lighted or turned off as desired. A table showing the equipment as it stood in 1911 and 1914 is here given:

Table Showing Electrically Lighted Cars, 1911 to 1914

Railway Company	No. of cars equipped 1911	No. of cars equipped 1914	Increase in cars equip'd
Pullman Co.	2,400	5,800	3,400
Pennsylvania R. R., E.	902	1,924	1,022
Pennsylvania R. R., W.	516	714	198
N. Y. C. & H. R.	202	1,007	805
N. Y., N. H. & H.	350	410	60
Lehigh Valley	81	384	303
Great Northern and others	480	650	170
Total in United States	10,825	18,572	7,647
Canadian Pacific Ry.	68	359	291
Grand Trunk	34	164	130
Grand Trunk Pacific	..	72	72
Canadian Northern	14	226	212
Total in Canada	116	821	705

Note—Figures of other roads in U. S. A. not included.

In 1911 the Canadian Pacific Railway had only 68 electric lighted cars, now they have 380, which includes 100 per cent of the compartment sleepers and observation cars, 85 per cent of the modern sleepers and 60 per cent of the total number of diners. The large increases on the Pennsylvania, New York Central Railroad and on the N. Y., N. H. & H. railway are probably due to the tunnels by which they enter New York City, gas or oil lighted cars not being permitted to enter either of these terminals. From the foregoing figures it is apparent that there is a demand for electric lighting in passenger cars, and also that the railway companies are meeting it in a liberal spirit.

The systems employed may be divided into three main systems, the Straight Storage, Head End and Axle systems, and a brief description of each may not be out of place. First, the Straight Storage System. This consists of a set of storage batteries contained in battery boxes under each car, the batteries being connected to the lamps by wires and controlled by a switch. This is certainly the simplest method of lighting, but we find the batteries have to be charged at each terminal, or after every eighteen or twenty-four hours, which necessitates the car being held in the terminal yard from 6 to 10 hours. It is apparent that this system is out of the question for transcontinental service. The chief user of this system is the Pennsylvania Railway, which operates almost sixteen hundred cars on its local trains, also baggage and day coaches on most of its through services, the dining, sleeping and parlor cars, which have a heavy lamp load, being all lighted with the Axle System. Another disadvantage which this system entails is the heavy capital cost of installing the necessary battery-charging facilities at all terminals.

It is interesting to note that at one of the New York yards three hundred and fifty outlets have been installed, each outlet having a separate pair of wires back to a switchboard in the power house. Power is obtained from three 250-k.w. motor-generator sets, giving 110 and 220 volts.

The Head End System is a steam-driven generator in the baggage car, as close to the locomotive as possible, from which it draws steam. The equipment consists of a 20 to 25 k.w. turbo-generator, controlled from a switchboard from which three main cables run overhead throughout the train. As the turbine must stop when changing engines or when standing in a terminal before the engine is coupled up, storage batteries have to be used. The Northern Pacific practice is to install 200-amp.-hour batteries on postal car, dynamo car, standard sleepers and the observation car of each train. The baggageman is instructed so that he can operate the electrical equipment.

A disadvantage here exists, however, that when trains are switched off at junctions and others put on, this necessitates the installation of electrical apparatus on a larger proportion of cars than would otherwise be necessary, thus increasing capital and maintenance costs. The steam consumption in the turbine is high, especially in the winter. On the N. P. axle devices have been used, consisting of a large axle-generator driven by a Morse silent chain, a generator and a lamp regulator. Thirteen trains have been so fitted.

The next system, and one largely adopted, is the Axle System. A generator is driven by a belt from the axle and a set of storage batteries go with the outfit. The design of the axle device involves overcoming five problems. These are (1) Universal polarity, due to the change in direction of rotation of the armature, when the car reverses the direction in which it runs; (2) The maintenance of a constant output in horsepower, irrespective of the speed of the train, after the generator reaches its maximum, which is 22 to 25 m.p.h.; (3) The lamp voltage must be held constant at the normal voltage, which is 30 in the United States and generally 24 in Canada, whilst the generator is running at a voltage of 40 in the United States and 30 in Canada; (4) The batteries must receive a sufficient charge to replenish the loss of current consumed at terminal stops, but at the same time must not overcharge them; (5) An automatic arrangement must connect the generator to the batteries when the speed of the train is such that the generator voltage is equal to that of the battery, and disconnect them when the speed falls below that point. To meet the foreging conditions there are about a dozen patent systems in use in Europe, none of these have ever been adopted in this country, with the exception of the Stone System, which is extensively used in Canada. In the United States there are five principal systems, namely, the Gould, Safety, Consolidated, United States and the E. S. B.

In the Stone System the change of polarity is effected by means of a rocking arm which is turned through an angle of about 30 degs. by a friction gear attached to the end of the armature shaft. Constant output is maintained by means of suspending the generator out of center and by means of a tension screw in the suspension, so that it is possible to vary the tension of the belt to give the desired watt output. This method of regulation appears at first sight to be rather crude, but it is surprising how well it acts in actual practice. Lamp Voltage Control is obtained by the use of two batteries, one being charged while the other "floats" across the lamps. The floating battery and lamps are supplied with current from the generator through fixed resistances in multiple, which are connected so that when certain circuits are switched on, a resistance is also switched in multiple with the others; by this means it is possible to obtain close regulation with a varying lamp load.

By means of specific gravity tests of the batteries, it is possible to regulate the tension of the belt so that the total output on the trip will take care of the lamp consumption and at the same time keep the batteries fully charged. A battery change-over switch is also used to reverse the charging and regulating battery at each stop. This is operated by a governor attached to the end of the armature shaft, in conjunction with the friction gear and rocking arm, operating a switch, which closes when the generator voltage equals that of the battery. The later design of Stone generator involves the use of an electrically operated automatic switch and pole changer which eliminates the mechanically operated switch gear on the generators now in use.

The Safety and Gould equipments have many points in common. The change of polarity is effected in the Safety system by means of rocking the brush holder through an angle of 90 degs. by means of the friction between the brushes and the commutator. In the Gould system a double-throw switch is operated by means of a "dog" attached to the end of the armature shaft engaging a cam when the direction of the rotation is changed. In both systems the voltage of the generator is held constant by voltage coil connected across the brushes, this coil operates a solenoid which, by a lever, reduces the pressure in a carbon pile in series with the "field." Lamp voltage control is obtained by inserting a carbon pile in the lamp circuit, the pressure of the discs being regulated by means of a solenoid connected across the lamp mains. As the voltage increases, the solenoid operates to reduce the pressure on the pile, thus increasing the resistance in the circuit. In the Gould system a pilot or small carbon pile is introduced to operate the large carbon pile with the object of giving finer adjustment in the system, the main pile is short-circuited when the car is at rest, and allows the battery to feed the lamps direct.

In both systems the voltage of the generator is maintained constant. As the battery becomes charged its voltage rises until it equals the generator, when the charge is reduced to about 3 amps. A series coil, in conjunction with the voltage coil of the generator regulator, operates the carbon pile in the field, preventing the output exceeding a predetermined amperage. An automatic switch, which governs the change from generator to battery, is electrically operated, a voltage coil being connected across the brushes, which lifts a switch when the generator voltage reaches the battery.

The United States lighting system provides for the change in polarity of the generator, by rocking the brush holders through an angle of 90 degs. The generator regulation is governed by a carbon pile in series with the field, which is operated by a solenoid. The lamp regulation is also taken care of by a carbon pile in series with the lamp circuit, which is operated by a shunt coil connected across the lamp mains. A feature in this system is the control of the battery charge by the ampere hour meter. The later Consolidated equipment use a similar arrangement.

The E. S. B. system presents several features of interest, using the Rosenberg generator on which the main brushes are short-circuited, the armature current being collected from two main brushes at 90 degs. to the auxiliary short-circuited ones, the polarity of this generator always remains the same. The generator voltage is constant, irrespective of speed, by a wheatstone bridge connected across the field, and as this voltage is set to thirty-six, charging 16 cells in series, it is said to be impossible to overcharge the batteries. Owing to this low charging voltage, the lamp regulator is dispensed with. It is necessary, however, to use 34-volt lamps, which are not a standard. The principal claim of this system is that there are no moving parts on the generator regulator except the automatic switch, and that it is not hard on the battery. The system has been applied to a number of cars on the Santa Fe Railway.

If a number of electricians who operate electric-lighting equipments were asked to name the details which cause the most trouble, certainly 90 per cent would reply, The batteries. The battery is not a source of power, but simply retains electrical energy when charged from the axle generator or yard plant. It is composed of a number of positive and negative lead plates which are insulated from each other by means of hard rubber or wood separators, these plates being immersed in a solution of sulphuric acid, and the whole contained in a lead-lined holder. Each set of plates are burned on to a bridge to which lead lugs are attached for connecting to the next cell. The method of determining the state of charge is usually by means of the hydrometer. The voltage test is also used, a fully charged cell reading 2.2 volts on discharge and gradually dropping to 1.8 volts per cell on full discharge. The capacity depends on the area of these plates, and as a rule in car-lighting service, varies from 250 to 350 amp.-hours at the eight-hour rate.

To maintain a storage battery in good working condition it should receive 25 per cent more charge than discharge, but continuous overcharging causes the plates to buckle and creates an excessive deposit. Either of these causes a short circuit. Overcharge increases the evaporation of the electrolyte, which, if not replaced, causes damage. Undercharge also operates adversely, as the action of acid on the plates in a discharged condition forms sulphate of lead, which reduces the capacity of the cell. A charge in a set of batteries gradually leaks out when left standing for a long time, and cars should not be stored where there are no charging facilities existing if it is possible to avoid it. Current may leak to the earth through the lead-lined tanks. At the point of leakage a hole is eventually formed through electrolytic action. This happening in one cell will probably start the rest in that battery box. To prevent this, the outside of the cells and floor of the battery boxes as dry as possible and also insulated from the metal work of the cars.

The question of organization is the chief factor to be determined if efficient results are to be obtained, in fact it is difficult to convince some managements that such is even required. To illustrate the capital expenditure and maintenance costs, take, for example, a road having 400 electric-lighted cars. As each installation will cost, say $1,500, we have a total expenditure of $600,000, of which $800 per car or a total of $320,000 is liable to be permanently destroyed through want of attention. Again let us consider the maintenance cost per car per month. Assuming a total of 400 cars at a cost of $12 per car per month, we have a cost of $4,800 per month, or $57,600 per annum. To show how these costs may be increased or reduced, a few figures may serve to illustrate the effects of closely watching the performance of the equipments. Suppose that by better handling we save one lamp per car per month, we effect a saving of $180 per month, or $2,160 a year. As to the battery, a conservative estimate will place the life of a set at five years. Assuming we have twenty-four batteries per equipment and we increase their life by one year, taking the cost of the batteries as $630, we have:

Depreciation at 5 years	$126	per annum
Depreciation at 6 years	105	" "
Saving per car	$21	" "

Multiply by 400 cars and we have $8,400 a year saved. As to belt life, a saving of one belt per car per annum will approximate $5 for each car in a year, or $2,000 on 400 cars.

Summarizing we have:

Saving of one lamp per car per month	$2,160 per year
Extending life of batteries by one year	8,400
Saving one belt per car per annum	2,000
	$12,560 per year

The above reasoning may be applied to various details of the equipments which would increase the amounts saved, but the figures in themselves show what may be saved or lost through properly handling or neglecting the equipments, setting aside the discomfort caused to passengers due to light failures.

The work which has been accomplished by the Association of Railway Electrical Engineers, in conjunction with the train-lighting committee of the Master Car Builders' Association and the various manufacturers, has resulted in the working out of various standards and specifications which have assisted in raising the art of electric lighting of passenger cars to its present satisfactory state.

Prompt Rise of Brake Cylinder Pressure

How the Rapid Filling of the Brake Cylinder is Accomplished for Various Kinds of Applications

In the course of a paper on "Recent Developments in Brake Engineering Principles," Mr. W. S. Dudley, chief engineer of the Westinghouse Air Brake Co., said some things on the caption at the head of this article. The time elapsing from the instant the valve mechanism on a car responds, until the beginning of pressure development in the brake cylinder, delays the effective braking on each car. It also lengthens the time of full braking force on the train as a whole.

When a triple valve (PM equipment) acts so as to apply the brakes, the compressed air passing from the auxiliary reservoir through the triple valve to the brake cylinder finds the brake cylinder piston back against the pressure head. The piston must be moved, and to do that the volume so displaced must be filled from absolute zero to the pressure of the atmosphere and above, before effective pressure can be transmitted to the brake shoes.

For an 8-in. brake cylinder having 8-in. piston travel this requires 402 cu. ins. of free air, while two 16-in. cylinders, which are used on some heavy cars, with 8-in. piston travel require 3,216 cu. ins. or exactly eight times as much. The time lost in the filling of the cylinders would be correspondingly greater if the same size ports were used for all cylinders. The valves for the larger cylinders are made with proportionately larger ports. The ports in the triple valves must be large enough to permit the pressure in the auxiliary reservoir of the largest equipments to drop at the same rate as for the smallest, since both have to conform to the rate of drop in brake pipe pressure.

With the LN equipment the quick service venting of some air from the brake pipe to the cylinders, supplementing that coming from the auxiliary reservoir, tends to compensate for the piston displacement effect, but does not eliminate it.

Considering the requirements of ordinary steam railroad passenger service, the possible delay of from 1 to 1½ seconds in filling the cylinder is negligible when making service stops, in which the time required to make a full service application may vary from 7 or 8 seconds up to 10 or 20 seconds, according to the length of the train.

In emergency applications, where time is important, the quick venting of a considerable amount of brake pipe air to the brake cylinders and the use of large supplementary reservoirs and large ports reduces the effect of the piston displacement to a negligible amount.

Another source of delay in starting the service braking action on each car lies in the time required to cause the various parts of the apparatus to move. In the PM and LN equipments this is not great, as they move by a drop of 1½ to 3 lbs. in the brake pipe, and this takes place within the first second. Trouble often results from this very sensitiveness. If brakes apply on a 2 or 3-lb. drop of pressure on account of a slight overcharge, unavoidable brake pipe pressure fluctuations may be caused by a sluggish feed valve, or it may come from too light an application, and such brakes are likely to stick.

For this reason a stability feature has been incorporated in the later PC and UC brake equipments so that from 4 to 7-lb. brake pipe reduction must be made before effective brake pressure is obtained. The elimination of the chance of stuck brake trouble is an advantage which is worth some sacrifice. As a matter of fact the cylinder pressure obtained with equipments not having this feature, these slight reductions are not enough to push the shoes against the wheels, even though there is pressure admitted to the brake cylinders. Beyond this point the building up of pressure is the same with or without the stability device, so that nothing is lost in the rate of pressure building when a bona fide service reduction of more than the predetermined minimum is made, and at the same time protection is afforded against stuck brakes or slow release, which may follow very light brake pipe reductions with equipments not having the stability feature.

As to the rate of rise of brake cylinder pressure it may be said that air flowing out of the auxiliary to the brake cylinder, is automatically governed by the triple valve so that the reduction in auxiliary reservoir pressure is made to take place uniformly with that of the brake pipe. Consequently the time required to obtain full cylinder pressure is substantially the same as that occupied in making a full service brake pipe reduction. This is limited by the design of the brake valve and equalizing reservoir, and it becomes a minimum time of from 5½ to 6½ seconds from 110 lbs. initial brake pipe pressure, 7 seconds to 9 seconds from 70 lbs., the time becoming longer than this for all pneumatically controlled brakes as the length of the train is greater.

This limiting rate has been determined by years of experience and study of the requirements for proper service braking. A pneumatically controlled brake which permits the retarding force to be built up more rapidly than this in service applications, gives the engineman no chance to use his judgment and skill. The bad effects of slack and of the time elapsing between the action of the brakes on successive cars are magnified, and this tends to increase shocks, especially with the long trains of heavy cars.

One important factor is often overlooked: the effect of the brake rigging in causing the piston travel to be short when the pressure in the brake cylinder is low and permitting it to lengthen as the cylinder pressure increases. The size of the auxiliary reservoir (and magnetic valve-choke for electro pneumatic operations) must necessarily be suitable for proper results with some particular piston travel. Variations from the proper and intended results are therefore certain to follow when the piston travel differs from that for which the equipment was designed, viz.: Eight inches running travel with a full service brake cylinder pressure.

There is always some stretching taking place as pressure is built up with even the best brake rigging. On a large proportion of the cars there is a considerable additional travel of the piston after the shoes are first brought against the wheels.

The result is that (proportionally) considerably higher pressures are obtained for light than for heavy brake pipe reductions, the light applications not producing pressure enough in the brake cylinder to push the piston out of the standard travel used in establishing the volume of the auxiliary reservoir. While it is possible that this shorter than standard travel is an indication of efficiency in the brake rigging, tending to neutralize the excess of pressure over that intended for the light reductions, it is not always true, nor is the inefficiency necessarily any less after the piston reaches the intended travel under heavier pressures.

It is of great importance to keep the relation between cylinder pressure and piston travel clearly in mind when comparing theoretical with actual results, as well as when designing and installing brake rigging from which highly efficient performance is desired.

The simultaneous action of electrically controlled air brakes permits of a more rapid rate of service application than with the pneumatic brakes and there is less danger of rough handling, and less skill and judgment are required to produce a given result. Another important advantage secured by the electric control is the possibility of making the brakes apply uniformly on all cars in the train. This is impossible with the ordinary brake, which causes the brake on the head end of the train to apply before those on the rear. With electric control the same service rate of brake application is produced on trains of all lengths, and a given handling of the brake valve will produce the same braking results, whether the train is short or long.

For emergency applications the maximum cylinder pressure is imperatively required in the least possible time. The high speeds, heavy cars requiring large brake cylinders, and long trains of today have imposed severe handicaps upon this feature of the brake and have necessitated the adoption of apparatus, reservoirs and connections of ample size such that large volumes of compressed air can be admitted very quickly to the brake cylinders. The increased capacity of modern brake equipments in this direction can best be realized by comparing the time required by the High Speed (PM) brake equipment on a 60-ton car, using a 16-in. brake cylinder, to reach its maximum of about 80 lbs. pressure (110 per cent braking ratio) which is about 6 seconds, with that of the Universal valve (UC) equipment which reaches its maximum of 100 lbs. cylinder pressure (150 per cent braking ratio) in about 2 seconds. The possibility of filling the same cylinder volume with 20 per cent more air in one-third the time required by the best brake equipment of ten years ago is what is now done. During the P. R. R. brake tests of 1913, this was demonstrated to be one of the most important of the several directions in which the maximum attainable effectiveness had to be utilized if the heaviest modern trains are to be stopped by emergency applications in the same distances which were possible with the trains of ten to fifteen years ago.

Electricity for the Railway Mechanic

By J. H. WICKMAN

First Aid Suggestions for Workmen as to How to Handle Troubles in Shop

Of recent years the installation of electric motors, head-lights and other electrical apparatus and equipment in the railroad shops has surpassed all other methods or modes of applying motive power for driving machine tools, line shafts, wood working machinery and furnishing light; and while this equipment has been in use for some time it is not as fully understood as it

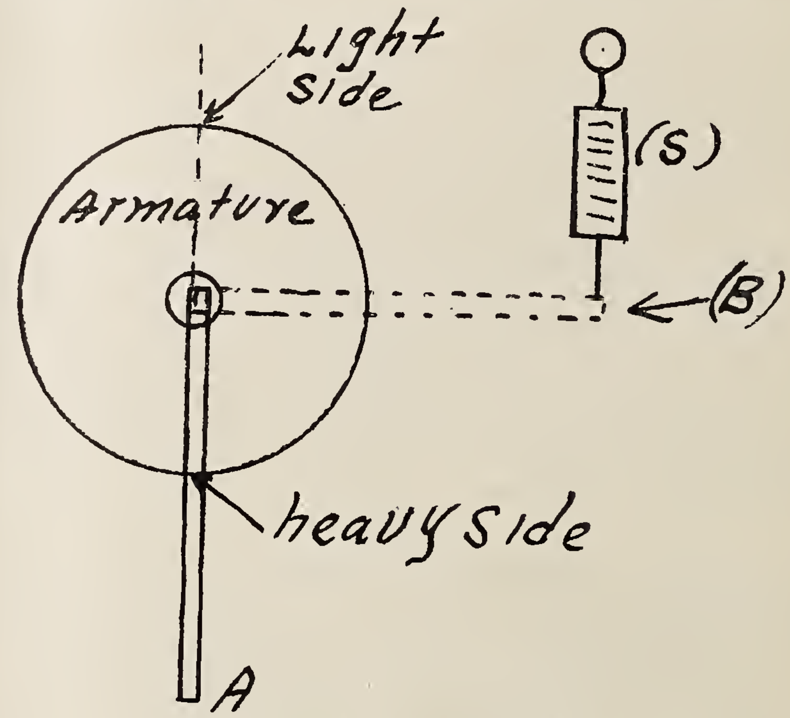


Fig. 1. Balancing an Armature

might be. The correct method of operation and maintenance, to obtain the maximum efficiency at the lowest operating cost, has not yet been completely reached.

In many shops where no electrician is kept on constant duty, the mechanical force oftain maintain the electrical equipment to the extent of their ability, and from this point of view it will be our endeavor to show, in plain language, how the shop mechanic with common intelligence can still go farther in helping to reduce operating expenses by the proper maintenance of such electrical equipment as may come under his care. There is no more mysterious element in connection with the handling of electricity than there is with work in any other calling, each must be learned. Knowing how to locate trouble quickly on a motor has no more mystery than knowing how much counter balance should be placed on the driving wheels of a locomotive or knowing how to find out how much will be required. One of the cases of trouble that often occurs with a motor is when the rotating element becomes unbalanced from minor repairs and causes vibration of the timbers or machine on which it rests. Such a case as this should be treated in practically the same manner as balancing the driving wheels, only on a smaller scale. To do this the rotating element should be removed and rested on its bearings, on two perfectly leveled surfaces so that the heavy part will seek its position, which will be the bottom side, on account of gravity. There are two ways in common use for balancing an armature or rotor, one is by the cut-and-try method and the other is my weighing. To use the first method a weight should be fastened to the top part exactly opposite the heavy side; this weight should be a little too heavy so that it will be necessary to keep cutting off parts until the rotor will rest in any position it is placed in, on its two leveled supports. This method is the one used most often. The second method would be to attach a piece of very light wood to the rotor, parallel to the axis on the heavy side as at point A, Fig. 1, and then turn the armature or rotor 90 degs. or to the position shown by the dotted line B in the figure, the reading from the scale S would be made, and then subtract one-half the weight of the wood used as an arm, the result should be the amount of counterweight to apply at the opposite side marked light side, in the figure shown.

The removing of an armature or rotor from a motor, no doubt, causes quite a large percentage of the troubles with the windings due to carelessness on the part of those handling the rotor. A good rule to follow in removing these rotors is, that both ends of the shaft should have support at all times and that the rotor should be withdrawn or pulled out exactly in a straight line, parallel to the bearings of the motor. Should the end-housing of a large motor be removed and no means of support be provided for that end of the shaft, there is a chance of bending the other end of the rotor-shaft or breaking of a bearing-lining. Where very large armatures are to be removed, as in the case of those such as are in use on gas-electric cars, a sling may be fastened around the pinion end of the armature, supported by chain hoist so as to carry the weight of that end of the armature until the housing is unbolted, and then the sling and armature can be slid along, parallel to the motor bearings, until the shaft is nearly out of the opposite bearing. By this time there will be room between the motor end-housing and the frame to allow either a sling or some kind of support to be placed under the body of the armature, then it can be removed entirely from the frame; the workman must remember all the time not to rub the rotor against the frame part of the motor, which is a source of producing winding troubles. A very practical method in use is to have a long extension arm to fasten on the pinion after the sling has been placed on the body of the rotor; this extension arm is then used as a lever, and the sling, the fulcrum and the rotor would be the weight. By using these methods a very heavy armature can be removed by two men after the first time or so within one hour. This is no doubt much less than half of the time usually consumed in doing this work. Where the rotor or armature is light and can be lifted by one man, or even by two, it is not necessary to use any sling, but the same precautions should be taken whether the motor is one-half or 200 horse power.

There is probably no other class of electrical machinery in use where the bearings play such an essential part as they do with the motor or generator. Mostly all classes of machines will run and operate fully as well with a bearing that is considerably worn, but this is not true with a motor, because as soon as the bearing commences to wear the rotor is thrown out of the exact center, and this will cause an uneven distribution of magnetic flux and cause an undue heating in that part of the windings that are the nearest to the rotor. There are many cases on record where trouble has occurred to the windings in this part of the machine when the rotor was allowed to get too near them. Another reason for not allowing much wear on motor bearings is that there is but very little clearance between the rotor and the stator or frame part. No matter for what reason a motor is taken apart, whether to repair the armature or the stator, the bearings should be checked before it is taken apart to see if the clearances are evenly distributed, and if they are not repairs should be made to the bearings at the same time. The babbiting or re-lining of a motor box should not be thought of as just a common piece of machine work because it differs from this in more than one respect.

Common babbit should not be used. Accuracy to the one-thousandth of an inch is required. No air holes should be allowed in the running surfaces.

There are several different ways to re-babbit a motor bearing that have proved successful; however, only two of the most commonly use methods can be mentioned here. One method is to take off the end-housing where it is in two parts and place pieces of sheet tin in the air-gap, just enough to place the rotor in a central position as shown in diagram Fig. 2. These supports should extend the entire length of the rotor so as to keep and

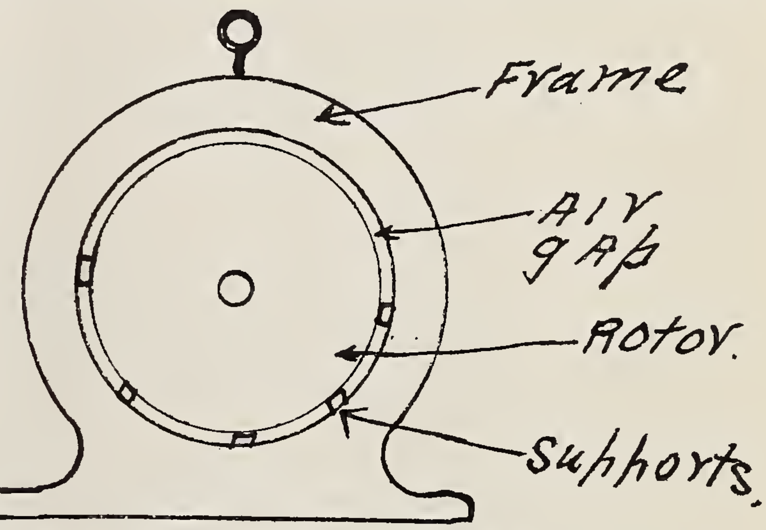


Fig. 2. Babbitting, by Keeping Rotor Central

hold it level, and after it has been supported and the old babbit melted out of the boxing the lower half of the housing should be replaced on the motor frame to support the boxing of that half, and poured, using the motor shaft as a mandrel. The shaft should be wiped perfectly clean with waste dampened in light oil before pouring and heated a little with a torch. In most all cases if a good hard babbit or white bronze is used, the shrinkage will be enough to allow for clearance. After the first half is poured the same process is gone through with the top boxing, as the two parts of the end-housings are always interchangeable to allow motors to be supported bottom side up. The oil grooves should then be cut and the clay or putty filling should all be cleaned out and the motor re-assembled.

The other method is to have a mandrel turned up on a lathe, to the exact diameter of the shaft, and then pour around this, or one may have a tapering mandrel of smaller diameter than the shaft and then turn out the babbit to the correct shaft diameter. The latter method is recommended, as accurate work can be done along the entire length of the bearing, but for places out in yards and away from machine shops the first method has given good results.

The following are mechanical defects that would cause trouble with motor bearings, and particular attention should be given all motor bearings when first starting the machine. Excessive belt tension is the most common. A motor does not need a belt any tighter than is necessary to allow it to pull its load without the belt slipping, and the load should be pulled from the bottom side of the pulley if the motor can be so placed. Poor or insufficient lubrication is often the cause of many motor failures. Common black oil such as is used to oil car journals, is not good enough for motor bearings. It has been the writer's experience frequently to find this kind of oil being used around motors on turntables, air-compressor motors and others that are maintained by shop mechanics. Motor bearings require a good grade of light oil, such as is usually kept at railroad shops, and therefore there is no good excuse for using inferior oils. Lubricants which give satisfactory results are Dynamo Oil, to be used as it comes; Gas Engine oil, add about one-fifth part of good valve oil; Robinson's engine oil, to be used as it comes. Any of the three mentioned oils are adaptable for use on any type of electric motor or dynamo, but an inferior oil will always endanger the safety of motor bearings, and as a rule will in the end be more expensive than any good lubricant, because inferior oil tends to produce hot bearings, which means a stopping of machinery.

There are very few cases where insufficient lubrication has been the cause of trouble, as in most cases it has been over-sufficient lubrication, that is, finding the bearings to the extent of getting the oil in the windings, which in time causes trouble in them. There is one thing that should be impressed on the minds of all members of the shop force, and that is, whenever a motor is to be placed on a wall or bottom side up, the end-housings should be turned 180 degs. around so that the oil wells will be in the correct position. Poor leveling or aligning of a motor will often cause the bearings to run hot. The rotor in any motor if properly leveled should have a little end play. A bent shaft caused by poor management in removing the rotor, or caused by reversing the motor while in motion, will also cause considerable trouble. These four mentioned causes of trouble are in nearly all cases avoidable if any precaution is taken by the shop force to intelligently handle this kind of work.

A motor bearing will probably operate hotter than any other kind and still cause little trouble. This is on account of the better quality of metal used in making the bearing; however, a limit is reached about 200 degs. Fahr., and prompt attention should be given at that time, if not before.

One other point worthy of mention before leaving the question of motor bearings and heating of the same, and that is, after once a motor has been put in operation by the electrical department and the motor is carrying its load with satisfaction it should not be the practice of any one to put more load on the motor, unless a test is run to make sure that it will stand the excess load. It is not like other machines in this respect that are used in railroad shops. Additional load means additional heating to all electrical equipment, and all this kind of equipment is rated on the number of degrees raised in temperature. Additional heating caused by overloading will within a very short time bake the windings to such an extent that the insulation will char and burn, thereby stopping the motor. Almost any motor will pull two or three times its rated horse power for a very short time without damage, but no motor will do this continually without the insulation eventually breaking down.

Safety First on the N. C. & St. L.

The president of the Nashville, Chattanooga & St. Louis Railway, Mr. John Howe Peyton, writing to the RAILWAY MASTER MECHANIC, says in effect that the campaign for safety will be conducted along practically the same lines as has been followed by various other railroad companies, i. e., by the organization of local safety committees on our several divisions, and of a central safety committee, to be composed of general officers of the company. The local committees will hold monthly meetings, at which will be discussed and decided questions relating to matters of personal safety. Questions arising at these local meetings that cannot be disposed of by that body are to be referred to the central safety committee for final action. It is our purpose that the local committees shall be composed largely of men of the rank and file, and through this medium we hope to educate the men to the point where preventable accidents will be very materially reduced. The office of the department of safety will keep in close touch with the accident situation and endeavor to analyze each case and place before our employes the cause of, and the remedy for, avoidable accidents. This will be done in such a way as, if possible, to prevent a recurrence. We will have bulletin boards at various points along the line, where they will do the most good, for the purpose of keeping constantly before employes striking examples of thoughtless and careless practices as may be indulged in by the average railroad employe. This office will also furnish to the heads of various departments, with statements at regular intervals, indicating the manner in which accidents are occurring. In the event that accidents on our line increase at any particular point, special investigation will be made with a view of determining what action, if any, should be taken for the elimination thereof.

We have not yet definitely decided what course we will pursue in an effort to suppress trespassing on our line. However, this is a very important matter and will be given careful consideration just as soon as we have the movement perfected among our own employes.

Some Good Sized Figures

There are at present 23,707 employes on the Panama Canal and the Panama Railroad, made up of 3,595 white Americans and 20,112 laborers. With the exception of 185, all the laborers are West Indian negroes. In a recent month material to the value of $943,280.23 came forward in 36 steamships, the total weight of which, outside of piling and lumber, was 26,255 tons.

There were more than 5,000,000 feet, board measure, of lumber in these consignments, 22,876 linear feet of creosoted piling, 172,023 bags of cement, 4,800 cases of dynamite and 60,929 barrels of fuel oil. It requires a vast army of men and enormous quantities of material to build and maintain this gigantic piece of government work.

Preparedness for Promotion

The man who achieves success and secures advancement always does more than he is paid to do; that is the kind of man any firm wants. No employer will hire a man unless he can make money out of him, and the more money he can make, the better pleased the employer is with the man and the more desirous he is to advance him. This is one of the paths to success—do more than you are paid to do, and—do it cheerfully.—Howe.

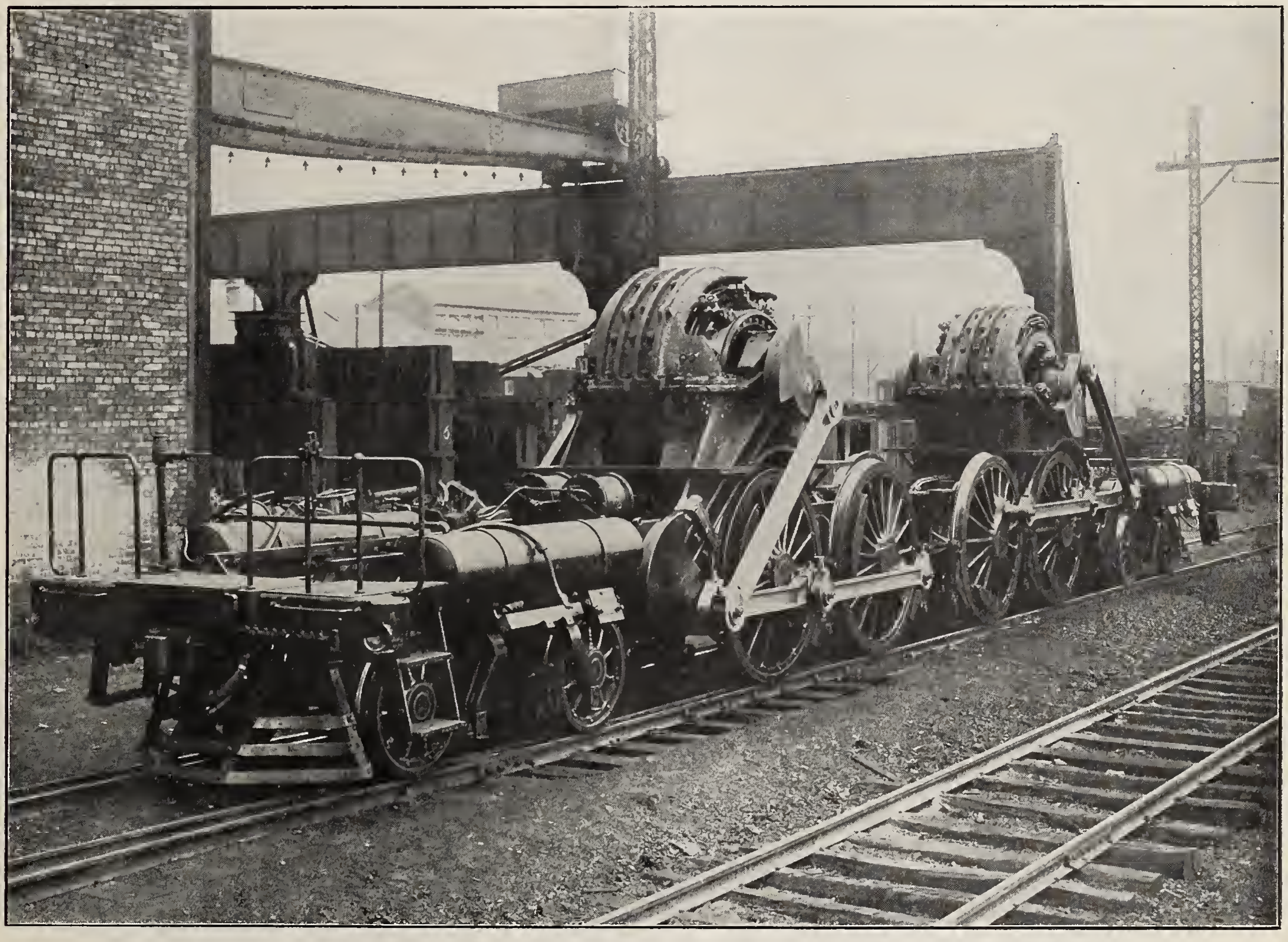
Comparison of Railway Electric Locomotives

By REGINALD GORDON

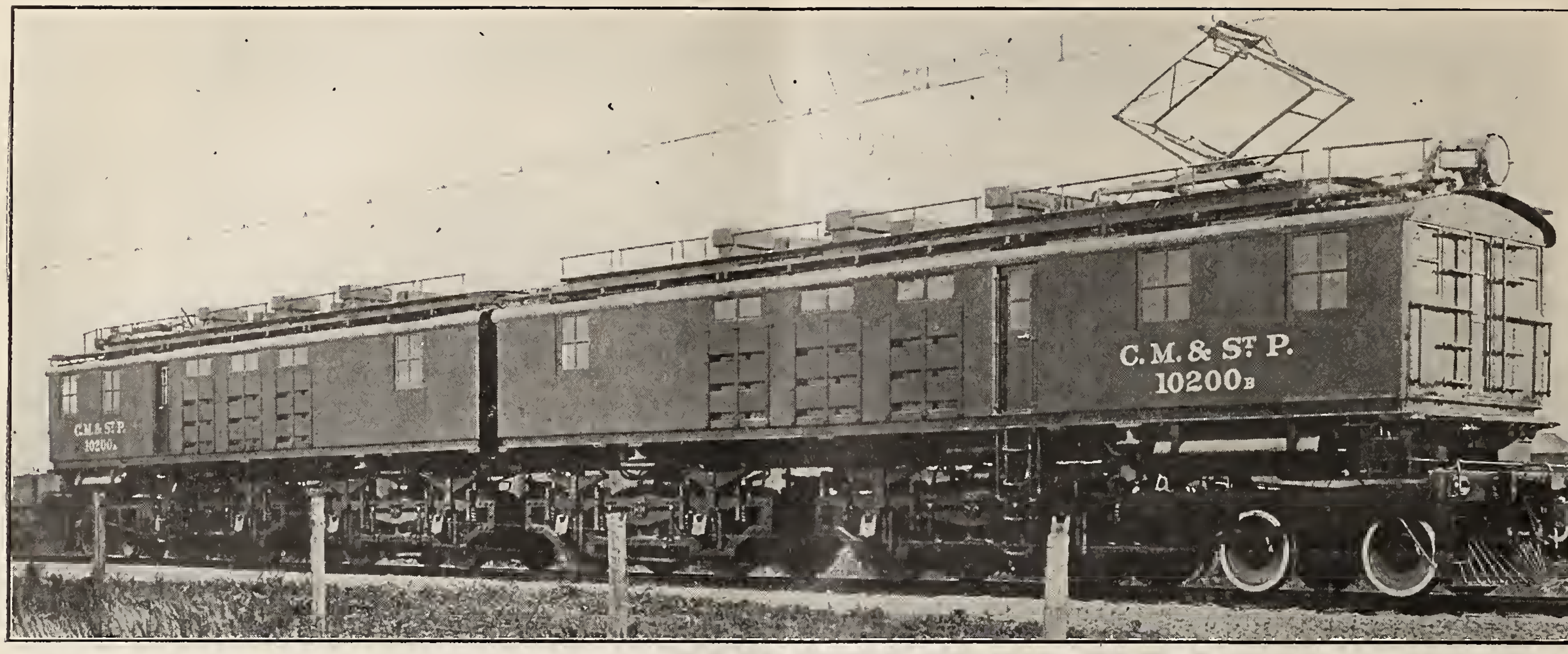
Historical Review of their Adoption, Characteristics of Types, and theV arious Types Compared

At the beginning of the year 1916 there were 372 miles of steam railroad line in the United States being operated by 267 electric locomotives. More than 300 additional miles were about to be equipped for electric power. This enumeration comprises eleven different railroads, and in the following article an attempt has been made to review the situation and point out in what features the electric systems installed on the various roads differ from one another, and to show the characteristics of each, without favor or discrimination.

The first road to use electric power was the Baltimore & Ohio, which in 1895 introduced direct current locomotives of 1,440 horse-power to haul trains through the Baltimore tunnel. In 1902, elevated, and in 1904 subway lines and portions of the Long Island Railroad were equipped. This group of lines, however, did not employ electric locomotives, but motor cars. It is interesting to note that the improvement of motors and the development of control apparatus by that time had made possible the operation of trains of motor cars controlled by one motorman on any car in a train. This is called the "multiple-unit system." It was not until 1906 that further electrification of steam roads was carried out. In that year the New York Central and the New York, New Haven & Hartford began running electric locomotives out of New York City—the former to High Bridge, 7 miles, and Wakefield, 12½ miles; and the latter to Stamford, Conn., 33 miles away. Both these roads use the same tracks for 12 miles out of New York, and as each adopted a different system of electric power the locomotives of one of the roads had to be designed for use on both systems. The New York Central electric engines installed direct current locomotives taking 600-volt energy from a third rail. The New Haven locomotives were designed for 11,000-volt A. C. energy supplied from an overhead conductor. Ordinarily A. C. motors will not run properly on direct current; but by a modification of the motor windings the New Haven engines were adapted to direct current and equipped with shoes for collecting that kind of energy from the third rail when running over the New York Central tracks. As soon as they reach the New Haven rails, 12 miles out from the Grand Central Terminal, the trolley is raised so as to take A. C. power from the overhead wire, and the motors run as A. C. motors. There is some loss of efficiency in such ma-



P. R. R. Electric Locomotive, Without Cab, Showing Arrangement of Countershafts for Direct Drive.



Side View of Chicago, Milwaukee & St. Paul Electric Locomotive.

chines owing to their adaptation to both kinds of current; but they do the work required of them and handle the traffic in a highly satisfactory manner. During the ten years that have elapsed since the New York Central and the New Haven installations, while larger and more powerful engines have been introduced for both roads, there has been an interesting demonstration of the suc-

P. R. R. Electric Locomotive Used at New York

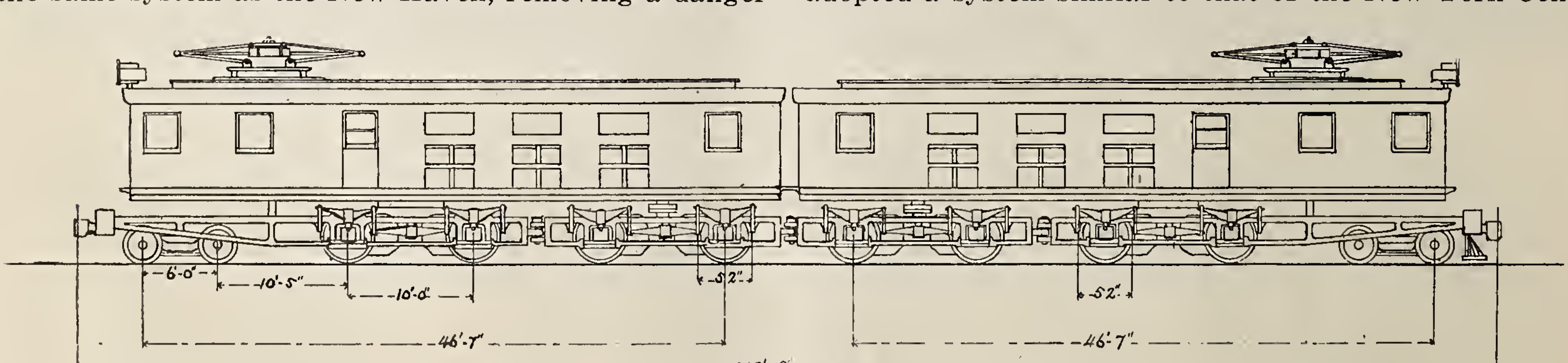
cessful operation of two kinds of electric locomotives on the same tracks; and the elimination of smoke and cinders has made travel on these lines pleasanter and more comfortable.

In 1906 the Grand Trunk adopted 3,300-volt A. C. power for operating locomotives through the St. Clair tunnel between Port Huron and Sarnia. In 1909 the Great Northern had four locomotives built for use through the Cascade Mountains tunnel. The following year the Pennsylvania opened its New York City Terminal and began hauling all its trains there by 4,000 horse-power D. C. locomotives. That same year the Michigan Central put in 600-volt D. C. power through its tunnel between Detroit and Windsor. The Boston & Maine electrified the Hoosac tunnel in 1911, using the same system as the New Haven, removing a danger spot on the road and increasing the capacity of the tunnel. The Butte, Anaconda & Pacific was the first road to use higher direct current voltages. This ore road put in a 2,400-volt D. C. system with overhead wire in 1913, and has been followed by the Chicago, Milwaukee & St. Paul, which is the first of the great steam roads to use 3,000 volts direct current. The St. Paul installation and locomotives were described in the December, 1915, issue of "Railway Master Mechanic." In contrast to this, the Norfolk & Western, with its 11,000-volt A. C. system and locomotives with polyphase induction

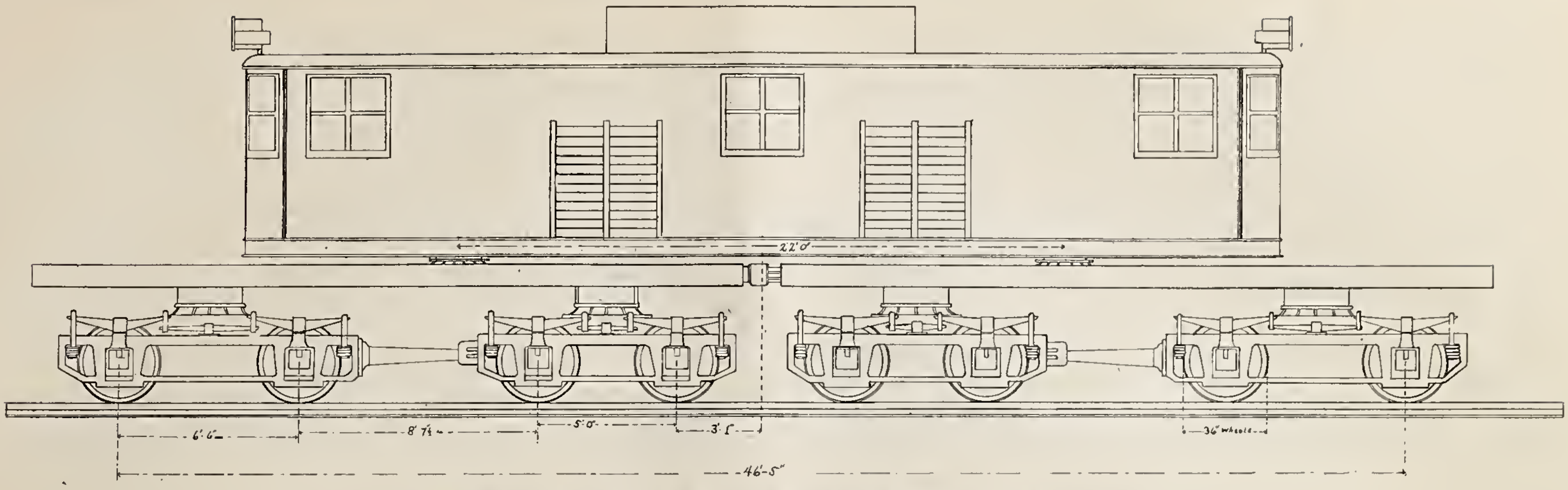
M. C. R. R. Locomotive Used in Detroit Tunnel

motors, forms an interesting comparison—see Railway Master Mechanic, October, 1915."

The question of the adoption of A. C. or D. C. power, and of the voltage at which the locomotives must work, has to be settled for each individual case. Thus, in the original New York Central-New Haven installations the General Electric engineers designed their New York Central motors for third rail current collection; while the Westinghouse engineers, owing to the high voltage they were using (11,000), were obliged to employ an overhead conductor to collect it. The Pennsylvania adopted a system similar to that of the New York Cen-



C., M. & St. P. Electric Locomotive, Showing Wheel Arrangement.



Articulated New York Central Railroad Electric Locomotive

tral, although the locomotives, as shown in our illustrations, are totally different. A few years later, however, the Pennsylvania decided to electrify its suburban zone to Paoli, 20 miles from Philadelphia, and adopted motor cars propelled by 11,000-volt A. C. power and an overhead conductor through which it was supplied—see "Railway Engineering," January, 1916.

So many factors must be taken into consideration when comparing different electric power systems that it is difficult to do full justice to any one in contrast to others. Much depends upon the local conditions prevailing on any particular railroad. Distribution of power by high tension alternating current direct to overhead conductors costs less than to accomplish the same result through substations that are necessary when direct current locomotives are employed. The comparative costs of third rail and overhead wire systems must be considered, and the length of line and trackage are often determining factors where direct current is to be used. Then again, D. C. locomotives cost less per horse-power developed, and in addition are more powerful per ton of weight than A. C. locomotives. Yet, in certain instances these considerations are outweighed by others more important and that have a more direct bearing on the usefulness of an electric locomotive for moving traffic. The accompanying table and illustrations are intended to show some of the locomotives in successful use and some particulars as to their motor arrangement, power, etc., as well as the mileage electrified for each road mentioned.

Table of American Railroads Using Electric Locomotives, Showing Power System, Tractive Effort and Weight

Road	Miles of line equipped	Power System	Motors	Tractive effort	Weight
B. & O. (Tunnel)	3	D. C. 600 volts Third rail	4 geared, 275 h. p. each, 1 hour rating	Maximum 50,000 lbs. 1 hour rating 26,000 lbs	200,000 lbs. All on drivers
N. Y. Central (1909)	57	D. C. 600 volts Third rail	4 gearless, 550 h. p. each	Maximum 32,000 lbs. 1 hour rating 20,460 lbs	230,000 lbs. 140,000 on drivers
N. Y. Central (1913)	57	D. C. 600 volts Third rail	8 gearless, 325 h. p. each, on 1 hour rating	20,000 lbs. on 1 hour rating	220,000 lbs. All on drivers
N. Y. N. H. & H. (1909)	73	A. C. 11,000 volts Overhead wire	4 gearless Quill-mounted 240 h. p. each On 1 hour rating	Maximum 20,000 lbs. 9,700 lbs. on 1 hour rating	204,000 lbs. 154,000 on drivers
N. Y. N. H. & H. (1912)	73	A. C. 11,000 volts Overhead wire	8 geared twin motors 210 h. p. each	Maximum 40,000 lbs.	232,000 lbs.
Great Northern (Tunnel)	6	3-phase A. C. 6,600 volts 2 overhead wires	4 geared 475 h. p. each	1 hour rating 47,600 lbs.	230,000 lbs. All on drivers
Grand Trunk	3½	A. C. 3,300 volts Overhead wire	3 geared 240 h. p. each	22,300 lbs.	132,000 lbs. All on drivers
Michigan Central (Tunnel)	4	D. C. 600 volts Third rail	4 geared, 275 h. p. each, 1 hour rating	35,000 lbs.	200,000 lbs. All on drivers
B. & M. (Tunnel)	8	A. C. 11,000 volts Overhead wire	4 geared, 325 h. p. each	26,000 lbs.	260,000 lbs. 204,000 on drivers
B. A. & P.	30	D. C. 2,400 volts Overhead wire	4 geared 325 h. p. each	Maximum 48,000 lbs. 25,000 lbs. continuous	160,000 lbs. All on drivers
Pennsylvania 1/3 in Tunnels	13	D. C. 600 volts Third rail	2 2,000 h. p. each connecting rods and counter-shaft	Maximum 79,000 lbs.	314,000 lbs. 200,000 on drivers
Norfolk & Western	30	A. C. 11,000 volts Overhead wire	8 induction motors, 430 h. p. each, hourly rating. Geared to counter shaft in pairs	Maximum 133,000 lbs. 85,000 lbs. on 1 hour rating	540,000 lbs.
C., M. & St. Paul	113	D. C. 3,000 volts Overhead wire	8 geared, 375 h. p. each	Maximum 135,000 lbs. 85,000 lbs. on 1 hour rating	564,000 lbs.

Meeting of Executive Committee

Chief Interchange Car Inspectors' and Car Foremen's Assn., Hotel La Salle, Chicago, Ill., February 22, 1916

At the meeting of the executive committee of the Chief Interchange Car Inspectors' and Car Foremen's Association, held in Chicago, February 22nd, a number of changes in the Constitution and By-Laws were recommended for presentation at the next convention for ratification.

Among the more important changes is that admitting to membership car inspectors, master car builders' bill clerks and other employes in the motive power or car departments of steam railways or private car lines engaged in the interchange, maintenance or building of cars. It is felt that by such change the membership will be greatly increased, the organization as a whole strengthened and the scope of its activities broadened.

The Chief Interchange Car Inspectors' and Car Foremen's Association has always felt that the railways throughout the country have not offered sufficient inducements to young men about to engage in railroad work to become identified with the car department. Special apprentice courses are provided in the electrical, engineering, locomotive and other departments, but for some unexplained reason, due recognition has apparently not been given to the car department.

In order, therefore, that the matter may be favorably brought to the attention of railway officials, the association has donated a cash prize of $50 to be awarded, $25, $15 and $10, respectively, for the three best papers presented on "Car Department Apprenticeship Course."

The association feels that in offering these prizes friendly rivalry will be stimulated and at the same time increase the number of contestants. It should be understood that it is not necessary to be a member of the association in order to compete for the prizes. All papers bearing on the subject should be forwarded, not later than August 1st, to the chairman of the apprenticeship course committee, W. T. Westall, general foreman, New York Central Railroad, Collinwood, Ohio. All papers which are deemed of sufficient merit will be read at the next annual convention to be held at Indianapolis, Ind., October 3rd, 4th and 5th, 1916, and prizes will be awarded by the executive committee. It is earnestly hoped that there will be a ready response to contestants for the prizes.

The following committees were appointed to present papers on subjects assigned, at the next convention:

PASSENGER CAR CLEANING AND MAINTENANCE			
J. R. Schrader, Chairman	D. G. F.	N. Y. C. R. R.	Mott Hav'n, N.Y.
F. M. Combs	G. C. F.	C. & A. R. R.	Blooming'ton, Ill.
C. B. Friar	G. C. F.	N. Y. O. & W.	Middlet'n, N.Y.
H. W. Marsh	G. F.	C. & N. W.	Chicago, Ill.
C. Charleton	P. F.	Penna. Co.	Cincinnati, O.
REVISION OF CONSTITUTION AND BY-LAWS			
M. B. Elliott, Chairman	F. C. D.	T. R. R. Assn.	E. St. L., Ill.
J. C. Keene	T. C. I.	Wab. R. R.	Decatur, Ill.
M. W. Halbert	C. I. I.	All Lines	St. Louis, Mo.
APPRENTICESHIP COURSE—CAR DEPARTMENT			
W. T. Westall, Chairman	G. F.	N. Y. C. R. R.	Collinwood, O
W. K. Carr	G. C. I.	N. & W. R. R.	Roanoke, Va.
C. N. Swanson	S. C. S.	A. T. & S. F.	Topeka, Kan.
J. H. Douglas	F. C. R.	W. & L. E.	Toledo, O.
B. F. Patram	F. C. R.	Sou. Ry	Richmond, Va.
INTERCHANGE INSPECTION			
H. Boutet, Chairman	C. I. I.	All Lines	Cincinati, O.
F. T. Rice	C. I. I.	All Lines	Ft. Worth, Tex.
A. R. Denne	C. I. I.	All Lines	Binghamt'n, N.Y.
E. R. Campbell	G. C. F.	M. T. Co.	St. Paul, Minn.
S W Demint	C. I. I.	All Lines	Shreveport, La.
FREIGHT CAR REPAIR WORK			
C. J. Wymer, Chairman	G. C. F.	Belt Ry.	Chicago, Ill.
A. Kline	G. C. F.	C. & S.	Denver, Colo.
O. G. Eubanks	G. C. I.	A. C. L.	Montg'm'ry, Ala.
C. R. Dobson	G. C. F.	C. R. I. & P.	Cedar Rapids, Ia
S. Skidmore	G. F.	C. C. C. & St. L.	Cincinnati, O.
MASTER CAR BUILDERS' BILL CLERKS			
J. V. Berg, Chairman	M.C.B. Clerk	N. Y. C. R. R.	Cleveland, O.
L. H. Retan	M.C.B. Clerk	A. A. R. R.	Owosso, Mich.
F. A. Eyman	C.C.-S.M.P.	E. J. & E.	Joliet, Ill.
W. G. Babcock	Mgr. Cl'ngH.	D. & H. Co.	Watervliet, N.Y.
F. A. Rowley	M.C.B. Clerk	D. & R. G.	Denver, Colo.
EMPLOYMENT			
F. C. Schultz, Chairman	C. I. I.	All Lines	Chicago, Ill.
T. J. O'Donnell	C. I. I.	All Lines	E. Buffalo, N.Y.
C. D. Mitten	Supt.	Armour Car Lines	E. St. L., Ill.
J. T. Markham	F. C. R.	Sou. Ry.	Atlanta, Ga.
W. A. Colling	A. G. C. F.	U. P. Ry.	Denver, Colo.
FINANCE AND MEMBERSHIP			
C. Bossert, Chairman	A. C. I. I.	All Lines	Excelsior, Ill.
C. B. Zachrist	G. C. I.	Soo Line	Chicago, Ill.
L. J. Tenbroeck	Foreman	D. & H. Co.	Sidney, N. Y.
E. A. Sweely	M. C. B.	A. C. L.	Portsmouth, Va.
Wm. Cunningham	C. J. I.		Detroit, Mich.
FREIGHT CAR MAINTENANCE			
I. J. Justus, Chairman	G. C. I.	N. Y. C. R. R.	New York, N. Y.
H. H. Harvey	G. C. I.	C. B. & Q.	Chicago, Ill.
J. J. Gainey	G. F. C. D.	C. N. O. & T. P.	Ludlow, Ky.
J H. Gimpel	G. C. F.	D. & R. G.	Denver, Colo.
E. S. Barstow	G. C. F.	W. & S. R. R.	Vanc'uv'r, Wash.

The Coming "Safety First" Exhibit

During the week of April 17 this year, at the Grand Central Palace, New York, the Baltimore & Ohio will install an exhibit far superior to its diplay at the last congress. Claiming its right to the title of America's first railroad, it will furnish historical proof that it was the first railroad in the country to put in vogue many of the refinements in transportation service; the first to put in effect a department of safety, enlisting its employes in a regular campaign of protection, and to do this the Baltimore & Ohio will occupy double the space of its previous grand prize installation.

Object lessons relating to the principles of safety first with suitable photographs and records showing the decrease in accidents will be one of its special features.

President Willard holds the honor of inaugurating the statement, "Safety first above everything else," and the company's exhibit will bear out his statement to this effect and prove that this well-chosen remark has been a permanent motto on the Baltimore & Ohio.

Pure Iron and Iron-Carbon Alloys

A report on the preparation of pure iron and iron-carbon alloys has been prepared by the United States Bureaus of Standards and is given in Scientific Paper No. 266 of the publications of that bureau. Previous work has been unsatisfactory because of the great uncertainty of chemical composition of the materials used. It has been thought necessary to produce a series of alloys of great purity to form the basis of a redetermination of the diagram at this Bureau.

The general method pursued consisted in melting electrolytic iron with sugar carbon in magnesia crucibles. The electrolytic iron was prepared from ingot iron anodes in a chloride bath, with or without the use of porous cups. The operation of melting the iron with carbon gave great trouble at first, because the ingots obtained were full of blowholes and contained considerable quantities of impurities. The difficulties were overcome by melting in a vacuum furnace and forming crucibles of especially pure magnesia made and calcined with great care. A satisfactory procedure was finally worked out and a series of alloys prepared, of which the composition is $Fe+C=99.96$ per cent.

The Mount Washington Railway

By HUGH G. BOUTELL, Washington, D. C.

The use of rack railways for the ascent of steep gradients, which locomotives would be unable to climb by adhesion alone, is an expedient familiar to most of your readers who are familiar with railroads, but owing to the fact that there are comparatively few of these so-called "cog roads" in use at the present time, a short description of the line, the rolling stock and mode of operation of the oldest rack railway in the United States, and I think in the world, may be of interest.

The White Mountains have been for years a favorite resort of tourists from all parts of the world, and even

Fig. 1. Train Ascending Mt. Washington

when the means of communication with the surrounding country were slow and unsatisfactory, many people willingly submitted to the inconvenience and spent their summers in this beautiful section of New England. It was but natural, therefore, that the idea of a railway to the summit of Mount Washington, the highest peak in the eastern portion of the United States, should have claimed the attention of engineers very early in the history of railroading, but it remained for Mr. Sylvester Marsh, a native of New Hampshire, to carry the scheme to a successful completion.

Great difficulty was experienced in securing the original charter, and the opposition of the members of the state legislature is not to be wondered at when we remember that the project was absolutely without precedent at that time. Nevertheless, the road was com-

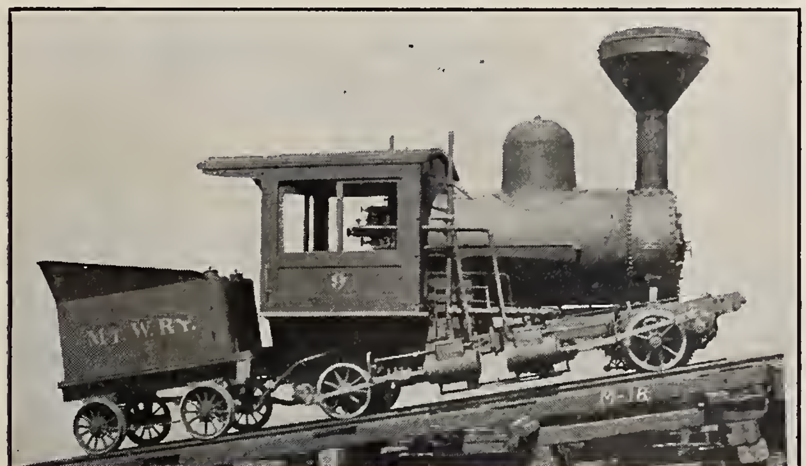


Fig. 2. Am. Loco. Co. Engine for Mt. Washington Ry.

menced in 1866 and completed in 1869, from a point known as the Base Station to the summit, a distance of a little over three miles. Probably no other three miles of railroad in the world were ever covered with greater difficulty, yet the first cost of the road was comparatively low, amounting to about $150,000, including all equipment.

The track rises about 4,000 ft. in its length of three miles, the elevation at the summit of the mountain being 6,290 ft. The greater part of the road is constructed on wooden trestle work, at some points the rails being 30 ft. from the ground. As originally built, the road was laid with strap iron rails, secured to wooden stringers, but these gave a great deal of trouble and were soon replaced by light rails of the ordinary form. The gauge of the road is 4 ft. 7½ ins. owing to a fancy of Mr. Marsh that he needed a "close gauge." The rack rail consists of two angle irons, placed back to back, with round iron pins between them, the ends of the latter being riveted over, thus forming an iron ladder, up which the locomotive climbs.

This comparatively light looking rack rail enables the train to ascend a grade of 1,980 ft. to the mile, or 37.5 per cent, the heaviest grade on any "cog road" in the world, with the exception of the railway up Mount Pilatus in Switzerland, which, however, is of an en-

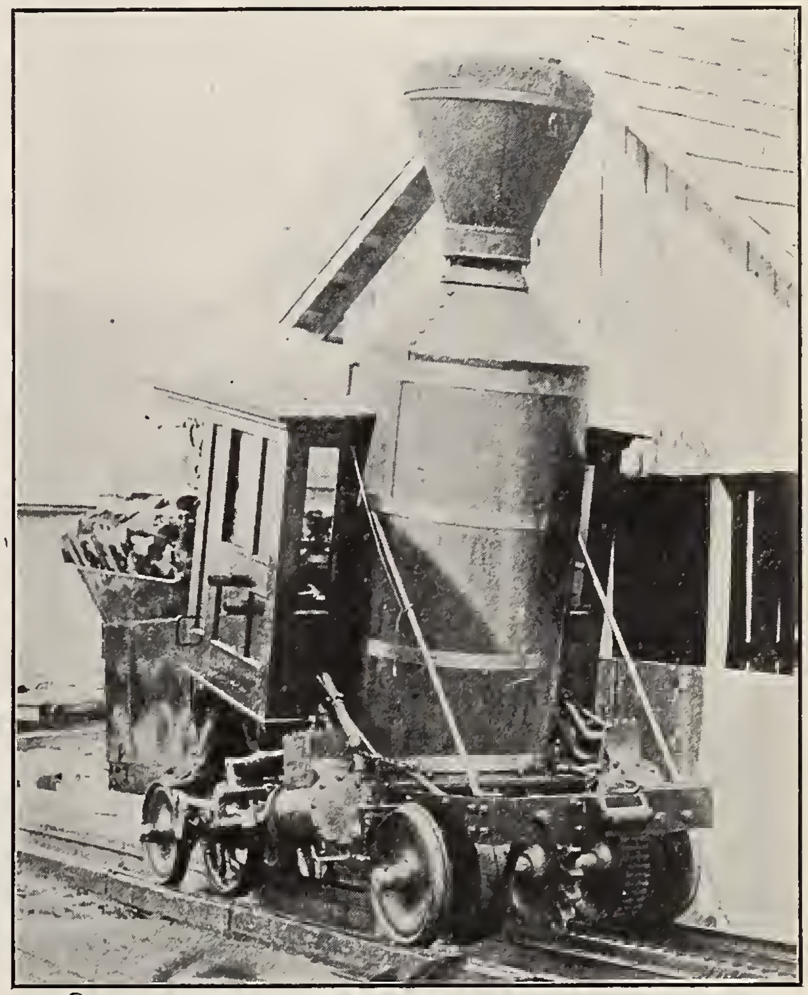


Fig. 3. First Type of Locomotive Used on the Mt. W. Ry.

tirely different type and can not properly be classed with the Mount Washington line. The steepest grade occurs on the long trestle known as "Jacob's Ladder," and when viewed from below, presents rather a terrifying appearance, but no accident has occurred on the road in its 46 years of operation. The average rise of the track is at the rate of 1,300 ft. per mile, which is "some grade" in itself, to use the well understood slang of this era.

The first locomotives, shown in Fig. 3, were provided with vertical boilers and a single cogwheel for engaging the rack rail, which was turned, through gearing, by the motion of pistons in a pair of cylinders, 10 ins. in diameter and 16-in. stroke. These locomotives were not wholly satisfactory and were replaced by the type of engine still in use on the road. These engines are most peculiar in construction and appearance, differing in many ways from those used on an ordinary railroad. The engine is carried on four wheels of small diameter, the two axles also having mounted on them the gearing and gear wheels for connection with the rack rail. The wheels are turned, by means of this gearing, and a pair of cylinders for each set of wheels.

The boilers are short and of comparatively large diameter and are of the ordinary locomotive type. They are set to be level on the average grade, and therefore, when standing on level track the engine presents a very odd appearance, being all down in the front like a "hog." The speed of the locomotive, while ascending, is controlled by a fly-ball governor, similar to the kind used on stationary engines, and when running down hill speed is checked by the water brake. This is a device once used quite extensively on our western mountain roads, and depends for its operation on the fact that the engine is in the reverse motion, the cylinders acting as air compressors. By means of a suitable valve in the cab leading from below the water line, it provides the amount of back pressure, against which the pistons work, and consequently the speed of the train may be regulated. The name, "water brake," comes from the fact that the small amount of water admitted to the cylinders to keep them cool, is turned to steam and finally escapes in that form. Other friction brakes on the engine and cars are also provided for use in emergency. Until a couple of years ago, the engines burned wood for fuel, and they are still equipped with the old style "sunflower" stacks, which add to the oddity of their appearance.

The road owns eight locomotives, numbered from one to nine, No. 7 being missing. No. 9, the latest engine, was built by the Manchester Works of the American Locomotive Company in 1908, and we are able to give a good representation of her in Fig. 2. The details show up clearly, and the peculiar little tender, with wheels like a hand-car, may be noticed. The boiler of this engine is 48 ins. in diameter; the cylinders are 8 by 12 ins. The drivers are 24 ins. in diameter, and the tank has a capacity of 500 gallons. The steam pressure carried is 120 lbs. An interesting comparison may be made between these figures and the dimensions of an ordinary modern locomotive.

The rolling stock consists of quite a number of four-wheel passenger cars and a few small flat cars. In practice, one passenger car and one flat car constitutes a load, and the engine always pushes the passenger car, Fig. 1, so that no coupler is necessary. The cars are lightly constructed, but the seats, which are set on a slant, so as to be nearly level on the grade, are very comfortable. Each car holds about 50 people. The up trip of three miles takes about one and one-half hours, including three stops for water. Not very fast running to be sure, but if you close your eyes, the sound of the exhaust of the geared engine gives an impression of much greater speed.

For some time there was no railroad connection with the Base Station, but at last a branch was built from the main line of the Boston, Concord & Montreal, now the Boston & Maine, at Fabyans, about seven miles away. A train of open cars is run over this branch to connect with the "cog trains." This branch is quite an interesting piece of engineering, in itself, and has some very heavy grades. As on the mountain road, the engine pushes the cars, so there is no inconvenience from dust, dirt or cinders.

The view from the summit of Mount Washington is one of the finest in the world, and in the opinion of many, it is not surpassed by anything in this country. The panorama lacks some of the grandeur of the Rockies, but the tints on the distant mountains and in the valley, far below, are soft and most beautiful. On clear days the cities of Portland and Portsmouth, with the ocean beyond, may be seen, and the whole forms a picture never to be forgotten. The ruins of the old Tip-Top House, recently destroyed by fire, add picturesqueness to the scene, and a short distance below the beholder, and near the track, is the quaint wooden monument to Lizzie G. Bourne, of Kennebunk, Me., who lost her life at that point during a storm, September 14th, 1885.

The New Summit House is a well-appointed hotel, completed this year, and the good lunch that may be obtained there, adds greatly to the comfort of those making the trip. The writer desires to state that he is indebted to the American Locomotive Company for the photograph and particulars of engine No. 9, and also to his wife, who helped in the preparation of the article, and to who he believes, it owes what amount of literary merit it may possess.

Pennsylvania R. R. Fire Department

There were 1,029 fires on Pennsylvania Railroad property in 1915. Spontaneous combustion was the cause of fifteen; thirty-six broke out on adjoining property; twelve were of incendiary origin; lightning started two; small boys set two; tramps eleven, and 130 were due to unknown causes. Tobacco and matches originated a dozen more and caused damage of more than $10,-000. This is extremely interesting information. Had it not been for the very efficient fire department on this great system results would have been more disastrous. The total fire losses for the year, as shown by the annual report of the company's insurance department, amounted to $278,730. The property which was exposed to the fire risks is valued at $350,000,000, and the damages were assumed by the insurance fund established by the company. The efforts of the employes saved $14,000,000 worth of property from the ravages of fire by using apparatus provided by the company, this representing as many as 441 distinct blazes. Besides these, more than $6,000,000 worth of property was threatened; but slight damage occurred by reason of especial efficiency on the part of the employes' fire brigades. Forty fires were extinguished by apparatus used on locomotives; fifty were put out by chemical appliances, while twenty-six were checked by fire pails and casks. In the case of six more, high-pressure fire lines, constructed by the company, were employed. The example set by this well managed institution is worthy of the attention of all the large railway systems in the country.

"Dining Car" Title to Be Abandoned.—The Pennsylvania Railroad Co., by special order to take effect April 1, have discontinued the use of the name "Dining Car." Hereafter these cars will be known as "Restaurant Cars." Inasmuch as "dining" refers to dinners only, and from the fact that the three meals of the day are furnished in what is known as a "dining car," the substitution of "restaurant" is deemed more appropriate.

The "Dining Car," which has been in vogue for more than a generation on all the first-class railroads in the country, has had its day, so to speak. The present times call for more appropriate terms. The Pennsylvania is generally in the lead, not only in such matters, but in many others of much more consequence.

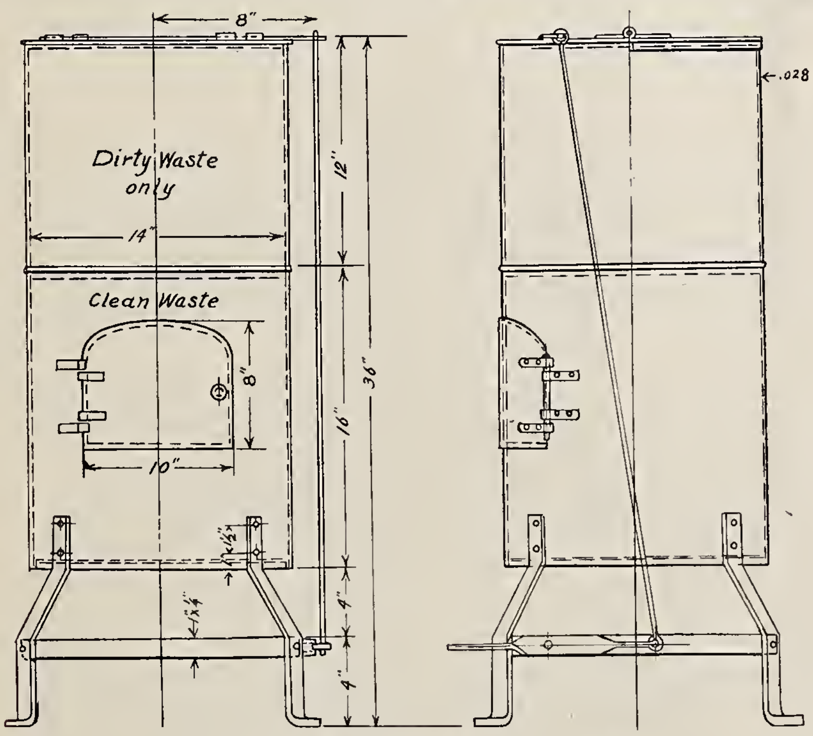
It's opinion, not truth, that traveleth the world without passport.—Sir Walter Raleigh.

Practical Suggestions from Railway Shop Men

Waste Receptacle for Round House

By C. W. SCHANE, Huntington, Ind.

The sketch sent with this shows a new type of waste storage can or receptacle for clean and soiled waste. This receptacle is fire-proof and is always closed and cannot be left open. It is of use in engine houses, paint shops, tool rooms, machine shops, etc., and is quite handy outside a railroad shop around an automobile



Round House Receptacle for Waste

garage where gasoline is kept. Fire risks from oily waste in and out of railroad shops are lessened.

The lid is opened by foot power applied to a series of levers and rods. This can or receptacle may be built of scrap engine jacket iron or car roofing, or indeed any light plate, and it does all that is expected of it. I send this because you say that new devices and ideas will be acceptable.

Grinding Up Old Boiler Lagging

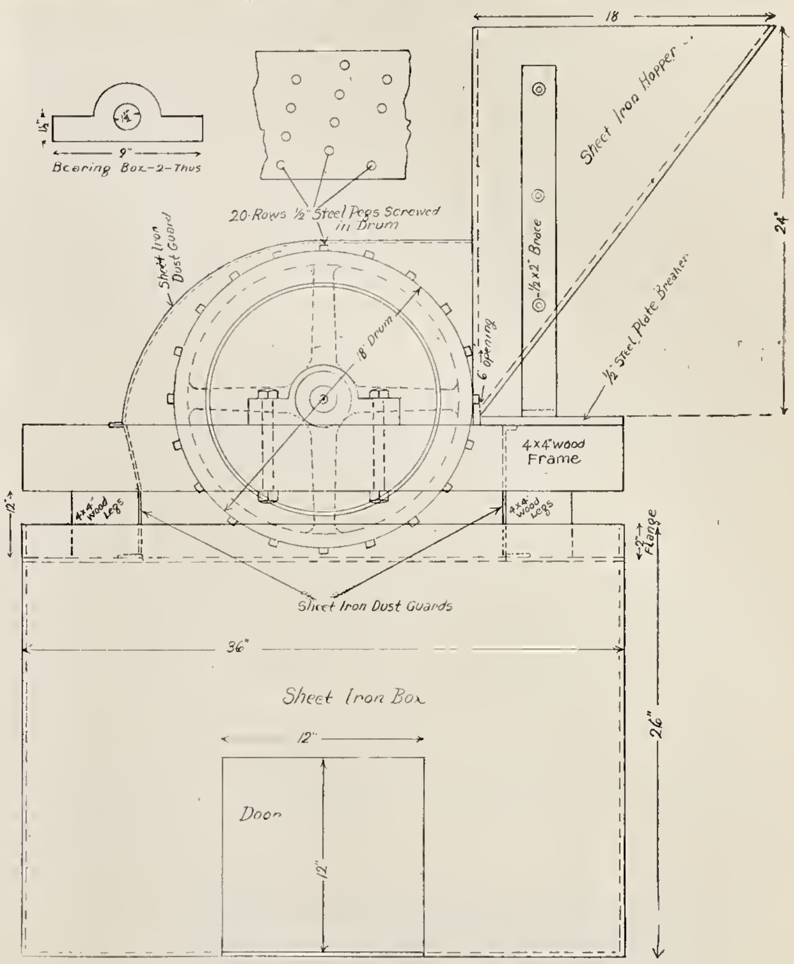
By C. L. DICKERT

Asst. Mast. Mech. Central of Georgia Ry., Macon, Ga.

Here is a sketch of a machine for grinding or breaking up old boiler lagging. I do not want full credit for this machine, as I was not the originator. I am unable to say who first designed a machine of this kind. The machine I have in service is different in many respects from the original drawing, as I found it necessary to make changes to get better results.

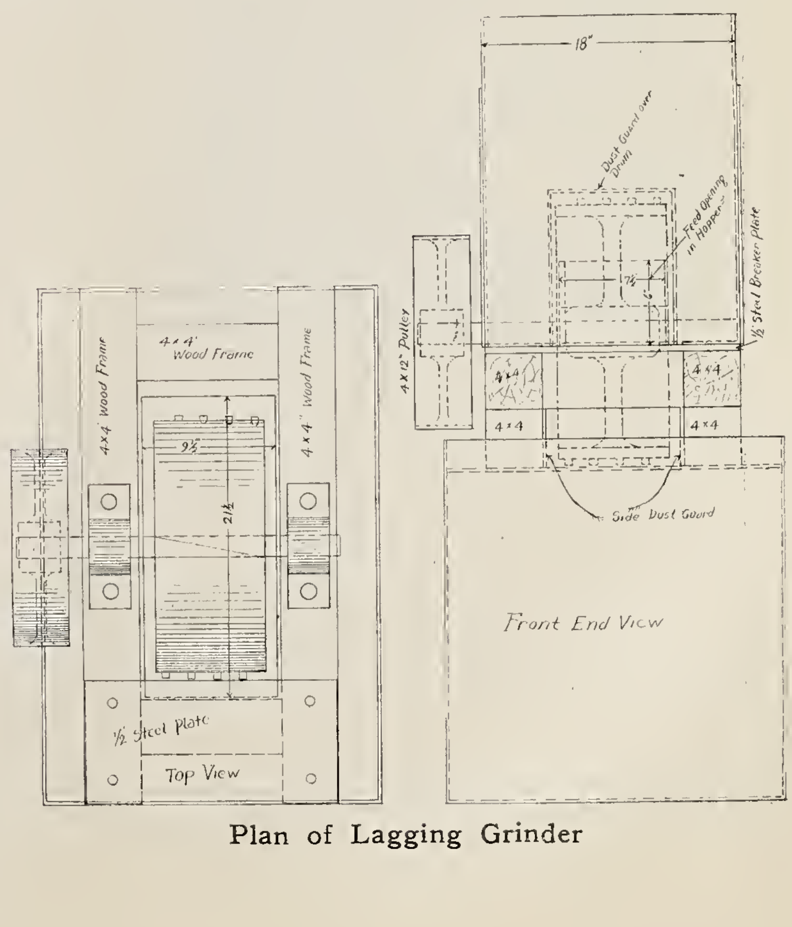
If you care to publish this kink, I will be glad if you will make mention of the fact that credit for original machine is due some one unknown to me.

The sketch, as I said, shows a machine for grinding old boiler lagging. It is simple in design and inexpensive to make. Prior to installation of this machine one laborer was regularly assigned to beating up old boiler lagging. Since the machine was put in service, one day each week grinding lagging will more than supply the demand.



Machine for Grinding Up Old Lagging

Where sectional lagging is used there are a number of more or less small pieces that cannot very well be re-applied, but can be ground up and used for plastering. Where a boiler has been plastered and lagging removed, this must be re-ground before it can be re-applied. The machine is portable and is run by portable motor.



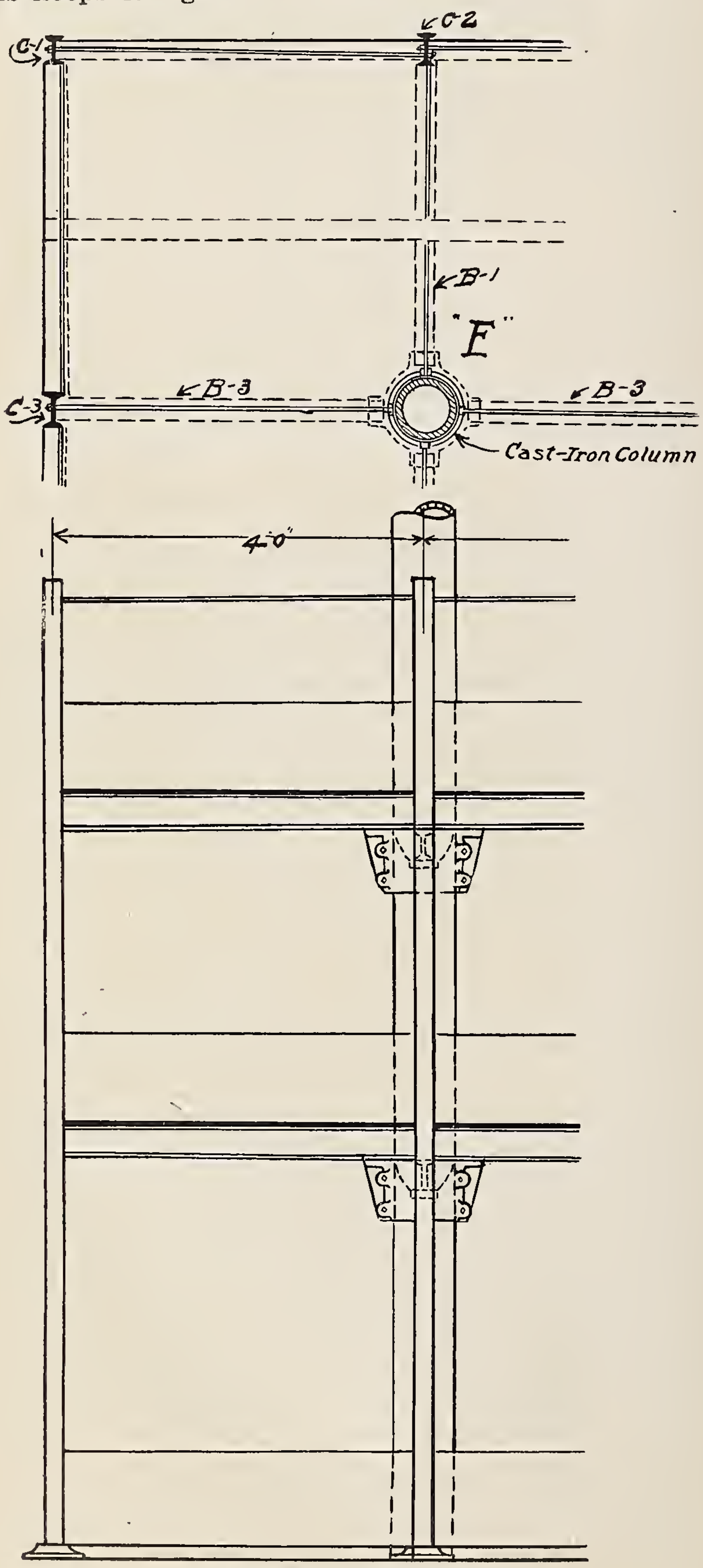
Plan of Lagging Grinder

Structural Steel Material Bins

By W. H. WOLFGANG
Toledo, Ohio

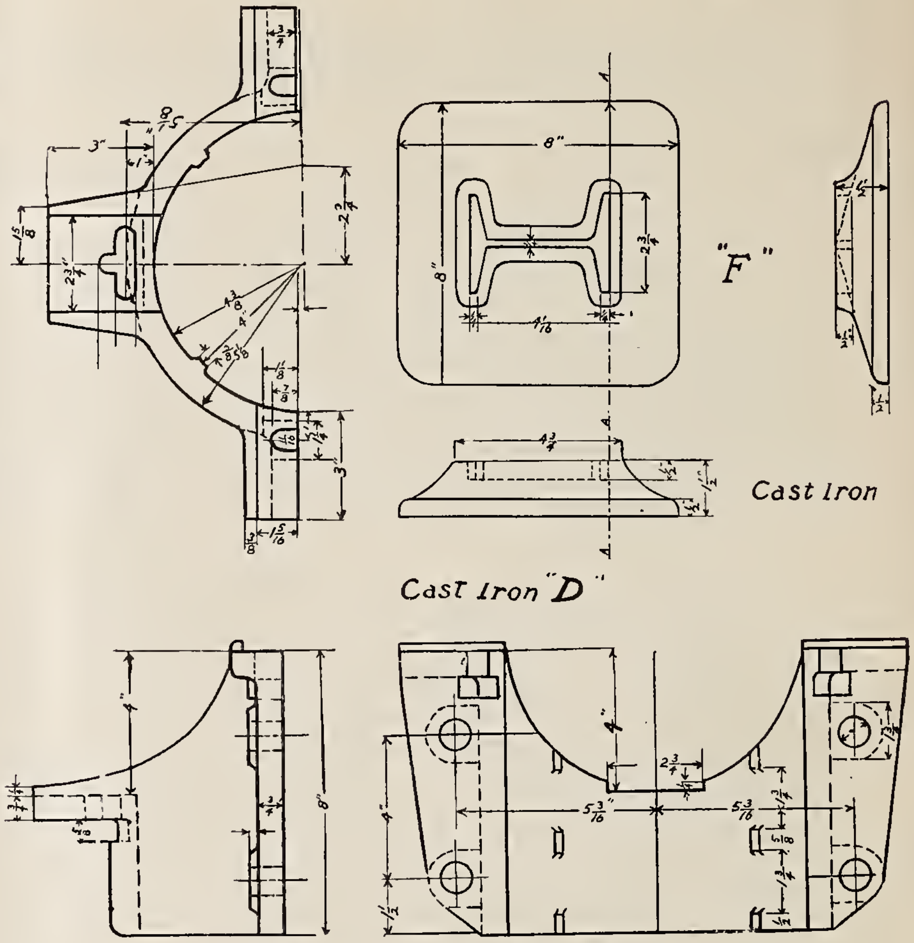
In most warehouses wooden bins are in use, but these soon become ragged and broken, through much usage. Steel bins cost more, but a comparison of wood and steel shows that steel is the best, neatest and most convenient, and they do not take up much floor space. Small castings and fittings can easily be shoveled, and the shovel will not catch on the floor of the bin as in wooden bins. Other material can be easily handled.

In the illustration B, a section of steel bin is shown which can be made any height, width or length. All second-hand material can be used, if desired. The framework of the bin is made of 4 ins. 7½ lbs. I-beams, which are riveted together as shown. Three-sixteenths inch steel plates are used for the floor and sides, which are supported by the casting, as shown at G. Half-inch steel rods are made to tie the framework together, and this keeps it rigid.

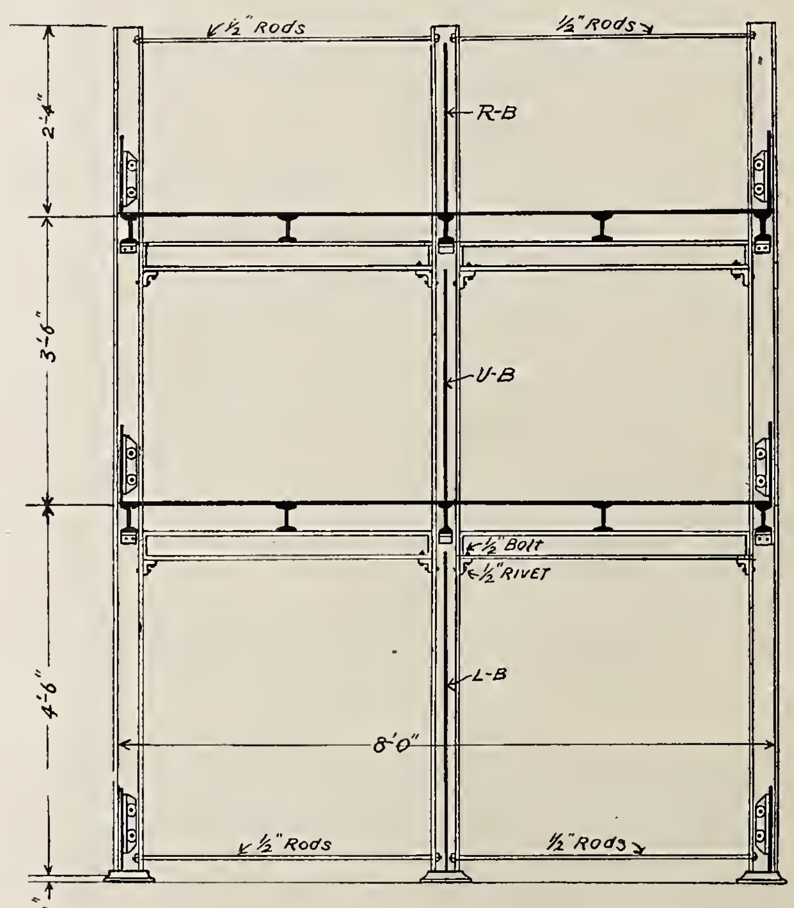


Plan and Elevation of Bin

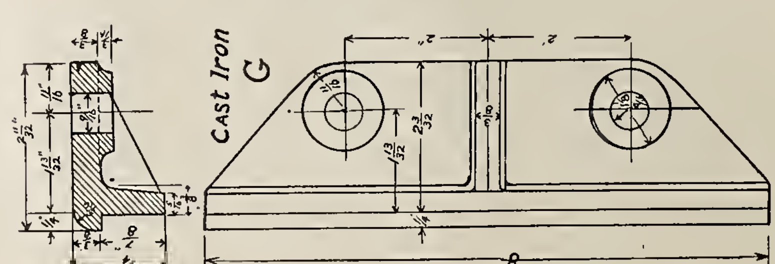
The castings F in illustration are slipped on the bottom of the 4-in. I-beams so as to have a good footing. Of course the footing can be made to suit conditions.



Details of Bin Posts and Feet



Side View of Bin



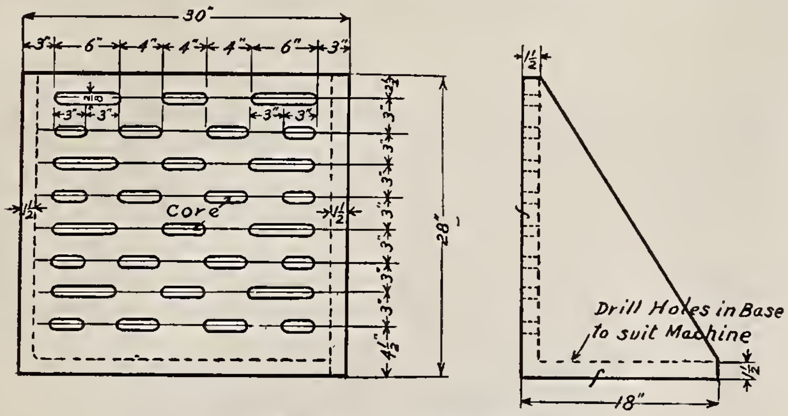
Casting for Foot of Posts

Angle Plate

By W. H. WOLFGANG

Toledo, Ohio

Various angle plates have been designed and are in use, but most of them answer few purposes only. In the illustration is shown a cast-iron angle plate which was designed to take a large variety of work, from small castings and forgings to large castings.



Cast Iron Angle Plate

The angle plate was designed mostly for use on radial drill presses, but it can also be used on large planers. All drilling and tapping jigs can readily be clamped to it, and it saves backache for the workman in taking work out of the jig and putting it in.

Book Reviews

English Railways; Their Development and Their Relation to the State. By Edward Cleveland-Stevens, M. A. Published by George Routledge & Sons, Limited, London. E. P. Dutton & Co., New York. Price, $2.25 net.

If any one cares to read a most interesting book on the history of English railways from the earliest days down to the present time he will find it in this work. It relates especially to the organization and later to the consolidation of the railways of England. Some railroad questions of moment are also treated of now and then; but the matter of consolidation is paramount. The entire subject is well snugged up and is therefore readable, although the material at hand upon which the book is written is most voluminous. There are explanatory maps and in the eleven chapters of the book there are interesting statements made relating to the important general subject of English railway consolidation or, as is frequently mentioned, railway amalgamation.

Annual Report of the Department of Railways and Canals. Dominion of Canada. April 1, 1914, to March 31, 1915.

This is a most interesting document, very complete in details and illustrations, besides furnishing a collection of maps. Prepared by the deputy minister, it contains statements of the accountant, agreements, contracts, water powers, reports of the general manager of the government railways, the chief engineer, the board of engineers, superintendents of canals, and matters relating to the various government railways and canals; acts relating to railway subsidies, together with excellent photographs and various plans. A pocket in which are to be found eleven maps for reference accompanies this voluminous report. Anyone who desires to become thoroughly familiar with the railways and canals of the Canadian government will find this report most interesting reading. The preparation of it has been attended by great care, precision and neatness. As a reference, it should find its place on the shelves of every railway library, and will doubtless be consulted often by financiers and others interested in the railways of our progressive neighbor—the Dominion of Canada.

Obituary

Robert Lawrie Stewart, mechanical superintendent of the Second District of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla, died suddenly at Kansas City, Mo., on Friday morning, March 24. He entered the service of the Denver & Rio Grande in 1885 as machinist's apprentice. After completing his course he was appointed roundhouse foreman, leaving that road in 1905. He later served the Atchison, Topeka & Santa Fe; the Kansas City Southern, and the Chicago, Rock Island & Pacific as general foreman and master mechanic. In 1914 he was promoted mechanical superintendent of the Third District of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla, and on January 1, 1916, his jurisdiction was extended to cover a portion of the old Second District when it was consolidated with the First and Third districts. At the time of his death Mr. Stewart was in the performance of his duties.

Theodore Voorhees, president of the Philadelphia & Reading Railway Co., died on March 12 last. The railroad world has lost an able executive. Mr. Voorhees was born in New York on June 4, 1847, and had therefore nearly reached man's alloted span of life. After graduating in 1869 from the Renssaeler Polytechnic Institute he joined the engineering staff of the Delaware, Lackawanna & Western and remained in that service for four years, when he was appointed superintendent of the Syracuse, Binghamton and New York Railway. Following this service he was made superintendent of the Champlain division of the Delaware and Hudson system, which position he held until he was appointed assistant general superintendent of the New York Central, later becoming general superintendent. He was selected in 1893 as vice-president of the Philadelphia and Reading, in charge of operation. He filled this office until 1914, when he was elected president of that road to succeed Mr. Baer. Mr. Voorhees was a man of rare qualities and experience and was a member of many societies. His life was both busy and successful.

Theodore Voorhees

New Methods and Appliances

Flat-Link Chain

The Cleveland Galvanizing Works Co., Cleveland, O., have reecntly placed on the market the Hodell flat-link chain, which consists of weldless links made of flattened wire. The designs of the links is novel, and is such that double wearing surface is presented at each end of the link. The edges are perfectly round-

Hodell Flat Link Chain

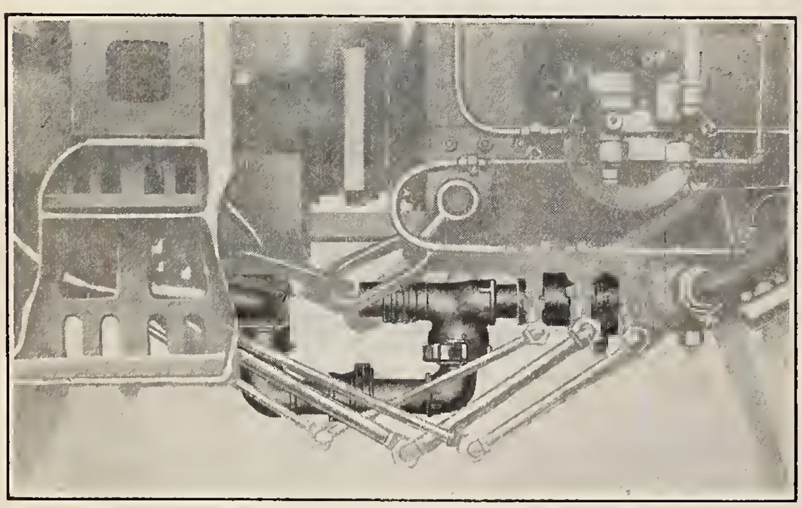
ed and symmetrical in design. The link is reinforced against elongation, is smooth on all surfaces and margins, is free from flaws, will take a fine polish, and can be made endless by the introduction of a special link. The chain is made in eleven sizes, and is available for sash suspension, lamp suspension and a variety of other purposes.

Water Joint for Injector Connection

The Franklin Railway Supply Co., New York City, have recently placed on the market the Franklin single water joint for injector connection. This joint is made large enough to accommodate a supply of water for two injectors and is so constructed that it provides for connections to two tank wells, unless otherwise desired.

The use of this all-metal conduit will eliminate the expense for injector hose and its capacity will insure furnishing a full supply of water to the injectors. It will insure against kinked hose and the hose lining working into the injectors. The probability of freezing is also reduced to a minimum, owing to the fact that either heater will keep it open while both heaters are required with the usual type of double connections.

The single connection is made so that it can be located



Franklin Water Joint Connection

directly under the draw-bar on the center line of the locomotive, at which point the movement of the joint will be reduced to a minimum.

The joint is connected up with extra-heavy wrought-iron pipe, having a union at the center, to be used when engine and tender are uncoupled. At either end of the joints tee heads are provided, the branches of each leading to the two tank wells on the tender and to the injector pipes on the engine. The flexible joint includes two ball joints and one slip joint, a combination of which takes any motion occuring between the engine and tender. The inside sleeve of the slip joint is threaded into an elbow connection, which turns downward and forms the outer casing for one of the ball joints. An extension is cast on this elbow, which is supported in a slide bearing, which is part of the slip-joint supporting bracket. This arrangement serves as a guide for the slip joint and relieves it from laterial strain.

New Trade Literature

Adams & Westlake Co., Chicago, Ill., have recently issued a two-page illustrated bulletin, B 42, describing their No. 80 reading lamp for locomotives, which conforms to the specifications of the Interstate Commerce Commission requiring a lamp in the cab, for reading train orders and time tables, which can be readily darkened or extinguished.

The Cleveland Galvanizing Works Co., Cleveland, O., have recently issued a 12-page illustrated bulletin, C-21, discribing the construction and sizes of Hodell flat-link chain, the links of which are made to resemble somewhat stamped sheet metal links, but are made of flattened wire. Chains are described in a number of sizes and for a variety of purposes.

G. A. Nelson, 30 Church St., New York City, has recently issued a 10-page folder describing the complete line of Hauck Kerosene Torches and Forges for brazing, rivet heating, soldering, engine heating, melting furnaces, blacksmith forges and other purposes requiring the use of powerful burners.

The Union Switch & Signal Co., Swissvale, Pa., have recently issued an 8-page illustrated bulletin describing the equipment of their forging shop foundry and machine shops, which are equipped for the manufacture of forgings, gray iron and mild steel castings. In connection with their machine shop they are in a particularly advantageous position to manufacture a wide variety of such material.

A. S. Cameron Steam Pump Works, 11 Broadway, New York City, have recently issued Bulletin 110. Bulletin 110 covers the Cameron line of Duplex Pumps, including both piston and plunger types, with single and compound steam cylinders for general service, boiler feeding, tank service, water works, hydraulic elevators, automatic pumps and receivers, brewery, quarry and mining work. The catalogue is well illustrated and also contains tables of sizes and capacities.

Air Brake Association Convention

Atlanta, Ga., May 2 to 5, 1916

Preparations for the annual convention of the Air Brake Association, at Atlanta, Ga., May 2 to 5, 1916, are being completed, and the indications are that there will be a very well-attended meeting, with a number of unusual features. The convention will be held at the Hotel Ansley, and any further information can be secured from L. H. Schneider, chairman of the committee, Jersey City, N. J.

Supply Trade News

Samuel G. Allen has been elected president of the Franklin Railway Supply Co. and Mr. Joel S. Coffin, formerly president, is now chairman of the board. Mr. Allen has served as vice-president since the incorporation of the company. He was born in 1870 at Warren, Pa., and was educated there and at Pennsylvania State College. Early in life he assumed business responsibilities immediately after leaving college and found

Samuel G. Allen

time to study law in a period of great business activity. He was admitted to the bar in Warren County, Pa., and practiced law for nine years. In 1901 the Franklin Railway Supply Co. was formed, with Mr. Joel S. Coffin as president and Mr. Allen as vice-president. The ability of Mr. Allen as a lawyer and as a business man is reflected in the success of the large number of concerns with which he is connected as an officer and a director. He is secretary-treasurer of the newly formed Locomotive Feed Water Heater Co.

Beaudry & Co., Inc., Boston, Mass., have recently announced the appointment of Sherritt & Stoer Co., Inc., 603 Finance building, Philadelphia, Pa., as exclusive sales agents in the Philadelphia district for the Beaudry Champion and Peerless power hammers.

J. W. Brewer has recently been appointed general foreman of the Lima Locomitive Corporation, at Lima, O. Mr. Brewer's experience includes nineteen years of railroad service, and he has served as master mechanic and superintendent of shops on the Baltimore & Ohio R. R., leaving that road in 1914. From that time until he entered the service of the Lima Locomotive Corporation he was with the Chicago & Alton R. R. on special work.

Walter H. Bentley has recently been appointed assistant to Burton W. Mudge, president of Mudge & Co., Chicago, Ill. Mr. Bentley entered the service of the Chicago Northwestern Ry. in 1903, in the storekeeping department. In 1909 he served for a time as locomotive fireman on the Duluth & Iron Range, returning to the Chicago Northwestern, where he filled various capacities in the engineering and purchasing departments.

Walter H. Bentley

In 1912 he joined the Chicago sales forces of the Baldwin Locomotive Works and the Standard Steel Works, and in 1914 was appointed western representative of the Curtain Supply Co., of Chicago, where he remained until the recent announcement of his connection with Mudge & Co.

Cambria Steel Co., Pittsburgh, Pa., have recently announced the appointment of John C. Neale, general manager of sales, succeeding C. B. McElhany.

The Curtain Supply Co., Chicago, Ill., have secured the services of T. B. O'Brien, who has been connected with the O. M. Edwards Co. of Syracuse, N. Y., for some time, to be their Southeastern sales representative. George E. Fox, formerly Southeastern representative, has been appointed Western sales agent with headquarters in Chicago.

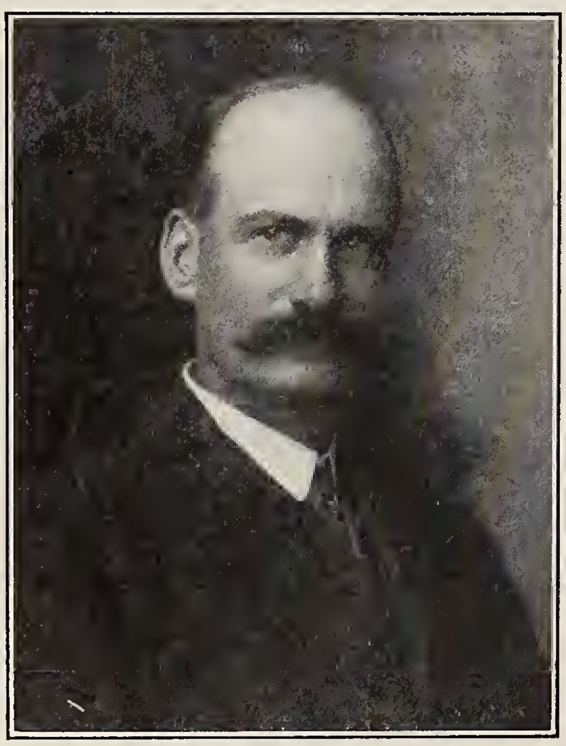
The Franklin Railway Supply Co., 30 Church street, New York City, due to the remarkable results secured by the use of the Stone-Franklin lighting equipment, has appointed Ralph G. Coburn sales manager of their electrical department. Mr. Coburn has been associated with the Franklin company for the past seven years, being formerly in charge of their Chicago office and for the last few years Eastern sales manager, with headquarters in New York, where he will continue in his new capacity.

The Locomotive Feed Water Co., 30 Church Street, New York, is a new railway supply company, organized last month. George M. Basford, formerly chief engineer, railway department, for Joseph T. Ryerson & Son, has been made president of the new company.

Associated with him, as vice-president, is Earl A. Averill, formerly with the Standard Stoker Co. The Locomotive Feed Water Heater Co. has been organized to handle an application to locomotive use, of the Lufkin Film Heater, which was invented by L. D. Lufkin, chief engineer of the New York Shipbuilding Co. This heater is one that has had a very successful development in marine and stationary practice and has already been successfully applied to locomotives.

The company includes Samuel G. Allen, as secretary-treasurer; Joel S. Coffin, chairman of the board, and H. F. Ball, L. D. Lufkin, J. E. Muhlfeld, G. L. Bourne, V. Z. Caracristi and Le Grand Parish, directors.

Mr. Basford, the new president, finished his education at the Massachusetts Institute of Technology in 1889. His first work was done when he entered the Charlestown shops of the Boston & Maine, later going to the Chicago, Burlington & Quincy as draftsman at Aurora, Ill. Later he went to Omaha, Nab., and joined the motive power department of the Union Pacific, and was connected with the test department of that road. Leaving the mechincal department he took the position of signal engineer of the Chicago, Milwaukee & St. Paul, after which he became superintendent of construction of the Johnson Railway Signal Co., and was for some time with the Union Switch & Signal Co., and was signal engineer of the Hall Signal Co. In 1895 he became mechanical department editor of the Railway & Engineering Review, and in 1897 was offered the position of editor of the American Engineer & Railroad Journal. It was while holding this position that he became widely known, and wrote his name large on the page of American technical journalism. Mr. Basford's conceptions of the position and work of a railroad man's



George M. Basford

paper are the highest and he has lived up to his useful, dignified and helpful conception of the part. The American Engineer in his hands was often affectionately referred to as "Basford's paper" by his many friends.

In September, 1905, he accepted a position with the American Locomotive Co. as assistant to the president, and later became chief engineer in the railway department of Joseph T. Ryerson & Son.

Mr. Basford has also to his credit the formation of the Railway Signal Association, which grew out of the Railway Signaling Club, which later developed into the national association. For the first two years, 1895 and 1896, he was secretary-treasurer of the organization.

Earl A. Averill, vice-president of the Locomotive Feed Water Heater Co., was until recently with the Standard Stoker Co. as engineer of operation. He was born at Richland, N. Y., on August 13, 1878, and after a preparatory education in public and private schools, entered Cornell University in 1896. He graduated in 1900 with the degree of mechanical engineer, having

Earl A. Averill

specialized during his senior year in railway mechanical engineering. He began practical railroad work the summer of 1899 in the shops of the Philadelphia & Reading, at Reading, Pa., and later went with the Chicago, Burlington & Quincy, at West Burlington, Ia. After four years' service with the Burlington, most of which was spent in the shop, roundhouse and on the road, Mr. Averill joined the staff of the Railway & Engineering Review of Chicago, where he remained for over two years. He left that publication to go to New York as associate editor of American Engineer & Railroad Journal, of which he was later made managing editor. He remained in that position until February 1, 1914.

The Feed Water Heater Co. has, in thus securing the services of these two gentlemen of the technical periodic press, possessed itself of executive ability of a high order, and starting as it does, officered as it is, a large measure of success should attend its endeavors.

Westinghouse Annual Banquet

At the sixth annual banquet of the Westinghouse Interests in the Pittsburgh district, held under the auspices of the Westinghouse Club last month, the principal speaker was Mr. Wm. L. Saunders, vice-chairman of the Naval Consulting Board and chairman of the board of directors of the Ingersoll Rand Co. of New York.

Mr. Saunders had chosen for his subject "Industrial Preparedness for Peace and War," and in the course of his remarks said that if the industrial strength of the United States became known no foreign country would attack us. The consumption of coal in the United States is five tons per capita, while the per capita coal consumption of the great industrial nations—England and Germany—is 4 tons, while that of France is 1.6 tons, and Russia is only ¼ of a ton. It is obvious that this industrial wealth cannot be utilized in full measure unless it is organized, and it is obvious that it takes a long time to organize a country, hence the importance of beginning now to place our industries in a position where they will respond quickly to the needs of the government in case of trouble.

The Railway Supply Manufacturers' Assn.

The progress being made on the 1916 exhibition at Atlantic City by the Railway Supply Manufacturers' Association would indicate that this year's exhibtion will exceed in size and interest last year's convention by a very comfortable margin.

At the present time there has been sold an amount of floor space equivalent to the entire amount occupied at the 1915 convention. A great many new concerns are planning to exhibit this year, and a number of new devices will in this way be available for study. A number of regular exhibitors have produced new designs, which will add materially to the interest of the convention. The unsettled labor conditions in many lines of railroad work have stimulated the production of labor-saving equipment, and these products will be consiedred with more than usual interest.

The association reports that the booth structure will be entirely new and that additional power will be furnished. The buildings on the pier are being improved; a new floor is being laid in Machinery Hall extension and the floor of the building is being leveled up. The Annex will be practically enclosed with glass sash. The entertainment features have not been definitely decided, but it is expected to have balls and carnivals similar to last year, also a golf tournament, and possibly a ball game and card parties. Rolling chairs will be provided for the use of the guests of the convention, as usual.

Some very choice space remains unassigned, and prospective exhibitors would do well to file their applications at once, in order to have as wide a selection as remains at this time. J. D. Conway, secretary and treasurer of the association, 2136 Oliver building, Pittsburgh, Pa., will be glad to place at the disposal of any prospective exhibitor complete information as to what space remains unoccupied and as to the advantages and conditions covering the exhibition.

The list of exhibitors who have applied for space to date is as follows:

Exhibiting Members

Acme Supply Co., Chicago, Ill.
American Abrasive Metals Co., New York City.
American Arch Co., New York City.
American Balance Valve Co., Jersey Shore, Pa.
American Brake Shoe & Foundry Co., Mahwah, N. J.
American Car & Foundry Co., New York City.
American Electric Ry. Association, New York City.
American Flexible Bolt Co., Pittsburgh, Pa.
American Locomotive Co., New York City.
American Mason Safety Tread Co., Boston, Mass.
American Steel Foundries, Chicago, Ill.
Anchor Packing Co., Philadelphia, Pa.
Armstrong Cork Co., Pittsburgh, Pa.
Ashton Valve Co., Boston, Mass.
Associated Malleable Iron Mfrs., Cleveland, O.
Automatic Ventilator Co., New York City.
Barco Brass & Joint Co., Chicago, Ill.
Besly, Charles H., & Co., Chicago, Ill.
Bettendorf Co., Bettendorf, Iowa.
Bird-Archer Co., New York City.
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Boyce Fuel Economizer Co., New York City.
Breakless Staybolt Co., Pittsburgh, Pa.
Buckeye Steel Castings Co., Columbus, O.
Buffalo Brake Beam Co., New York City.
Byers, A. M., Co., Pittsburgh, Pa.
Cambria Steel Co., Philadelphia, Pa.
Camel Co., Chicago, Ill.
Carborundum Co., Niagara Falls, N. Y.
Carnegie Steel Co., Pittsburgh, Pa.
Chase, L. C., & Co., Boston, Mass.
Chicago Car Heating Co., Chicago, Ill.
Chicago-Cleveland Car Roofing Co., Chicago, Ill.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chicago Railway Equipment Co., Chicago, Ill.
Chicago Steel Car Co., Chicago, Ill.
Chicago Varnish Co., Chicago, Ill.
Commonwealth Steel Co., St. Louis, Mo.
Consolidated Car Heating Co., Albany, N. Y.
Consolidated Elec. Light & Equipt. Co., New York.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Curtain Supply Co., Chicago, Ill.
Damascus Brake Beam Co., Cleveland, O.
Davis Machine Tool Co., Inc., Rochester, N. Y.
Dearborn Chemical Co., Chicago, Ill.
Detroit Lubricator Co., Detroit, Mich.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Dodge Metal Hose Co., Inc., Wellsville, N. Y.
Draper Mfg. Co., Port Huron, Mich.
Duff Mfg. Co., Pittsburgh, Pa.
DuPont Fabrikoid Co., Inc., Wilmington, Del.
Economy Device Corp., New York City.
Edison Storage Battery Co., Orange, N. J.
Edwards, O. M., Co., Inc., Syracuse, N. Y.
Electric Storage Battery Co., Philadelphia, Pa.
Elwell-Parker Electric Co., New York City.
Enterprise Railway Equipment Co., Chicago, Ill.
Equipment Improvement Co., New York City.
Ewald Iron Co., Louisville, Ky.
Flannery Bolt Co., Pittsburgh, Pa.
Flint & Chester, Inc., New York City.
Franklin Railway Supply Co., New York City.
Frost Railway Supply Co., Detroit, Mich.
Galena Signal Oil Co., New York City.
Garlock Packing Co., Palmyra, N. Y.
General Electric Co., Schenectady, N. Y.
Gold Car Heating & Lighting Co., New York City.
Goldschmidt Thermit Co., New York City.
Gould Coupler Co., New York City.
Greene, Tweed & Co., New York City.
Greenfield Tap & Die Corp., Greenfield, Mass.
Greenlaw Mfg. Co., Boston, Mass.
Griffin Wheel Co., Chicago, Ill.
Grip Nut Co., Chicago, Ill.
Hale & Kilburn Co., New York City.
Hanna Loco. Stoker Co., West New Brighton, N. Y.
Harrington, Edwin, Son & Co., Philadelphia, Pa.
Hauck Mfg. Co., Brooklyn, N. Y.
Hewitt Rubber Co., Buffalo, N. Y.
Hewitt Steel Corp., New York City.
Heywood Bros. & Wakefield Co., Wakefield, Mass.
Hunt-Spiller Mfg. Corp., South Boston, Mass.
Illinois Steel Co., Chicago, Ill.
Imperial Car Cleaner Co., Newark, N. J.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York City.
Jacobs-Shupert U. S. Firebox Co., Coatesville, Pa.
Jefferson Union Co., Lexington, Mass.
Jenkins Bros., New York City.
Johns-Manville, H. W., Co., New York City.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Jones, B. M., & Co., Inc., Boston, Mass.
Julian-Beggs Signal Co., Terre Haute, Ind.
Kerite Insulated Wire & Cable Co., Inc., New York
Keystone Equipment Co., Philadelphia, Pa.

Lehon Co., Chicago, Ill.
Locomotive Stoker Co., Schenectady, N. Y.
Locomotive Superheater Co., New York City.
Long, Chas. M., Jr., Co., Louisville, Ky.
Lubricating Metal Co., New York City.
Lukens Iron & Steel Co., Coatesville, Pa.
Lunkenheimer Co., Cincinnati, O.
MacRae's Blue Book Co., New York City.
Magnus Metal Co., New York City.
Magnussen, John A., Tacoma, Wash.
Mahr Mfg. Co., Minneapolis, Minn.
Manning, Maxwell & Moore, Inc., New York City.
Massachusetts Mohair Plush Co., Boston, Mass.
Metals Production Equipment Co., New York City.
Miner, W. H., Chicago, Ill.
Midvale Steel Co., Philadelphia, Pa.
Mudge & Co., Chicago, Ill.
McConway & Torley Co., Pittsburgh, Pa.
McCord & Co., Chicago, Ill.
McGraw Publishing Co., New York City.
McKinnon Chain Co., Buffalo, N. Y.
McQuay-Norris Mfg. Co., St. Louis, Mo.
Nathan Mfg. Co., New York City.
National Car Wheel Co., Pittsburgh, Pa.
National Lock Washer Co., Newark, N. J.
National Malleable Castings Co., Cleveland, O.
National Railway Devices, Co., Chicago.
National Tube Co., Pittsburgh, Pa.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
New York Air Brake Co., New York City.
Norton, A. O., Inc., Boston, Mass.
Nuttall, R. D., Co., Pittsburgh, Pa.
Nutter & Barnes Co., Hinsdale, N. H.
Okonite Co., New York City.
O'Malley-Beare Valve Co., Chicago, Ill.
Pantasote Co., New York City.
Parkersburg Iron Co., Parkersburg, Pa.
Paxton-Mitchell Co., Omaha, Neb.
Pilliod Co., Swanton, O.
Pocket List of R. R. Officials, New York City.
Pratt & Lambert, Inc., Buffalo, N. Y.
Pressed Steel Car Co., New York City.
Pyle Nat. Elec. Headlight Co., Chicago, Ill.
Pyrene Mfg. Co., New York City.
Q. & C. Co., New York City.
Railway Materials Co., Chicago, Ill.
Railway Periodicals Co., Inc., New York City.
Railway Review, Chicago, Ill.
Railway Supply & Equipment Co., Atlanta, Ga.
Railway Utility Co., Chicago, Ill.
Ralston Steel Car Co., Pittsburgh, Pa.
Reading Specialties Co., Reading, Pa.
Refrigerator, Heater & Vent. Car Co., St. Paul, Minn.
Reliance Elec. & Engineering Co., Cleveland, O.
Robinson Co., Boston, Mass.
Robinson Connector Co., Branford, Conn.
Rome Merchant Iron Mill, New York City.
Ryerson, Jos. T., & Son, New York City.
Safety Car Heating & Lighting Co., New York City.
Safety First Mfg. Co., Chicago, Ill.
Schaefer Equipment Co., Pittsburgh, Pa.
Schroeder Headlight Co., Evansville, Ind.
Sellers, Wm., & Co., Inc., Philadelphia, Pa.
Sherwin-Williams Co., Cleveland, O.
Simmons-Boardman Publishing Co., New York City.
Sips, James H., & Co., Pittsburgh, Pa.
Southern Locomotive Valve Gear Co., Knoxville, Tenn.
Southern Pine Association, New Orleans, La.
Standard Asphalt & Rubber Co., Chicago, Ill.
Standard Car Truck Co., Chicago, Ill.
Standard Coupler Co., New York City.
Standard Heat & Ventilation Co., New York City.
Standard Stoker Co., Inc., New York City.
Summers Steel Car Co., Pittsburgh, Pa.
Symington, T. H., Co., Rochester, N. Y.
Transportation Utilities Co., New York City.
Union Carbide Sales Co., New York City.
Union Draft Gear Co., Chicago, Ill.
Union Railway Equipment Co., Chicago, Ill.
Union Spring & Mfg. Co., Pittsburgh, Pa.
United Engineering & Foundry Co., Pittsburgh, Pa.
U. S. Light & Heat Corp., Niagara Falls, N. Y.
U. S. Metal & Mfg. Co., New York City.
U. S. Metallic Packing Co., Philadelphia, Pa.
Universal Car Seal & App. Co., Albany, N. Y.
Universal Draft Gear Att. Co., Chicago, Ill.
Valentine & Co., New York City.
Vissering, Harry, & Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, O.
Watson-Stillman Co., New York City.
Waugh Draft Gear Co., Chicago, Ill.
Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.
West Disinfecting Co., New York City.
Western Railway Equipment Co., St. Louis, Mo.
Western Steel Car & Foundry Co., New York City.
Westinghouse Air Brake Co., Pittsburgh, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Wheel Truing Brake Shoe Co., Detroit, Mich.
White Enamel Refrigerator Co., New York City.
Wilson Remover Co., Newark, N. J.
Wilson Welder & Metals Co., New York City.
Wood, Alan, Iron & Steel Co., Philadelphia, Pa.
Woods, Edwin S., & Co., Chicago, Ill.
Yale & Towns Mfg. Co., New York City.

Track Exhibit

Refrigerator Heater & Vent. Car Co., St. Paul, Minn.

The list of companies who have applied for non-exhibiting membership is as follows:

Non-Exhibiting Members

Amer. Brass Co. (Coe Brass Branch), Ansonia, Conn.
Assoc. of Mfrs. of Chilled Car Wheels, Chicago.
Baldwin Locomoitive Works, Philadelphia.
Belmont Packing & Rubber Co., Philadelphia.
Brooks, Clarence Co., Newark, N. J.
Eagle Glass Mfg. Co., Wellsburg, W. Va.
Edison, Thos. A., Inc., Bloomfield, N. J.
Ehret Magnesia Mfg. Co., Philadelphia.
Gutta Percha & Rubber, Ltd., Toronto, Ont.
Justice, Philip S., & Co., Philadelphia.
Keystone Drop Forge Works, Chester, Pa.
Kirby Lumber Co., Houston, Texas.
Lockhart Iron & Steel Co., Pittsburgh.
Maloney Oil & Mfg. Co., New York City.
McCord Mfg. Co., Detroit.
National Waste Co., Chicago.
New York Belting & Packing Co., New York City.
Niles-Bement-Pond Co., New York City.
Rogers, H. A., Co., New York City.
Standard Steel Works Co., Philadelphia.
Star Headlight Co., Rochester.
Union Steel Casting Co., Pittsburgh.
United & Globe Rubber Mfg. Cos., Trenton, N. J.
Warren City Tank & Boiler Co., Warren, Ohio.
Westinghouse, Church, Kerr & Co., New York City.

There must have been some few occurrences in the past year to which we can look back with a smile of cheerful recollection, if not with a feeling of heartfelt thankfulness.—The New Year.

Personal Items for Railroad Men

Elmer A. Borell, recently appointed engineer of motive power of the Philadelphia & Reading Railway, at Reading, Pa., has been serving that road in the capacity of general air brake inspector, which poistion is now abolished.

A. Brown, recently appointed district master mechanic for the Canadian Pacific at Winnipeg, Man., succeeding A. Peers, transferred to Moose Jaw, Sask., was before his promotion locomotive foreman at Fort William, Ont.

G. A. Budge, recently appointed traveling engineer on the northern division of the Chicago, St. Paul, Minneapolis & Omaha Ry. at Spooner, Wis., entered the service of that road in 1901 as fireman and was promoted to engineer in 1904. He has been serving in that capacity until the announcement of his recent appointment.

William A. Callison, recently appointed master mechanic for the Lehigh Valley Railroad at East Buffalo, N. Y., entered the service of the Chesapeake & Ohio at Huntington, W. Va., in 1895 and completed his apprenticeship in 1899. He was then appointed machinist in the shops at Richmond, Va., and in 1900 was transferred to Hinton, W. Va. In 1903 he was made roundhouse foreman and in 1905 general foreman of the motive power department, Kanawha coal district, at Handley, W. Va. In 1909 he accepted a position as division foreman with the Missouri Pacific at Wichita, Kan., and in 1910 returned to the Chesapeake & Ohio at Hinton, W. Va., as general foreman, being later transferred to Peru, Ind. In 1911 he was appointed master mechanic of terminals on the Chicago, Indianapolis & Louisville and later division master mechanic at Lafayette, Ind. In his new work with the Lehigh Valley, Mr. Callison succeeds D. D. Robertson, transferred to South Easton, Pa.

T. W. Coe has recently been appointed master mechanic of the Indiana Harbor Belt R. R. at Gibson, Ind., where he will have charge of the machinery and car departments.

John Dougherty, recently appointed road foreman of engines on the Michigan Central at Michigan City, Ind., entered the service of the New York Central at Batavia, N. Y., in 1891 on a road and wrecking train; was made brakeman on that train in 1892, and in 1893 entered the service of the Michigan Central as fireman. In 1900 he was made engineman, where he remained until in his present appointment he succeeds R. E. Dougherty, resigned.

Agnew Thomas Dice, the newly elected president of the Philadelphia & Reading, was born November 2, 1862, at Scotland, Pa. He entered railway service 1881, since which he has been consecutively: to 1882, flagman with engineering corps, Pennsylvania Railroad; 1882 to 1887, rodman and assistant engineer, same road; 1887 to 1888, engaged on special work on signals at Altoona, Pa.; 1888 to 1890, assistant supervisor, and 1890 to January 1, 1892, supervisor, same road; January 1, 1892, to January 1, 1893, superintendent of signals, New York Central & Hudson River Railroad; January 1, 1893, to April 1, 1894, assistant superintendent Hudson Division, same road; April 1, 1894, to January 1, 1897, superintendent Atlantic City Railroad; January

Agnew T. Dice

1 to February 1, 1897, assistant superintendent Reading Division, Philadelphia & Reading Railway, in charge freight terminals at Philadelphia, Pa.; February 1, 1897, to May 1, 1903, superintendent Shamokin Division, same road; May 1, 1903, to January 1, 1910, general superintendent, same road; January 1, 1910, to January 1, 1913, general manager, and thereafter vice-president and general manager, until March 15, 1916, when elected president of same road.

Clyde C. Elmes, recently appointed assistant superintendent of motive power and rolling equipment, of the Philadelphia & Reading, was in 1914 promoted from road foreman of engines to assistant mechanical engineer, and he has been serving in that capacity until the announcement of his recent appointment.

J. E. Gallagher, recently appointed road foreman of engines of the Philadelphia & Reading Ry. at Tamaqua, Pa., entered the service of that road in 1894. In 1897 he became a fireman and in 1899 an engineman, which position he held until his recent appointment, succeeding Clyde Elmes, promoted.

J. R. Greiner, recently appointed master mechanic of the Missouri, Oklahoma & Gulf Railway at Denison, Tex., served his apprenticeship on the Big Four Railway at Delaware, O., after which he worked for three years as machinist for the Cincinnati, Hamilton & Dayton Railway at Indianapolis, and for other roads. In 1908 he was appointed roundhouse foreman for the Cincinnati, Hamilton & Dayton Railway at Toledo, O., and in 1911 was made master mechanic of that road at Lima, O. In 1913 he was appointed master mechanic of the San Pedro, Los Angeles & Salt Lake Railway. In 1914 he was made master mechanic of the Missouri, Kansas & Texas, where he remained until his recent appointment, in which he succeeds James Carr, resigned.

W. K. Lynn, recently appointed master mechanic of the Gulf & Ship Island R. R., at Gulfport, Miss., entered the service of that road in 1901 as machinist, was later appointed general foreman of the Gulfport shops and then transferred to the Hattiesburg shops, where he remained until his appointment as master mechanic.

M. F. McCarra has recently been appointed master mechanic of the Illinois Southern Railway at Sparta, Ill., succeeding G. A. Gallagher, deceased.

J. McIntosh, recently appointed master mechanic of the Central New England Railway at Poughkeepsie, N. Y., entered the service of the New Haven in 1905 as car repairer at Falls Village. In 1897 he was transferred to the blacksmith shop and later to the boiler shop, where in 1900 he was appointed boilermaker, in 1904 boiler inspector and in 1909 foreman boilermaker at the East Hartford shops. In 1912 he was appointed assistant general foreman, acting as foreman boilermaker, as well as assistant general foreman. Mr. McIntosh in his new work succeeds F. B. Fisher, assigned to other duties.

R. N. Millice has recently been appointed assistant locomotive superintendent on the United Railways of Havana at Cienaga, Cuba, succeeding D. T. Roberts, deceased.

P. C. Moshisky, recently appointed master mechanic of the Denver and Rio Grande at Ridgway, Colo., succeeding J. A. Edwards, resigned, has been serving as general foreman for that road at Durango, Colo.

C. D. Powell, recently appointed general master mechanic of the Midland Valley Railroad at Muskogee, Okla., served his apprenticeship as boilermaker in the Baltimore & Ohio Railroad shops at Grafton, W. Va., and served in that shop later as boiler inspector and assistant boiler foreman. In 1910 he was appointed general boiler inspector of the Baltimore & Ohio Southwestern, with headquarters at Cincinnati. In 1911 his jurisdiction as general boilermaker was extended to include the Cincinnati, Hamilton & Dayton Railway. In 1913 he was promoted to general boiler inspector for the entire Baltimore & Ohio main line, with headquarters at Baltimore, Md. In 1914 he was appointed general inspector of machinery and boilers for the Texas and Pacific, with headquarters at Fort Worth, Tex., and he has recently accepted the position of general master mechanic of the Midland Valley Railroad.

C. J. Quantic, recently appointed master mechanic of the Pacific division of the Canadian Northern at Port Mann, B. C., entered the service of that road as apprentice machinist at Dauphin, Man., in 1900. In 1904 he was appointed locomotive engineer, in 1911 he was appointed master mechanic of the construction department of the Pacific division and held that position until that division was open for traffic and the office of master mechanic created.

H. H. Ray, recently appointed master mechanic of the Galveston Wharf Co., began his apprenticeship in the Galveston shops of the Santa Fe in 1891 and after completing his apprenticeship served as machinist both at Galveston and at Topeka, Kan. In 1897 he was appointed head machinist in the Santa Fe San Marcial shops. In 1898 he was appointed gang boss at Raton, N. Mex., and in 1899 was appointed machine foreman at Houston, Tex. In 1908 he was appointed roundhouse foreman for the Galveston Wharf Co., where he remained until the announcement of his recent appointment. During his years as machinist Mr. Ray has served on a number of the prominent Southern and Western roads and the variety of his service in that respect has especially fitted him for the newly created position to which he has recently been appointed.

John P. Risque has recently been appointed mechanical engineer of the United Railways of Havana at Havana, Cuba.

D. B. Sebastian, recently appointed assistant manager of fuel on the Chicago, Rock Island & Pacific, having jurisdiction over the purchase inspection, distribution, handling and economy of fuel, entered the fuel department of that road in 1907 and has filled many positions, including those of fuel supervisor and assistant to general fuel agent. In 1910 he was placed in charge of that department. Recently the fuel and mining departments of the road were combined and the purchase of fuel included in their jurisdiction, and in this combination Mr. Sebastian was appointed to the newly created office of assistant manager of fuel.

Safety-first Pictures on the B. & O.

Moving pictures will be used by the Baltimore & Ohio Railroad as an adjunct to their safety-first campaign. These pictures are intended to impress upon employes the importance of being careful in the interest of the personal safety of patrons and of themselves. The railroad has purchased a machine for exhibiting motion pictures of railroad operation as performed correctly and incorrectly. The machine will be added to the equipment of the general safety committee. "The House that Jack Built," a scenario written by Mr. Marcus A. Dow, general safety agent of the New York Central Lines, and produced by one of the larger concerns employing well-known stars, will be exhibited as a part of the program of the various safety committee meetings which are held each month by officials and employes.

Pensylvania Railroad Statistics

The Pennsylvania railroad system serves the District of Columbia, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, Ohio, Pennsylvania, Virginia and West Virginia. Half the population of the United States, or 50,000,000 of people, live within the boundaries of this section.

The length of the lines in the Pennsylvania system—in other words, the route mileage—is 11,823 miles. Three thousand seven hundred and sixty-one miles of these lines have two or more tracks, 828 miles are provided with three tracks, and 635 miles with four tracks. Besides, there are 9,656 miles of sidings owned by the company, not including thousands of industrial and other sidings. If this vast number of tracks was put into a single line there would be a railroad long enough to circle the globe and enough rails left over to double track it between New York and Kansas City. The Pennsylvania system gridirons the 12 States mentioned above as well as the District of Columbia.

Railway Master Mechanic

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The Horsepower of a Boiler

The use of the term horsepower in connection with a boiler is a misapplication of the expression. It is unscientific and, as a matter of fact, is fast disappearing from the vocabulary of the engineer when he is speaking of the steam-generating qualities of a boiler. Horsepower is in itself, when properly used, a scientific term of very great value.

Horsepower is the measure of the rate at which work is done, and work in the mathematical or engineering sense is pressure acting through distance. This is the definition, and work is expressed in foot-pounds. The rate at which work is performed is measured by the unit—horsepower. The origin of the expression is credited to Watt, who took what he considered as the average daily performance of a London dray horse and made that the basis of his hitherto unknown unit. As a matter of fact, the average was found to be too high for the sustained endurance of even these heavy and strong horses; but the unit having been established, was retained, and has now become one of the primary conceptions in engineering science.

Work in this case is 33,000 foot-pounds, and when a weight of 33,000 lbs, is lifted one foot high in one minute of time it constitutes one horsepower. When asked to define a horsepower, we say 33,000 lbs. lifted a foot in a minute. It is therefore easily evident that the production of steam in a boiler has nothing to do with the performance of foot-pound work in a given time.

Notwithstanding all this, the expression boiler horsepower still survives, and arbitrary as Watt's horsepower unit may have been, the unit of boiler horsepower seems to be quite as arbitrary. A boiler horsepower has been defined as the evaporation of 34½ pounds of water from and at 212 degs. Fahr. per hour. The turning of 34.5 lbs. of water into steam from and at 212 degs. Fahr. is a unit adopted in 1876, the year of the Centennial Exposition in Philadelphia, as it was then believed to represent what was required per indicated horsepower for the average stationary engine.

Some time ago the American Society of Mechanical Engineers recommended that in standard trials boiler horsepower should be 30 lbs. of water per hour evaporated from water at 100 degs. Fahr. to steam at 70 lbs. gauge pressure. This is practically equal to 34.5 lbs. evaporated from a feed water temperature of 212 degs. Fahr. into steam at the same temperature. This is equal to 33,305 B.t.u. per hour. One pound of water evaporated from and at 212 degs. Fahr. equals 965.7 B.t.u.

There is, of course, no connection between Watts' 33,000 foot-pounds and 33,305 British thermal units. Each of these things has a separate scientific value, although heat and mechanical energy are interchangeable and have a definite ratio existing between them. The general method of estimating the performance of a locomotive boiler is to consider the relative rapidity of steaming as the number of pounds of water evaporated per hour from one square foot of heating surface. The measure of the relative rapidity of combustion of coal in boiler furnaces is the number of pounds of coal burned per hour on a square foot of grate area. The question of the evaporative value of heating surface in a locomotive boiler is an indeterminate quantity, as it is generally considered that the heating surface of the boiler nearest the firebox is superior to that which is further away.

A rule recently proposed is that, in the absence of actual test intended to secure only an approximate result, when estimating boiler horsepower, is to take the heating surface (in feet), multiplied by 3, and divide the result by 34.5. The figure 3 used here is supposed to represent the average pounds of water evaporated from and at 212 degs. Fahr. per square foot of heating surface.

Locomotive boilers—and for that matter, marine boilers—are designed with direct reference to the engines they are to supply with steam, and in locomotive and marine work the expression boiler horsepower is not used. It is applied now-a-days more often to boilers which are purchased by themselves and are then connected to an engine for which they are thought to be most suitable. In such cases, the relationship of boiler to engine is not always determined beforehand, as it always is in the case of the locomotive, and the term boiler horse power, as applied outside of locomotive construction, is in any case only an approximation.

High Capacity Freight Cars

While there have been built from time to time in recent years freight cars of high capacities, generally speaking, the 50-ton capacity car has maintained its supremacy among hopper and gondola cars. Cars of 70 tons capacity are used to some extent and one road, the Norfolk & Western. This road began the use of 90-ton gondola cars a few years ago and now has in service such a large number of them that figures comparing them with other coal-carrying cars may be instructive.

These cars are mounted on six-wheel trucks and have a light weight of 59,300 lbs., with a carrying capacity, allowing 10 per cent for over load, of 198,900 lbs. This makes the total weight of car and lading 258,200 lbs., the revenue load being 77 per cent of the total load. Redesigning of the car with a view to reducing the weight without impairing its strength will probably result in bringing the weight down to 53,000 lbs.; this reduction will raise the ratio of revenue load to total load to 79 per cent. Comparing this car with the 57½-ton steel hoppers in use on the N. & W., it will be found that with the latter, which have four-wheel trucks, a light weight of 42,000 lbs., a gross capacity of 126,000 lbs. and a total weight of 168,000 lbs., the ratio of revenue to total load is 75 per cent. The ordinary coal-train load on the Norfolk & Western is 5,000 tons, cars and lading included, and with the two extra pairs of wheels on each of the 90-ton cars, although there are fewer cars in the train than in a train of 57½-ton cars, the train resistance per ton should be about the same. Considering, then, the lighter design of the 90-ton car, there is an increase of 227 tons in the amount of coal in a train of the heavier cars as compared with a similar train composed of the 57½-ton hopper cars.

If we examine the figures for the average 50-ton hopper car used in similar trains we find that the ratio of revenue load to total load is 72 per cent, the difference in the amount of coal in the train in this case being 439 tons in favor of the 90-ton gondola train. The 50-ton car considered has a light weight of 43,000 lbs. and a total weight of 153,000 lbs., allowing for 10 per cent overload. Again, as compared with a 70-ton hopper car mounted on four-wheel trucks and having a light weight of 46,000 lbs. and a total weight of 200,000 lbs., the ratio of revenue to total load is 77 per cent, which is very close to that of the 90-ton car, and the amount of coal in the train is the same as in the case of the heavier 90-ton car train, and about 120 tons less than that for the lighter 90-ton car train. As compared with the lighter cars there is a saving in the length of a solid train of the 90-ton cars, this being, in the case of a solid train of the 50-ton cars, about 300 ft.; but as stated above, the two extra axles on the 90-ton car bring the train resistance to a figure approximately the same as that for some of the lighter cars. The axle load necessary with the 90-ton cars equipped with four-wheel instead of six-wheel trucks would be so high as to be prohibitive for general use, but the six-wheel trucks give a better distribution of weight as affecting the wheel loads, the weight per axle being 42,000 lbs. as compared with 50,000 lbs. in the case of the 70-ton hopper. While no great advantage is indicated by the figures of the 90-ton hopper over the 70-ton car, conditions on the Norfolk & Western are more favorable to the employment of such high-capacity cars than they would be on many roads and the attainment of such low weight in a car of the dimensions necessary in obtaining this capacity and mounted on six-wheel trucks, is certainly a triumph for the designer.

Selecting Men

If the average man was asked to write down the qualifications of a good foreman, it is probable that most of the Christian virtues would be on the list of requisites. There would in all likelihood be two converging lines of thought which would indicate a general realization of the fact that the foreman, especially if a railroad mechanical department foreman, should possess the qualification of resourcefulness, which means that he should be able to overcome difficulties quickly and effectively and be able to do a great deal with very little.

The other line of thought on which there would be entire agreement, is that the foreman should have, and use, good judgment in the selection of men. What is this faculty of good judgment of men? On what is it based, and on what does it work? The requirement so often stated in broad generalities, is hardly ever defined. The faculty or the quality of using good judgment in selecting men practically amounts to getting hold of the right man by simply looking at him. This is easy to say, but hard to do, and in fact it is probably not done at all. Nevertheless fair or passable results are being attained in this line every day on a railway. The fact that roughly workable results are constantly being had in railway repair shops, does not throw much light on how even this class of results can be secured, for it tells nothing of what good judgment is based on or on what characteristics of the prospective employe, it seizes, so as to become effective.

A foreman sits in his office, trying to mentally estimate the merits and demerits of, say, three or four applicants. He knows the kind of work for which he requires a man. He has a general idea of the "atmosphere" of his shop, but nothing very definite, yet nothing serious against it, perhaps his thoughts are favorable. The foreman can select a machinist, if he wants one, without much danger of hiring an unskilled laborer, and that differentiation is almost automatic. He must, however, use "good judgment" in discriminating between the traits of men whose ability, qualifications, and skill have been stated by each with the palpable desire to secure the place.

Of this group of men, the applicants and the "boss," the only man the foreman really knows is himself. The others may, and probably do, tell their stories by face and form, action and build, but the foreman has not the subtle powers of observation necessary to discover them. The knowledge of himself, whether he believes it or not, is very largely that upon which his opinion of the others will probably be based. In the first place the old proverb "like master like man" applies with full force. When this is examined it will be found that the past actions and methods of the foreman will stand forth against him in judgment or will arise and call him blessed. If his shop is a bright and cheerful place to work in, he made it so. If his men are busy and happy, he is the cause. If they take a living interest in their work, he is responsible for that interest. If he is a man who not only has given his orders but has told his men what he is trying to accomplish by those instructions, he will get the finest kind of loyal support, and the thing required will be done fully and effectively. If he has encouraged enthusiasm of a wholesome and sane variety, he will never have to "give orders" and need only ask once. If the foreman has found out that he can only get out of his shop the same kind of material that he has previously put into it, and knowing this has chosen wisely, the quantity of his brand, will never be out of stock day or night.

In dealing with the men before him he is really making a selection of a man to become "one of us" and be a cog in his wheel, and here again the choice is partly, though not wholly, automatic. It is automatic in so far as the exercise of the qualities by which he gave his "wholesome atmosphere" to his shop or round house had become themselves part of his own personality. He unknowingly tends to attract his like, and with common-sense judgment based on the things he can see and take in, about the applicant's demeanor and style, he makes a choice in which his own ideals are unconscientiously reflected.

This brief survey of the subject is not flawless, and it does not attempt to deal with the thousand and one modifying circumstances which, as Tennyson says, forms that "wilderness of single instances," which we all know. It is rather an attempt to direct attention to a more or less obscured factor which has a distinct, though changing value. It may at one time be like the "constant" in an equation, and at another time be a "variable" of considerable magnitude. In the choice or selection of another, a man may only partly reveal himself, or he may draw a picture of his mental make-up that all who know him shall recognize the portrait. The value of the factor may vary within limits, but it is never completely eliminated. "Show me a man's friends and I will tell you what he is."

Railway Supplies for South America

The full measure of railroad development in South America may truly be said to be still in the future. As far as the manufacturers of railroad supplies are concerned, South America has not been as fully considered as it might have been or as it will be.

One of the greatest obstacles to commercial intercourse is want of knowledge of each other by buyer and seller. This want of understanding is fortunately being removed by the systematic campaigns of instruction which have been carried on by the technical and periodic press of the country. The establishment of New York branch banks in some of the principal cities of South America have provided facilities for the transference of credits, which formerly had to be done through the banking houses of London.

With the intention of gathering further information on the subject of South American trade as it affects railway supply houses in this country, the U. S. Department of Commerce, through its bureau of foreign and domestic commerce is preparing to send a special agent to investigate the markets of South America, for railway supplies.

As a preliminary the Department of Commerce plans to hold an examination on May 19 so as to obtain the most suitable man for the post. The salary of an appointee to this position will not exceed ten dollars a day for each day in the year; and actual transportation expenses.

There are many of our well-known railway supply firms anxious for the cultivation of the fruitful field which has too long lain fallow. It seems advisable that in an investigation so closely connected with the business life of railroad supply firms that the matter should be looked into, and reported upon by some one who has devoted many years of his life to the subject of the equipment of railway enterprises, or a man whose natural tendencies and peculiar abilities have led him to devote his activity to the railroad supply business.

Examples of Two New 2-10-2 Type of Locomotives

Comparison of These Engines With The Mikado Type; Lateral Motion Axle Boxes Applied to The 2-10-2 Engines. Many New Appliances Used

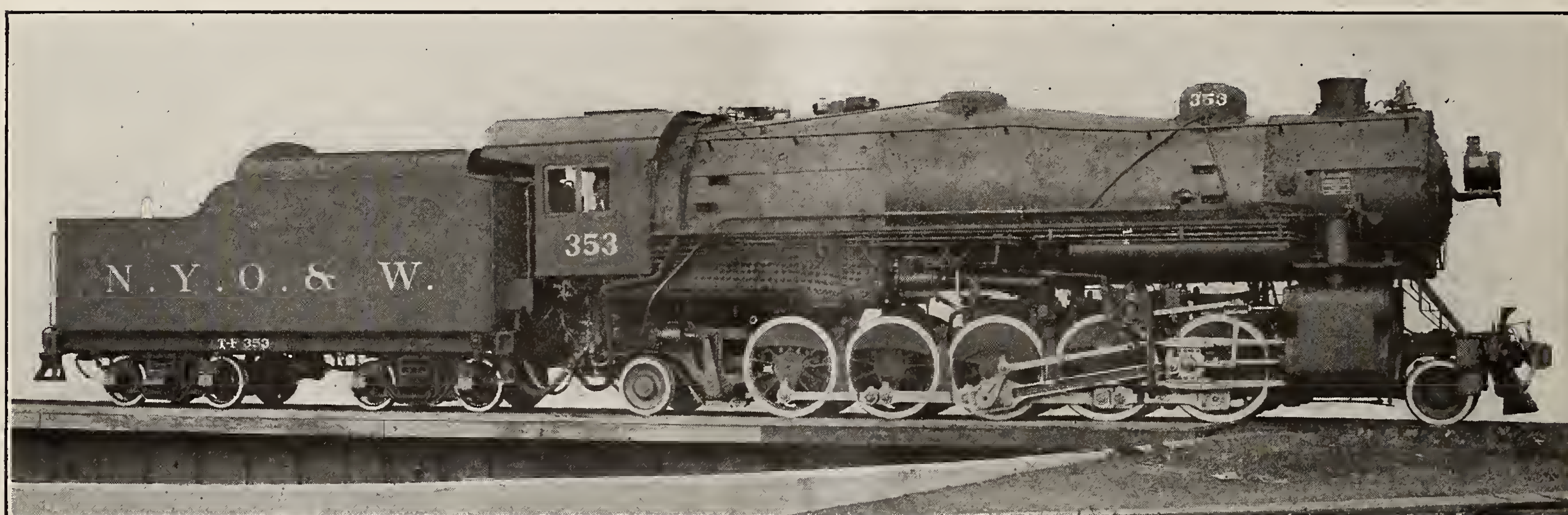
Twelve 2-10-2 type locomotives for the New York, Ontario & Western Railway and five for the Erie Railroad have recently been delivered by the American Locomotive Company. This type of locomotive has attracted the attention of many railroad officials.

As train loads outgrow the capacity of the Mikado or 2-8-2 type, the 2-10-2, sometimes called the Santa Fe type, becomes its logical successor in the same way as the Mikado type succeeded the Consolidation. The 2-10-2 type has been hitherto handicapped by its long, rigid wheel base. The application to these locomotives of lateral-motion driving axles and boxes has been made for the purpose of reducing the rigid wheel base to that which is in common use on locomotives of smaller capacity and at the same time securing the advantages of the 10-coupled wheel arrangement with the resulting increased capacity of the locomotive.

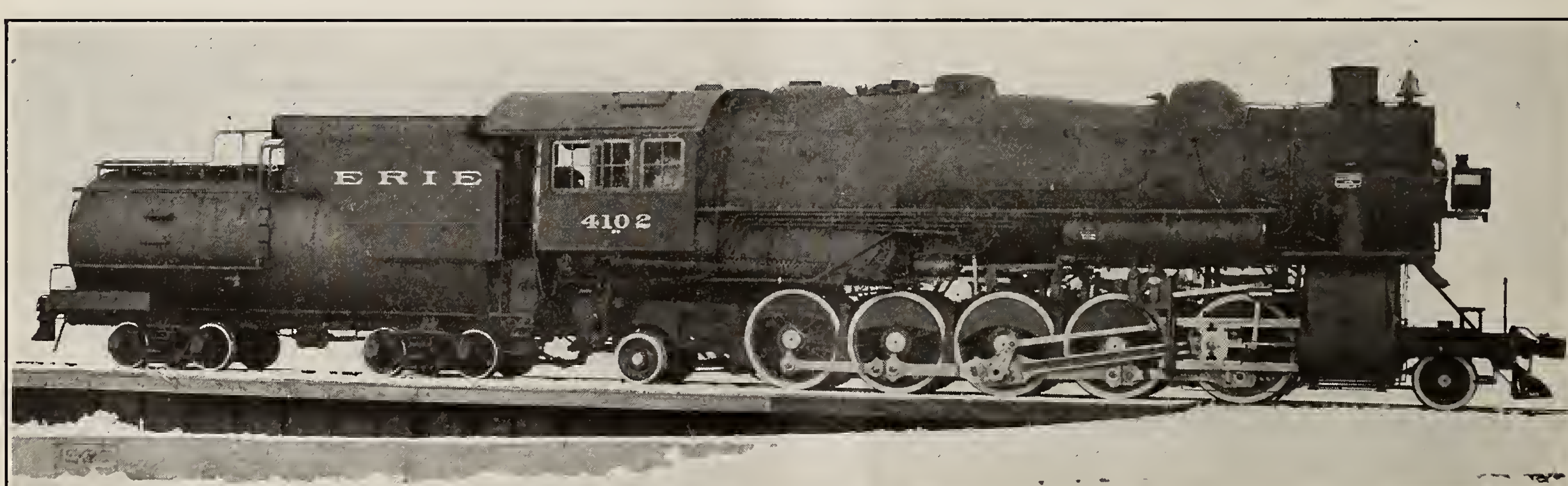
	Driving wheel base.	Rigid wheel base.
N. Y. O. & W....	20 ft. 0 in.	15 ft. 0 in.
Erie	22 ft. 6 in.	16 ft. 6 in.

These figures for rigid wheel base are well within the figures used on a very large number of Mikado and Consolidation locomotives now in service throughout the country.

The lateral box arrangement consists of two independent driving boxes, whose traverse lateral centers are about on a line with the inside of the main engine frames. These two driving boxes are held in a fixed relation to each other by a bridge or spacing member which engages the inner flanges of the boxes. The weight which is transmitted through this bridge member is applied to the boxes on their transverse centers. The lugs on the spacing member which engage the inner flanges of the boxes are for the sole purpose of maintaining the proper spacing of the boxes and do not transfer any vertical load. The driving springs are in about the normal position and are carried upon a cross member which has a vertical movement only between the engine frames, a wearing shoe being placed upon the inner side of the main frames to prevent side motion. Between this cross member and the bridge, or spacing member, mentioned above, are interposed two inverted rockers designed so that a lateral force equal to 20 per cent of the vertical weight transmitted is required to deflect them from their normal position. When



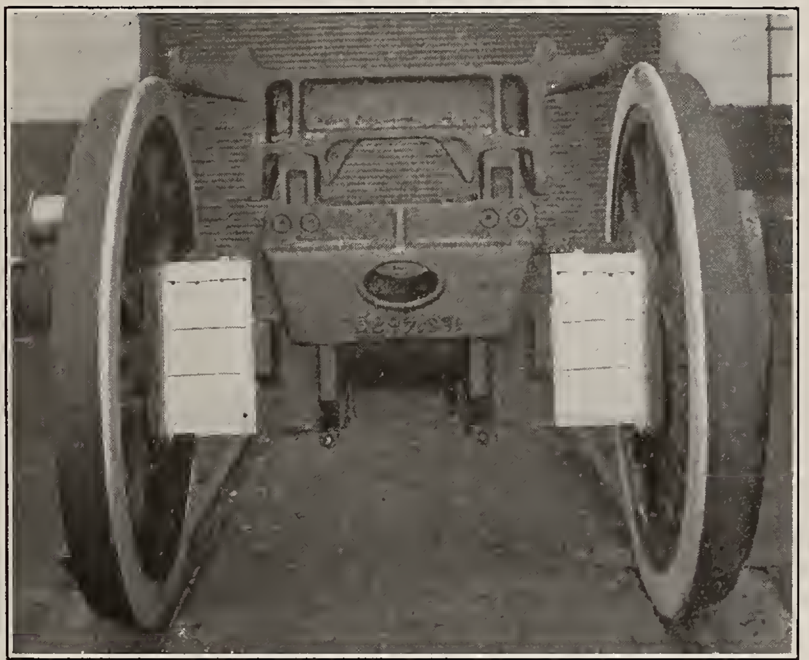
Heavy Freight 2-10-2 for the New York, Ontario & Western Railway
B. P. Flory, Supt. of Motive Power — American Locomotive Co., Builders



Freighter for the Erie Railroad, 2-10-2 Type
Wm. Schlafge, Gen. Mech. Supt. — American Locomotive Co., Builders

the boxes are deflected by a side movement of the first pair of driving wheels from their normal central position, the boxes and the bridge casting are moved laterally in reference to the member carrying the springs. This movement deflects the inverted rockers which offer a definite resistance against the motion. It will be noted that the spring and equalizer work is not shifted from its normal position when the boxes are deflected laterally.

It will be noted from the photograph and drawings that one side of the bridge member is carried down be-



Lateral Motion Arrangement for Drivers

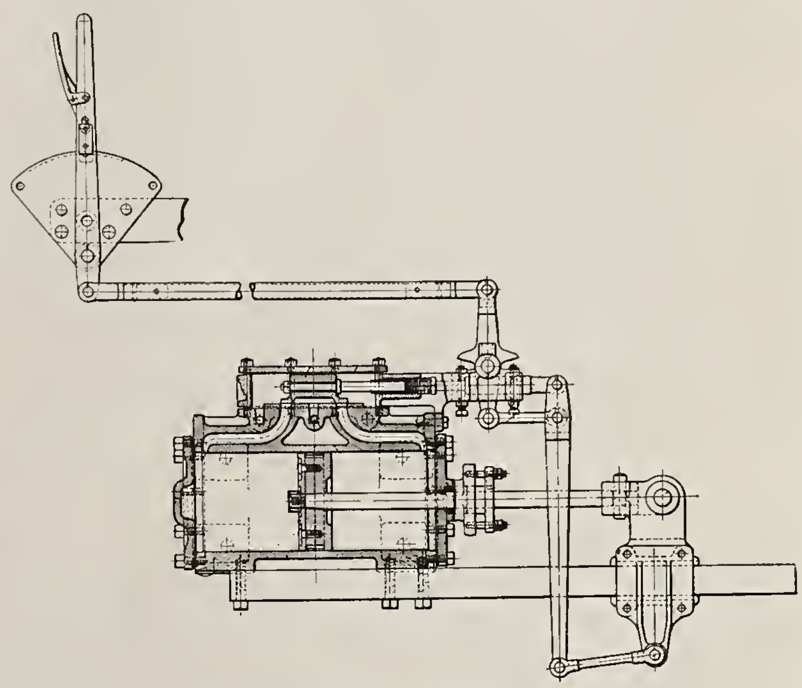
low the driving axle with a bolting flange. This is provided for the attachment of a finger to guide the brake beam and insure that the brake heads register properly with tires on No. 1 driver.

The rod connections between the first and second drivers are arranged with a ball knuckle joint ahead of the pin on No. 2 driver, which allows for lateral deflection of the side rods. The construction of the crank pin and rod bearing at No. 1 driver is clearly shown in our illustration. It consists of an ordinary design of cylindrical crank pin, on which is placed a hard bronze bushing, the interior being bored cylindrical and the outside turned to a spherical surface. Encasing this bushing are two half pieces of hard steel which are held in place in a rod end with a wedge, in the same manner as two ordinary half brasses. The bushing can revolve either on the crank pin or within the two steel halves. When the rod is deflected from normal position, the spherical bushing allows the parts to rotate sidewise around the center of the front crank pin; at the same time the bushing can revolve on the cylindrical portion of the pin. Several oil holes are provided through the bronze bushing which insure lubrication of both the spherical and cylindrical surfaces of the bushing.

The operation of the lateral motion axle should be considered in connection with the engine truck. It will be noted that the driving springs of the first and second axles are equalized in the usual manner to the engine truck; therefore, the weight upon the engine truck center pin and the lateral motion boxes on the first axle is divided in proportion to the arms of the front equalizer. The engine truck on this engine is of the inverted rocker type having a resistance of 50 per cent against the initial movement, and as stated, the resistance of the lateral device at the first driver is 20 per cent. These resistances are so chosen in relation to the weight coming upon each centering device that the lateral resultants at the engine truck and the first driver are just about the same in amount. It will thus be seen that in effect the engine truck and the first driver act in practically the same way as a four-wheel engine truck in guiding the front of the locomotive, except that the weight instead of being applied midway between the wheels and divided between them as in the case of a four-wheel truck. As far as guiding the engine is concerned, therefore, the arrangement is very similar to a four-wheel truck application with the rear wheel of the truck acting as a driving wheel.

The resistance of the lateral motion box is proportioned with the idea of providing enough initial resistance so that for any ordinary road service on tangent track or road curves the first driver will remain in normal position and deflect only when passing through turnouts and yard curves. The operation of the device in service has clearly demonstrated the correctness of the design in this particular. A close inspection of the engines in operation discloses the fact that the lateral motion first driver very rarely deflects when the engine is upon the road. When the locomotive passes through sharp turnouts or is operating around yards the lateral motion driver will deflect, thus preventing the cramping of the driving wheel base in the curve and of excess pressure upon the driving wheel flanges.

It should be remembered that the action of the rockers provides a limit to the lateral pressure which can be placed upon the first driving wheel flange. When this lateral resistance exceeds 20 per cent of the weight lateral resistance is applied in the plane of each wheel carried upon the lateral motion rockers the boxes will deflect, the excess lateral pressure being then transferred to the second driver, thus dividing the work of guiding the engine through curves between the truck and the first and second drivers, instead of between the truck and the first driver only, as in the ordinary 10-coupled arrangement. This lateral motion driving box



Ragonnet Power Reverse Gear

can also be applied to engines having four-wheel trucks. This device has been patented.

On the ordinary design of 2-10-2 types about 80 per cent of the total weight of the engine is carried on the drivers. It is therefore interesting to note the increase which has been obtained on these new engines.

	Total weight	Weight on drivers	Percentage
N. Y. O. & W......	352,500	293,000	83.2
Erie	401,000	335,500	83.7

Most careful attention was given to the boiler design.

	Total heating surface sq. ft.	Super-heating surface sq ft.	Tube length ft.	Diameter of boiler at largest course in.
N. Y. O. & W.	4498	1007	17	98
Erie	4959	1274	17	104

These boilers have the added advantages of a short tube length and a large diameter. A short tube length not only gives greater evaporative value per square foot of heating surface, but also reduces back pressure and consequently increases the power of the engine. A large diameter combined with short tube length practically places a large volume of water where the evaporative value of the tubes is the highest. This large volume of water is ready to quickly turn into steam and so increase the reserve supply of steam.

Both these engines have a short distance from the rear wheel to the draw bar. This not only makes the engine ride easier on curves, but it reduces the friction between flange of wheel and rail which helps to increase the draw bar pull.

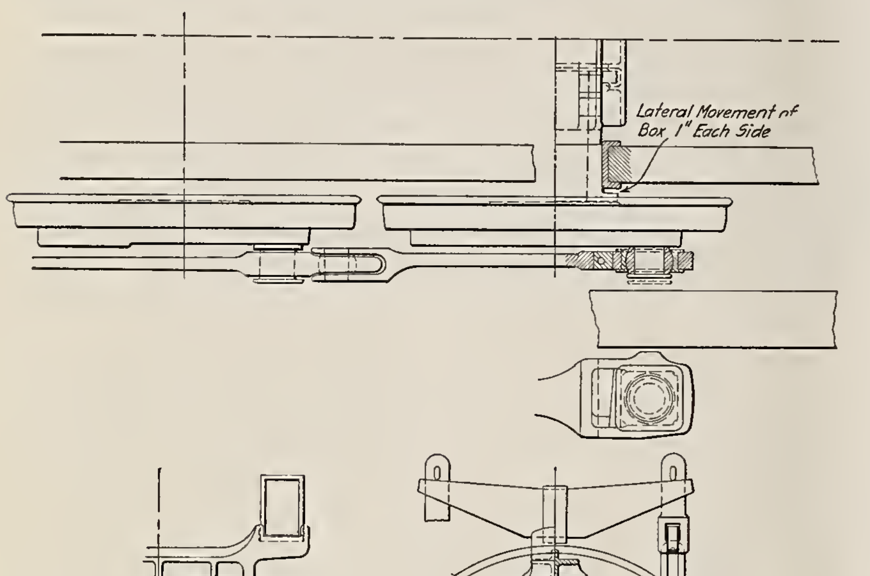
Both engines are equipped with superheaters, a combination Gaines and Security brick arch, Street automatic stokers, Baker valve gear, Ragonnet air reverse mechanism, Chambers throttle. Economy front and rear trucks and Vanadium frames. With regard to the reversing gear a word of description of the Ragonnet apparatus may not be out of place for the benefit of our readers who are not entirely familiar with the device. The gear is handled by the Eoconomy Devices Corporation of New York.

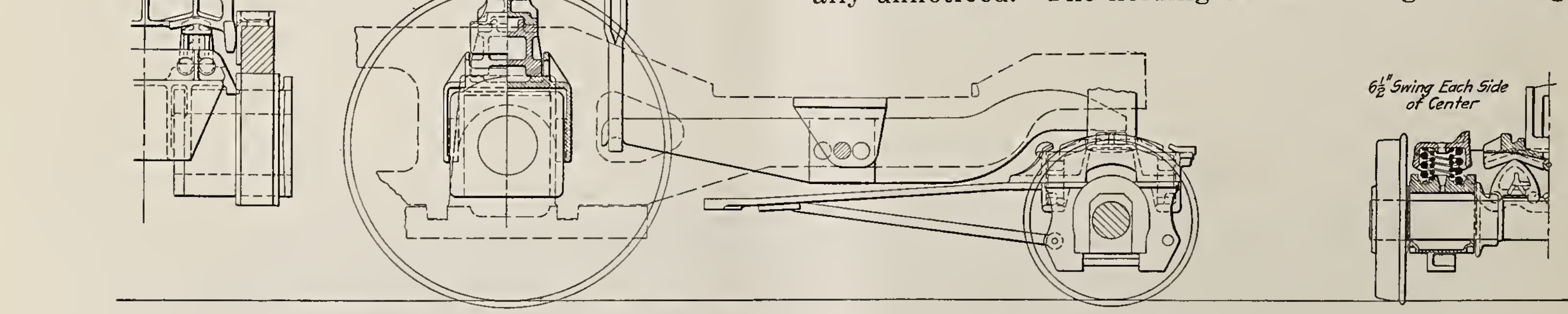
The Ragonnet device has been extensively used for several years. It has passed through the experimental stage and is an example of a practical solution of the power reverse gear problem.

The gear is preferably operated by air, although an auxiliary steam connection is provided. Distribution is controlled by an ordinary D-slide valve arranged for ouside admission, the exhaust or inside lap being materially greater than the admission or outside lap, which is very small. The cross-head gibs are held in place by a cast steel plate having an arm projecting downward. This arm is connected by a suitable link with the lower end of a floating lever, the upper end of which is pivotly connected to and supported by the valve stem. Through the agency of a rocker, the upper end of which is connected by a light rod with a small reverse lever and the lower through a link with the floating lever a short distance below the valve stem, the movement of the valve is controlled from the cab. The rocker is provided with tappets which strike the end of projecting set screws when the limit of travel of the valve is reached. These screws merely limit the throw of the reverse arm in either direction and require no adjustment after once being set. The reverse lever is locked in any desired position by an ordinary toothed quadrant.

It will be seen that the floating lever causes the valve to be lapped when the piston has reached a position in the cylinder corresponding to the position in which the reverse lever is placed. Assuming the reverse lever in mid-position and the valve normally covering both ports, when the lever is moved into full forward motion, which is to the right, as shown in our illustration, the valve will be moved to the right by the floating lever swinging about its lower end as a fulcrum, and air will be admitted to the left end of the cylinder. As soon as the lever is latched the valve will be moved to the left by the floating lever, swinging about its pivot on the connecting link, and will be lapped when the piston has reached its maximum travel to the right. Since the exhaust or inside lap of the valve is materially greater than the outside lap, air pressure is held on both sides of the piston at the same time. The mechanism is thus prevented from creeping or vibrating by an elastic cushion. In no case does the valve open to the exhaust when holding the gear in any desired cut-off position.

The entire mechanism is simple in construction and has proved reliable in service. Owing to the proportions of the valve lap the gear as designed is economical of air. When the piston and piston-rod packing is properly maintained the loss of air in holding the gear in a fixed position is exceedingly small and is practically unnoticed. The holding of the valve gear through the medium of an air cushion instead of by a rigid latch and quardrant tends to lessen the wear and tear on the valve gear and its connections.





Arrangement of the Lateral Motion Journal Boxes and the Side Rods

Dimension Data, Etc., N. Y., O. & W. Engine

Road, New York, Ontario & Western. Class, 2-10-2. Schnectady works. Track gauge, 4 ft. 8½ ins. Fuel, bitum. coal. Cylinder: Type, piston valve; diam., 28 ins.; stroke, 32 ins. Tractive power, simple, 71,200. Factor of adhesion, simple, 4.21. Wheel bases: Driving, 20 ft.; rigid, 20 ft.; total, 36 ft. 9 in.; total engine and tender, 66 ft. 10 ins. Weight: In working order, 352,-500; on drivers, 298,500; on trailers, 24,000; on engine truck, 30,000; engine and tender, 521,200. Boiler: Type, extended wagon top.; out. diam., first ring, 86 ins.; working pressure, 190 lbs. Firebox: Type, wide; length, 150⅛ ins.; width, 96¼ ins.; thickness of crown ⅜ in., tube ½ in., sides ⅜ in., back ⅜ in.; water space, front 5½ ins., sides 5 ins., back 5 ins., depth (top of grate to center of lowest tube) 2¾ ins. Crown staying, radial. Tubes: Material, see sheet No. 2; 337, 2 ins. diam; flues, cold drawn seamless steel, 50; thickness, tubes No. 11 B. W. G., flues No. 9 B. W. G.; length, 17 ft.; spacing, ⅞ in. Heating surface: Tubes and flues, 4,173 sq. ft.; firebox, 274 sq. ft.; arch tubes, 51 sq. ft.; total, 4,498 sq. ft. Superheater surface, 1,007 sq. ft. Grate area, 80.2 sq. ft. Wheels: Driv., diam. outside tire 57 ins., center diam 50 ins.; material, main, C steel, others C steel; engine truck, diam. 33 ins., rolled steel; trailing truck, diam. 33 ins., rolled steel; tender truck, diam. 33 ins., rolled steel. Axles: Driv. journals, main, 12 x 22 ins., others 10 x 13 ins.; engine truck journals, 6½ x 12 ins.; trailing tuck journs, 6½ x 12 ins.; tender truck journals, 6 x 11 ins. Boxes, all cast steel. Brake: Driver, Amer. W. U. 3 and B. C. West. E. T. 6; tender, West. E. T. 6; pump, two 11-in. West.; reservoir, two 20½ x 114 ins. Engine truck, A. L. Co., Woodward centering device. Training truck, radial constant resistance type. Exhaust pipe, single, nozzles 6 3/16, 6 5/16, 6 7/16 ins. Grate: Style, rocking; Street stoker applied. Piston rod: Diam., 4¾ ins.; packing, gun iron rings. Smoke stack: Diam., 21 ins.; top above rail, 15 ft. ½ in. Fender frame, cast steel. Tank: Style, water bottom; capacity, 9,000 gals.; fuel capacity, 15 tons. Valves: Type, piston, 14 ins.; travel, 6¾ ins.; steam lap, 1 1/16 ins.; ex., line and line; setting, ⅛-in. lead. Combustion chamber: Gaines arch, forming combustion chamber at front of firebox. Boiler tubes: Material, ½ Spellerized steel and ½ hot-rolled seamless steel, arranged so that in each boiler the tubes to the right hand of the vertical center line of the boiler are Spellerized steel and to the left seamless steel.

Dimension Data, Etc., Erie Engine

Road, Erie; class, 2-10-2 S 401; Schenectady works; track gauge, 4 ft. 8½ ins. Fuel, bituminous coal. Cylinder: Type, piston valve; diam., 31 ins.; stroke, 32 ins. Tractive power, simple, 83,000. Factor of adhesion, simple 4.05. Wheel base: Driving, 22 ft. 6 ins.; rigid, 22 ft. 6 in.; total, 40 ft. 3 ins.; total engine and tender, 71 ft. 9½ ins. Weight: In working order, 401,000 lbs.; on drivers, 335,500 lbs.; on trailers, 31,500 lbs.; on engine truck, 34,000 lbs.; engine and tender, 585,500 lbs. Boiler: Ext. wagon top; out. dia., first ring, 92⅛ ins.; working pressure, 200 lbs. Firebox: Type, wide; length, 160 ins.; width, 108¼ ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ ins.; water space, front 6 ins., sides 6 ins., back 6 ins, depth (top of grate to center of lowest tube) 3⅞ ins. Crown staying, radial. Tubes: Seamless steel, 317, 2¼ ins. diam.; cold drawn steel, 60, 5½ ins. diam; thickness, tubes No. 11 gauge, flues No. 9 gauge; length, 17 ft.; spacing, ¾ in. Heating surface: Tubes and flues, 4,617.5 sq. ft.; firebox, 296 sq. ft.; arch tubes, 45.6 sq. ft.; total, 4,959.1 sq. ft. Superheater surface, 1,274 sq. ft. Grate area, 94.8 sq. ft. Wheels: Driv., dia. outside tire 63 ins., center 56 ins; material, main cast steel, others cast steel; engine truck, diam. 33 ins., forged steel; trailing truck, diam. 33 ins., forged steel; tender truck, diam. 33 ins, cast steel. Axles: Driv. journals, main 13 x 22 ins., front 11 x 19 ins., other 11 x 13 ins.; engine truck journals, 6½ x 14 ins.; trailing truck journals, 6½ x 14 ins.; tender truck journals, 6 x 11 ins. Boxes: Driving, main, cast steel; others, cast steel. Brake: Driver, New York; tender, New York. Pump: Two, No. 5; reservoir, two, 20½ x 114 ins. Engine truck, 2-wheel, radial swing center; trailing, 2-wheel, radial swing center. Exhaust pipe: Single; nozzles, 6⅞, 7 and 7⅛ ins. Grate, style, rocking. Piston rod: Diam., 5 ins.; packing, snap rings. Smoke stack: Diam., 23 ins.; top above rail, 16 ft. 3 7/16 ins. Tender frame, Vanderbilt. Tank: Vanderbilt; capacity, 10,000 gals; capacity fuel, 19 tons. Valves: Type 16-in. piston; travel, 6½ ins.; steam lap, 1 in.; clearance, 1/16 in.; setting, lead, 3/16 in.

The Traveling Engineers' Association

The Traveling Engineers' Association will meet next fall, according to a circular recently issued by the secretary, Mr. W. O. Thompson, New York Central car shops, East Buffalo, N. Y. The circular says:

The next annual convention of the Traveling Engineers' Association will be held at Chicago, Ill., September 5, 6, 7 and 8, 1916.

The following are the list of subjects to be presented and discussed:

1. "What effect does the mechanical placing of fuel in fire-boxes and lubricating of locomotives have on the cost of operation?"
2. "The advantages of the use of superheaters, brick arches and other modern appliances on large engines, especially those of the mallet type."
3. "Difficulties accompanying the prevention of dense black smoke and its relation to cost of fuel and locomotive repairs."
4. "Recommended practice in the make-up and handling of modern freight trains on both level and steep grades to avoid damage to draft rigging."
5. "Assignment of power from the standpoints of efficient service and economy in fuel and maintenance."

Boiler Makers to Meet in May

The annual convention of the Master Boiler Makers' Association will be held at the Hollenden Hotel, Cleveland, O., on Tuesday, May 23, and will continue on the 24th, 25th and 26th. Beside the regular business addresses will be delivered by the Hon. H. L. Davis, mayor of Cleveland; Mr. B. R. MacBain, S. M. P. of the New York Central Railroad; Mr. Frank McNamany, chief inspector of the Federal Locomotive Boiler Inspection Service, and Mr. J. T. Carroll, assistant S. M. P. of the Baltimore & Ohio.

The regular program will consist of the discussion of fifteen reports presented by committees which have been at work on these topics during the year. Thirteen of these reports have already been printed and mailed to the members. Of special interest may be mentioned reports of flexible stays, oxy-acetylene and electric welding and cleaning and maintenance of superheater tubes. The work of the committees during the year has been thorough and all the reports will be found instructive and valuable.

Fairbanks-Morse Co.

A couple of bulletins dealing with type Y oil engines (style V) and with type Y (semi-Diesel) horizontal pattern. The first of these well-illustrated pamphlets explain that in construction the type Y oil engines combine the simplicity of the two-cylinder principle with accessibility and good design. The various points are taken up in order and explained and illustrated.

The bulletin dealing with the semi-Diesel form is also clearly illustrated. What are called the exclusive features, of which there are eight, are set forth in order, and the whole principle involved is explained as fully as can be in the pages of a pamphlet. This bulletin is H. 178B, and the one on type Y oil engines is H. 192C. The Fairbanks-Morse Co. will send these free on application.

What A Locomotive Brick Arch Does In The Firebox

The Origin of Fire Clay. Its General Composition. The Burning of Coal and The Effect of a Brick Arch in Securing Desirable Results

To many it may seem like an odd coincidence that the material of a fire-brick arch, in the firebox of a locomotive, which stands above the glowing mass of burning white hot coal, was in distant geological times formed immediately below the coal seam, which in fact rested upon the "underclay." It is, however, more than a coincidence, as a glance at the history of the formation of coal and fire-clay in Nature's workshop will show. The firebox of a working locomotive holds not only the highly inflammable material derived from the carboniferous period, but it also contains the most refractory substance known to science, and which had long been deposited in close association with the fuel, and in the same coal measures, of which it also was a product.

The formation of coal in swampy localities was effected by the gradual subsidence of the soil, and as it sank down it carried with it dense forest growths which flourished in the damp, warm air heavily charged with carbon dioxide, an essential of vegetable life. While the plants thrived, the ground on which these luxuriant forests grew was constantly drawn upon by the plants for those constituents required for their existence, and thus the soil was gradually depleted, and left purer, as far as the formation of clay was concerned. The process of rendering the soil free from what we call impurities was aided by the rapid growth of the vegetable life which it supported and eventually by the percolation through the soil of organic solvents from above, by which most of the lime and the alkalis were removed. The clay formation below the coal seam represents the ground upon which the plants originally grew, and it was to a certain extent, cleared, by the withdrawal of such mineral matter as was required by the plant and it was further refined by the solvent action of water or dilute acids.

Fire-clay is thus not only closely associated with the formation of coal, but its origin is part of the whole process in Nature, which gave us the coal measures. When the process of coal formation took place in tranquil lakes, trees and other vegetable matter was constantly washed down the steep shore slopes into the land-locked lake, as described in the December, 1915, issue of the Railway Master Mechanic, page 393. The fine dust and the surface earth which had already surrendered its plant-sustaining ingredients was carried from the land by rain, and wind, and stream. In this state fine particles of "mud" were deposited on the floor of the lake, previous to the sinking of the water-logged plants and trees which had floated out on the surface of the lake, and which were finally turned into coal.

The fire-clay which we use to-day and which goes into the manufacture of locomotive arch brick, is of the highest quality obtainable, as it is recognized that the service required of it is the most severe to which refractory materials are subjected. Fire-clay is for the most part composed of silica and alumina, and is, as a chemist would say, the silicate of alumina. An average of four independent analyses gives the amount of silica at about 52 per cent and alumina at about 35 per cent. The other constituents, consisting of lime, magnesia, potash, peroxide or iron, a little soda, and some water, are present in small quantities.

The heat-resisting qualities of this fire-clay are practically assured by the work of Nature in the formation of the clay, which has been reduced to an inert and highly refractory mass, but the service conditions call for the existence of several qualities over and above those which prevent melting. A locomotive arch requires to be composed of bricks sufficiently strong, not to break readily and to stand handling. The brick has to resist the powerful action of intense heat rapidly applied, and the violent contraction caused by cold air, suddenly thrust on and around it. It has also to withstand the continuous, heavy, abrasive action of a strong and steady flame, bearing particles of unburnt coal, soot or smoke and the finely divided solid matter which forms part of the ash. It has to stand this abrasion, carried along under and over it; the heated stream having a velocity greatly exceeding that of a violent sand storm, urged on by a hurricane. The problem is therefore to prepare the fire-brick so that it will meet these conditions, while preserving the heat-resisting qualities supplied by Nature.

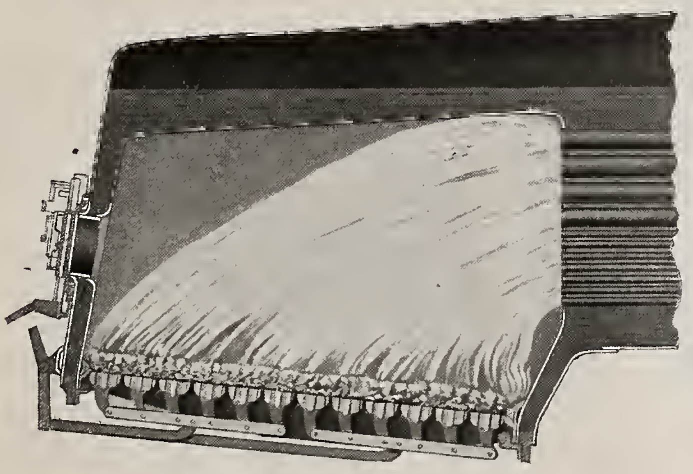
The fire-brick is made with sufficient strength not to break in the ordinary handling incident to the putting in or the removal of the brick. In order to save time when repairs have to be made, the P. R. R. issue asbestos gloves to the men who do this work, which permit a hot section of the arch to be taken out without hurt to the man or injury to the brick. The hot brick, when taken out, can then cool, as the faculty of "giving" a little under temperature changes is one of the satisfactory qualities it possesses.

Plastic fire-clay is first mixed with some very hard or flint clay. This is used on account of its heat-resisting qualities, and when mixed with plastic fire-clay gives the necessary porosity to the finished product. This enables it to withstand violent changes of temperature, by affording the whole mass a chance for minute interior expansions and contractions which obviate the danger of cracking. The porous clay mixed in, adds the bonding quality to hold the brick together and gives it the resistance to abrasion, which is a necessary characteristic of its usefulness. The flint clay, during the vicissitudes of geological time has been very finely ground up and has become compressed into a hard mass. It breaks with a concoidal fracture, which is another way of saying that it separates in a series of convex elevations and concave depressions, and is in itself close grained and dense.

When the mass of plastic and flint clay have been kneaded and formed into bricks, they are fired in a kiln, and here the utmost care is taken in the process, so that the brick may be burned and become a highly serviceable commercial product, possessed of the qualities which will enable it to oppose the action of intense heat, stand sudden cold, and resist powerful abrasive action. Having secured such a substance in useful commercial size and form, one may, with propriety, glance at the function it is intended to perform in a locomotive firebox and thus get an outline view of the whole matter.

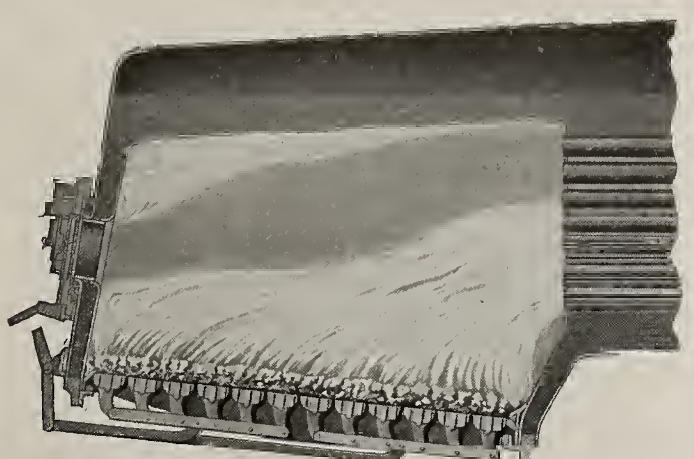
In 1885 Mr. James N. Lauder, then master mechanic of the Old Colony Railroad, made a series of tests to ascertain the value of the brick arch. His conclusion was that the arch produced a saving of coal. This conclusion is borne out by subsequent tests and the experience of many. To understand the rationale of the coal-saving process, it is necessary to consider some of the general principles of coal combustion. Coal is composed in the main of fixed carbon which in burning, combines with the oxygen. It requires a full supply of that gas and when burning, glows intensely and gives off CO_2, with little or no smoke. Coal, however, also contains carbon in combination with hydrogen, and this forms, when distilled from the solid coal, a series of allied gases each with a different igniting temperature and requiring various quantities of oxygen. These are the carbo-hydrates or volatile gases, also called the hydro-carbons, which contribute a large amount of heat when properly burnt, but they are easily lost, and when not consumed, tend to lower the firebox temperature.

In order to liberate the hydro-carbons, it is necessary that heat be applied to distill them from the coal and drive them off in the form of hot gas. When they are thus liberated, they split up into the members of the



Firebox Without Brick Arch

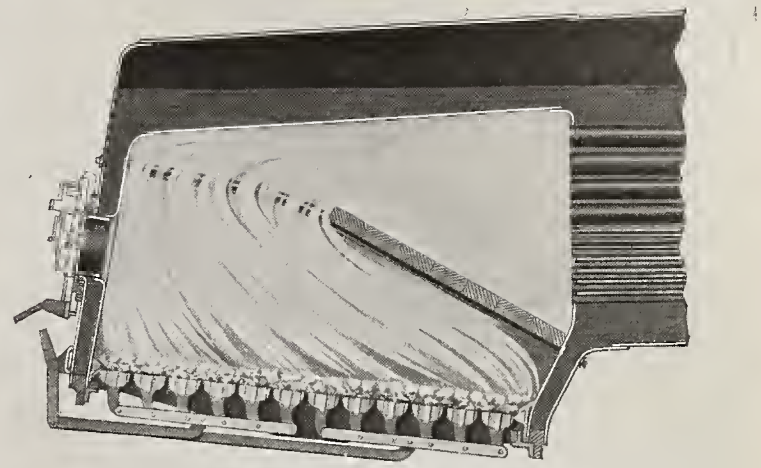
series of gases to which they belong, and they have then to be supplied with appropriate quantities of oxygen. All this takes some appreciable time and requires a most thorough mixing of gas and air. Just here an analogy between the process of feeding, adopted by thoughtless mankind, and that of the rapidly expelled hydro-carbons, readily strikes the imagination. The gases given off near the flue sheet are drawn into the tubes at once with little or no time to be properly burnt. The gases from under the fire door take a slightly longer time before they are sucked into the tubes, but in either case the time is too brief to properly allow for their combining with the oxygen of the air, and the engine, like the unwisely hurried man, bolts its food. The brick arch interposes an inclined baffle wall above the grate, which practically doubles the length of the flame-way and increases the time required for the proper mixing of the hydro-carbons with



Cold Air Entering from Door

the oxygen of the air. This fact spells "coal-saving" by causing the fuel to give out more heat to the pound, and it therefore enhances the value of every square foot of heating surface in the boiler.

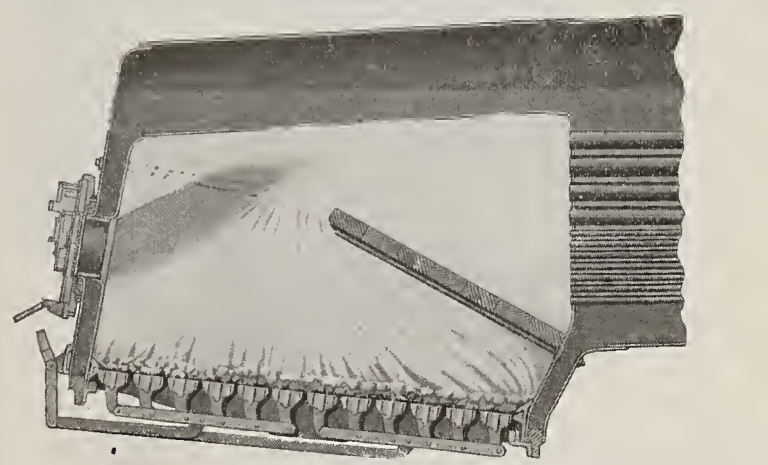
With hand-fired engines a remarkably good result comes incidentally with the use of the arch. In order to get coal into the firebox the firedoor must be opened a great many times on the trip. Every time the door is opened a stream of cold air enters the firebox; and as it were, entirely cuts out a volume of hot gases already performing its function. The cold stream chills the tubes and reduces the temperature of the firebox at the very time that the hydro-carbons are being distilled from the coal and when heat is essential. This unde-



Arrangement Showing Brick Arch

sirable condition is practically eliminated by the brick arch, for by its shape it directs a flow of hot gas against entering cold air, and instead of permitting the cold inflow to take its curved, but unobstructed sweep, to the upper tubes, it causes the hot firebox gases to surge against, around and through it, and before it reaches the flue sheet it has become, with the oxygen, a useful part of the intensely hot gases, which enter the tubes and ultimately deliver their heat to the water. Practically the same result takes place when a hole in the fire develops, and although neither of these contingencies are desired in locomotive operation, they recur from time to time and the presence of the brick arch acts with beneficial counter play and greatly minimizes, if it does not entirely eliminate, the loss which would otherwise take place.

In making the brick for locomotive use, the underside is formed with a series of pockets something like



Effect of Arch on Cold Air from Door

what foundrymen would call "lightening cores." This is done with the important object of presenting a roughened surface over which the gas is rolled and in so doing thoroughly mixes the hydro-carbons with air. It incidentally lightens the brick, and requires less material. Reverting to our simile once more, we may say that these gases and the oxygen are not "bolted," but thoroughly "masticated" before entering into what corresponds to the alimentary canal of the iron horse. The brick arch as displayed in one of our illustrations shows a slight appearance as if a solid drip had just begun. The presence of icicles, or if we may change to a more appropriate word, we may say the stalactites on the underside of the brick, are not due to a tendency of the brick material to melt or "run." They are caused by impure emanations from the coal, such as ash and slag, which are carried up by the strong rush of flame, adhere to the underside of the brick, and are more slowly fused in the intense heat. They thus add to the roughening of the underside of the brick and con-

Brick Arch Showing Particles of Slag Forming Stalactites

tribute to the gas and air the mixing action secured by the pockets which are a part of the design of the brick.

The locomotive arch is based on scientific principles and performs a useful function in a locomotive, where coal is burned in larger quantity per square foot of grate area than in any other form of furnace. The area of the grate is hardly larger than an ordinary dining-room table, yet within the closely set walls and ends of the box, the fire rages, urged to the greatest intensity

Cold Air from Hole in the Fire

by forced draft, which can be varied as the engineman alters the position of the reverse lever. In this white hot storm the brick arch mixes the gases arising from the coal, and remains itself intact, while it lengthens the flame-way and delays the exit of the heated gas, so that cinders are greatly reduced, while it curtails the formation of smoke, and as far as may be, all the heat represented by the burning of the coal is applied to the generation of steam.

These facts lead naturally to the conclusion, verified by the statements of men familiar with conditions and with locomotive performance, that the brick arch not only saves coal, but gives a greater sustained horse power, permits less smoke to form, maintains the flues in better shape and with fewer stoppages and cloggings, and causes them to last longer and that, as a consequence, fewer steam failures occur. The most important feature, depending on the more thorough burning of coal, which the brick arch permits and following naturally from the coal saving, is the increased and sustained horse power now within reach. A pound of coal gives off a certain quantity of heat when burned. The more perfectly the combustion is effected the more available heat there is, part is not lost by rapidly rushing out of the stack, nor is it stifled at the start and forced to uselessly produce soot and smoke. The brick arch provides a way for all the available heat units to seek the one object—that of boiling water under pressure—and so increasing the capacity of the engine for doing useful work. It is like the difference between dragging at a stone with the hands or using a lever to move it.

The locomotive is not now the crude machine of twenty-five years ago, when the ability to haul cars even at a wasteful cost was permitted. To-day the object of the master mechanic and his staff is not only to haul cars, but to do it economically by the employment of scientific methods. Based on the knowledge of what combustion really is, and how the exacting conditions of modern locomotive service have to be met, and how difficulties are to be overcome, the locomotive of to-day is in the hands of intelligent railroad mechanical officers and men, is making

Action of Arch on Air from Hole in Fire

substantial progress, and may in time approximte to an instrument of precision.

The Railroad Mechanical Conventions

Atlantic City, N. J., has been decided upon as the place for holding the railroad mechanical conventions this year. The Master Car Builders' convention will be held on Wednesday, Thursday and Friday, June 14, 15 and 16, and the Master Mechanics' convention on Monday, Tuesday and Wednesday, June 19, 20 and 21, 1916. The meetings will be held, as was done last year, in the Greek Temple, on the ocean end of Young's Pier.

The Marlborough-Blenheim Hotel has been selected as the headquarters for both conventions. The president, executive committee and secretary will have offices there, and accommodations will be furnished for meetings of the various committees. The registration booth will be in the Entrance Hall of Young's Million Dollar Pier. In order that a correct record may be made of the members in attendance, it will be necessary to register once for each convention. Members of either or both associations are advised to go to the registration booth before attending either convention, announce name and badge will be issued.

There is a new badge to be used during the convention this year. It will be furnished after registration.

The badges for the families and guests of members will be of a different design from last year, and should be procured as soon as possible after arrival of a member.

Mr. Joseph W. Taylor is secretary for both associations; his address is 1112 Karpen Building, Chicago, Ill. Further information, if required, may be had by addressing him.

The Railway Supply Manufacturers' Association

The secretary believes that indications point to a larger attendance than ever of the R. S. M. A. in connection with the Master Mechanics' and the Master Car Builders' Associations. A list of the hotels, with prices for accommodation, may be found on the circular issued by the secretary-treasurer, Mr. J. D. Conway, 2136 Oliver Building, Pittsburgh, Pa.

Exhibitors may begin installation of exhibits on May 29 and must have booths completed not later than 6 p. m., June 13. All shipments must be prepaid and plainly addressed to the exhibitor's company, with exhibit space number, Million Dollar Pier, Atlantic City, N. J. Contract has been made with the Eldredge Express and Storage Warehouse Company to deliver all freight shipments from the railroad to exhibitor's booth, to handle and store all empty crates and boxes, and at the close of the convention return them to the railroad, at the following rates: Consignments weighing over 300 lbs., round trip per net ton, $6; consignments weighing over 300 lbs., one way per net ton, $3; consignments weighing under 300 lbs., round trip per case, $1; consignments weighing under 300 lbs., one way, per case, 50 cents. Payment for delivery as above is to be made direct to the Eldredge Express and Storage Warehouse Company. A city ordinance prohibits throwing of papers or refuse matter on the beach or in the ocean.

Mr. Alex. W. Porter, 813 Arctic avenue, Atlantic City, is the contractor for sign work. He will charge exhibitors 20 cents per lineal foot for the standard descriptive signs. Special work, such as gold lettering, trade-marks, card signs, etc., will be as may be agreed upon by those interested. Mr. William W. Paxson, Million Dollar Pier, Atlantic City, N. J., has been selected as official electrician to perform special electrical work, such as signs, etc. Those desiring electric power of 110 volts, alternating current, which is not provided by the association, should make arrangements direct with him. Price for electric sign work is: 12-in. letters, $2.30 each; 18-in. letters, $2.60 each. This price includes hanging, maintenance and current, from the opening to the closing of the convention, during sessions. Mr. W. E. Shackleford, manager of Million Dollar Pier, will provide mechanics and other workmen when called upon to assist exhibitors in the installation of their exhibits. A contract has been made with Mr. C. M. Koury of Atlantic City, who will rent furniture, Oriental rugs and other furnishings to exhibitors. Contracts for furniture should be closed at once. If furniture circulars and contracts have not already been received notify the secretary-treasurer. Mr. J. J. Habermehl's Sons, Bellevue-Stratford Hotel, Philadelphia, Pa., are the official florists for the convention. Mr. George A. McKeague, 165 South Chalfonte avenue, Atlantic City, will be the official photographer. He will have headquarters on the pier, and will be available for any work in his line. Miss L. H. Marvel will have an office on the pier and will be prepared to do letter and statement work at special rates. Dictation may be given at exhibit booth upon request, and work delivered. Mr. W. E. Shackleford, manager of Million Dollar Pier, Atlantic City, will provide drinking water and cooler service, including icing and the proper attention. The Edwards-Bergdoll Taxicab Company, Inc., 25-27 N. North Carolina avenue, Atlantic City, has contracted to provide taxicabs, touring cars and garage service. This company will also care for machines of members.

A temporary postoffice will be opened in the executive office of the R. S. M. A. at the front of the Million Dollar Pier, as a convenience to members. Mail addressed care R. S. M. A. office, Million Dollar Pier, Atlantic City, N. J., will be taken care of and distributed to exhibitors' booths. Members are requested not to send general circular matter for distribution to other exhibitors, which is in violation of the association rules.

After May 29, and until the conventions are over, the executive office of the R. S. M. A. will be temporarily located on Young's Million Dollar Pier, Atlantic City, N. J. Mail matter may be addressed accordingly.

American Locomotives in New Zealand

U. S. Consul General Alfred A. Winslow at Auckland, New Zealand has made an interesting report to the Commerce Board at Washington regarding the performance of some locomotives purchased from the Baldwin Works in 1915 by the New Zealand Government. His report, among other things, quotes a statement made by one of the leading journals of Auckland:

"The big railway engines imported from the United States last year have done more than meet expectations. At the time of the order being placed with the Baldwin Locomotive Co. some protests were made in Parliament against the giving of orders for railway engines to countries not part of the British Empire, but the fact was shown that the engines were urgently required and that Great Britain could not supply them as quickly as the United States could. The locomotives are now at work on the lines of this Dominion, and their hauling capacity is exciting the admiration of experts. A remarkably fine effort over hilly country was recorded a few weeks ago, when one of these engines hauled 275 tons from Wellington to Palmerston North (89 miles) without having to replenish either water or coal supplies." The European war will eventually turn the attention of the countries, now engaged, to supplying their needs from the United States on a large scale in every direction. The munitions supply is and will be but one of the sources of large earnings. The wastage and destruction abroad can only be made good from outside the countries now being devastated.

The Pennsylvania Railroad Pension List

Under the pension rules of the Pennsylvania there were 54 employes placed on the "Retired List" as of March 1, 1916. Four of them had completed more than 50 years of active service each, and 31 had been employed 40 years or more each. On this "Roll of Honor" there are now 4,570 names. Since January 1, 1900, when the pension plan was adopted, the expenditures therefor have amounted to $12,474,911.44. This is a most interesting showing and speaks well both for the employes as well as the great system which put this philanthropic idea in vogue.

In every person who comes near you, look for what is good and strong; honor that; rejoice in it; and, as you can, try to imitate it; and your faults will drop off, like dead leaves, when their time comes.—Ethics of the Dust.

Heat Characteristics and Braking Effects on Chilled Wheels

The Effect of Unequal Heat on the Various Parts of a Wheel. The Origin of the Various Defects Explained and a Scientific Explanation of the Shelled out Spot

In dealing with heat characteristics and the brake shoe effects on wheels, Mr. F. K. Vial in his paper on "The Chilled Iron Wheel," read before the Richmond Railroad Club, said in effect: If one looks at Fig. 1, he may see a variety of characteristic blemishes which have for their origin excessive local heating. The special character of any one of these blemishes depends upon the origin of the heat, whether between the wheel and rail or between wheel and brake shoe, and is the result of the friction being either continuous around the circumference of the wheel, or its being localized, as in the case of skidding on the rail. The terms by which these various defects are known were established by experience with chilled iron wheels, and were found to apply equally well to steel, although modifications are necessary when discussing the defects in steel wheels.

In ordinary service, with the proper brake adjustment, to equalize the work of retardation over all wheels of the train, it is of rare occurrence that sufficient heat will deveop to cause heat checks, yet the total number tire circumference becomes intensely heated, and when the heat becomes excessive and is generated in a sufficiently short period of time, it causes the metal to break up into fine heat cracks.

In many trains there are a number of cars in which the brakes are ineffective or are cut out. The effect of this is to make the tonnage to be controlled by the cars with good brakes greater than it otherwise would be, and even under these unfavorable conditions, there is not much danger of burning the treads of the wheels if the brake shoes are in proper position and effective; but for various reasons the brake beam is not always central, and one shoe may overlap the rim while the other crowds the flange, as shown in Fig. 2.

The pressure on the shoe is not changed on account of its position, hence, when the bearing area is reduced, the pressure and the resulting heat per square inch are increased in the same proportion as the bearing area is decreased. This accounts for the number of brake burnt rims and also for cracked flanges when the shoe bears heavily on the flange.

Fig. 1

A	B	C	D	E	F
Slid Flat	Comby from Slid Flat	Shelled Out	Brake Burnt	Brake Burnt	Comby from Brake Burn

of wheels removed on account of metal becoming overheated amounts to 10 to 15 per cent of the total wheels removed from freight service.

In discussing these various blemishes it is essential to know the terms used, and their meaning. The following are the commonly accepted terms: Brake burn, comby from brake burn, comby from skidding or sliding, shelled out.

In brake burnt wheels the tread is broken up into fine hair lines running parallel to each other across the tread of the wheel, generally covering a considerable portion of the circumference, and in extreme cases the cracks may open considerably, even though no metal is broken away; this is brought about by the rapid heating and cooling of the tread over the area covered by the brake shoe. On heavy grades the brakes are applied to control the speed and therefore the action may occupy considerable time. Under such conditions there is very little danger of sliding the wheels, hence the en-

In Fig. 1 the wheel marked E shows the condition of the rim of wheel when brake shoes overhang, as outlined in Fig. 3. This condition is quite prevalent and is likely to crack the plate of the wheel on account of the expansion at the rim while the tread of the wheel near the flange is cold, which produces a heavy strain, throwing the front plate into tension of sufficient intensity to sometimes cause the metal of the front plate to crack or break for a distance long enough to relieve the tension.

When a chilled iron wheel has become brake burnt and is kept in service, the subsequent pounding disintegrates the metal which drops out little by little and results in a condition called "Comby from Brake Burn." This leaves the metal in a ragged condition, as the plane of cleavage is radial or perpendicular to the tread, and small prisms of metal break off more or less irregularly. This may be seen in Fig. 1, wheel F.

When a wheel slides an intense heat is generated almost instantaneously, and the metal is rapidly worn away, leaving a flat spot, often showing a fine network of hair cracks over the area of the flat surface. This condition usually appears in spots about 2 ins. long, either singly or at various parts of the same wheel. If

Fig. 2. Results of Defective Hanger Arrangement

the slid flat spot is not large enough to require removal, and the wheel remains in service, the metal which has been disintegrated by the heat may break up and drop out, resulting in a condition known as "Comby from Sliding." This is apparent in Fig. 1, wheel marked B.

The term "shelled out" refers to spots on the wheel where the metal has dropped out from the tread in such a way that a raised spot is left in the center, with a cavity more or less circular around it. In this case, in addition to the radial lines of cleavage, there is a cleavage parallel to the surface of the tread, and therefore the bottom of this defect is more or less smooth, somewhat resembling an oyster shell.

The cause of shelled out spots does not seem to be as self-evident as that of comby wheels. The conditions which exist and give rise to this condition require careful consideration.

Usually the maximum air brake pressure is adjusted for the light weight of the car, so that the wheels are not likely to slide under loaded cars. Sliding often occurs just before a train comes to a standstill. This is occasioned by the greater efficiency of the brake shoe as the velocity of the wheel decreases. The greatest frictional resistance between the wheel and brake shoe occurs just as the wheel is about to stop revolving, and often at this point exceeds the frictional resistance of wheel on rail, in which case the wheel begins to slide. After the wheel once begins to slide the friction between the wheel and the rail is very much lessened, and

Fig. 4. Shape and Size of Wheel Bearing on Track Under Various Loads

sliding will continue until the brake pressure is reduced.

When the sliding is over a distance of only a few feet before the car stops, the term "skidding" is applied, and when a small flat or skidded spot the size of the area of the wheel in contact with the rail is produced. The diagram marked Fig. 4 shows the actual size and shape of the contact areas under various loads. This was published in the "Transactions of the American Society of Civil Engineers," the test being made with new 33-in. chilled iron wheels on 75-lb. rail having a top radius of 14 ins.

A flat spot no larger than the contact area shown is not sufficient to cause the removal of the wheel, but the subsequent pressures and blows received in regular service very often result in the metal breaking or shelling out around the center of this contact area, forming a shelled out spot. During the time the wheel is sliding all the mechanical energy represented in the resistance to motion is changed to heat through the agency of friction; and as mechanical energy and heat are mutually convertible, the exact amount of heat generated can be calculated. It is a matter of common observation that the melting point is often reached.

This local high temperature causes violent expansion and almost as rapid contraction as soon as the sliding ceases. The small area on being suddenly brought to an intense heat while the other parts of the wheel are comparatively cold, is put under intense compression, being tightly restrained around its circumference. There is also a slight displacement or flowing of the metal on account of the enormous surrounding pressure on the small area of the intensely heated surface. The line of least resistance is toward the center of the spot

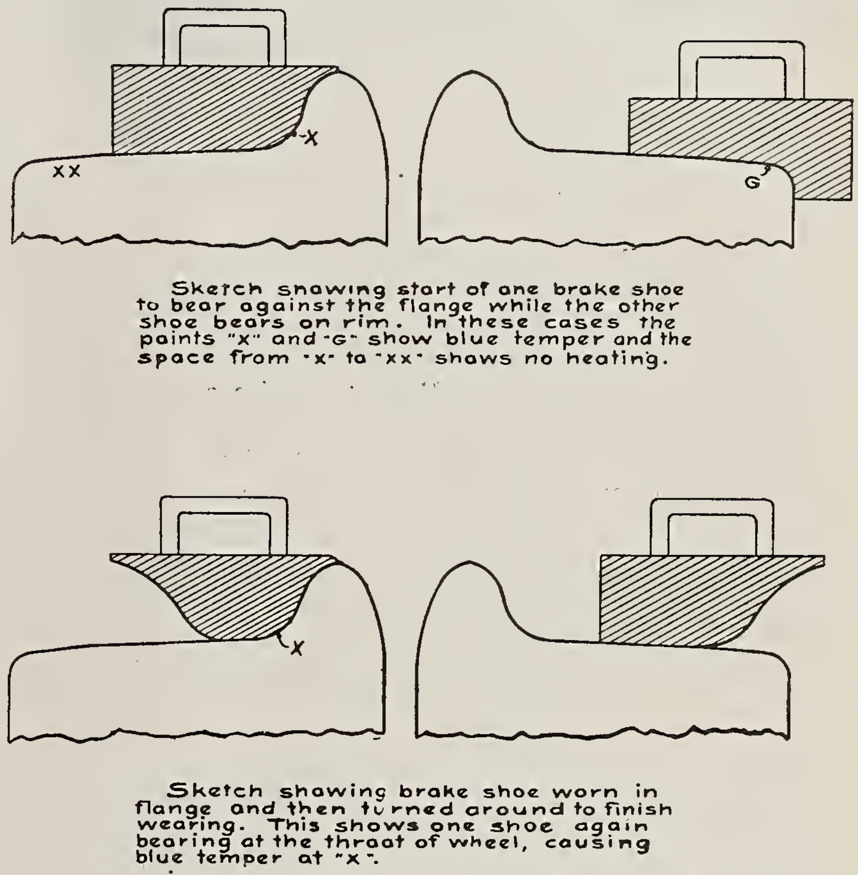


Fig. 3. Showing Various Improper Methods of Brake Bearing

at the surface of the wheel. The direction of this least resistance starts on the surface at the center and extends downward into the metal, sloping in all directions receding from the center, like the sides of a miniature hill.

After the expansion and contraction on this small area have taken place, it only remains for successive pressures and blows which follow in service to break out small pieces of metal which have been weakened by the excessive strain to which they have been subjected by intense heating and sliding stresses. After the metal has commenced to break out, the defect becomes a typical shelled out spot.

Where the wheel slides some distance and the melting point is reached, the metal in contact with the rail is rapidly rubbed away and the area of contact increases, giving a much larger area to receive the heat, and the temperature is accordingly reduced. In this case the heat may be sufficient to cause a disintegration of the metal, forming a network of hair line cracks which, after subsequent pounding in service, results in pieces breaking out, giving a rough, jagged appearance at the spot. This defect is commonly termed "comby from slid burn." Should the sliding continue over a much longer stretch of track, a typical flat spot is the

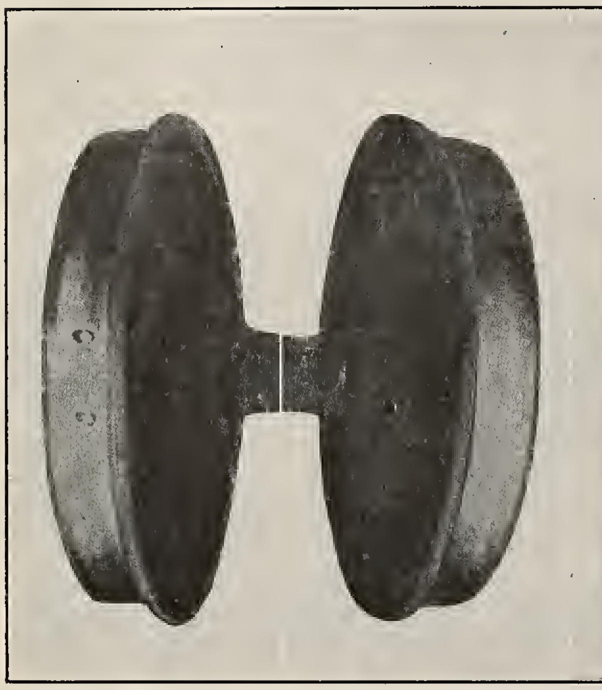
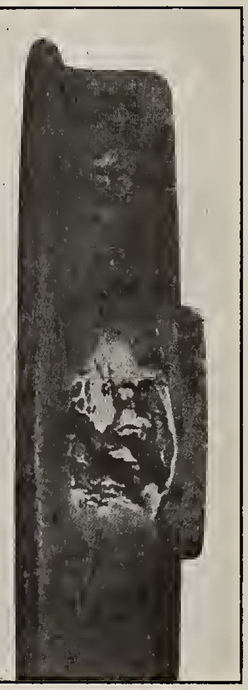



Fig. 5. Fig. 6.

result, which becomes evident to those within hearing distance.

While it would seem that both wheels on an axle should be affected alike from sliding, such is not always the case, as may be seen by a glance at Fig. 5. In going around a curve, or when the load in a car is unequally distributed, the weight is not the same on both wheels; also at times, one rail may be dry or sanded, causing much more friction than the other, which may be wet or greasy. One wheel may bear on the rail at the center of the tread or near the throat, and the mate may bear near the rim at the time the sliding takes place. In such a case, if the flat spot is small, the wheel first mentioned may develop a shelled out spot later on, while the wheel which has become flat near the rim may not, owing to the fact that this part of the tread may not run on the rail near the rim, in subsequent service. This permits it to avoid pounding on the flat spot which is necessary to cause a shelled out spot. A number of cases have been observed where a wheel was slid flat enough to cause its removal, while its mate was apparently not affected.

In discussing the cause of shelled out spots we are often asked, "How do you account for engine truck wheels, without brakes, shelling out?" At first this appears to overthrow the argument that shelling is the after result of sliding, but it is not conclusive. Truck wheels have inside bearings and the inside faces of the hubs are generally 10 to 12 ins. in diameter, and are faced off smooth to make a bearing surface.

On examining truck wheels worn out in service it will generally be found that the inside face of the hubs shows considerable wear, often as much as 1 in. in depth. In fact, the face hubs of steel wheels often wear out before the tire, and it is common practice to bolt on a new face to the hub. This indicates that there is considerable friction between the hub of wheel and the bearing, especially where enough allowance for play has not been made. In rounding curves the lateral pressure on the flange and on the face hub often exceeds the load on the wheel, and when such is the case sliding results.

The load on the truck wheels is generally insufficient to produce a large flat spot, though they sometimes do occur. As a rule, however, a small skid is produced which occasionally develops into a shelled out spot. This is not of common occurrence.

These shelled out spots occur in all classes of wheels, regardless of the amount of chill, the percentage by tape size being in proportion to the number in service. Wheels of all makes are apparently affected alike, and there is no metal suitable for car wheels that will withstand the heat action which develops from sliding or skidding. The effect on steel and chilled iron wheels is shown in Figs. 6, 7 and 8.

It is generally conceded that where this condition occurs in pairs it is conclusive evidence that the wheels have been slid and most contracts specify that such wheels will not be made good by the makers. Where the defect occurs singly it is just as true that it is the result of sliding, but this is held as evidence that the defect was in the wheel and bears no relation to service conditions, hence most contracts call for replacing the wheel to the railway by the makers.

Where one wheel on an axle has developed a shelled spot and the mate appears to be unaffected, it will often be found on polishing the tread of the good wheel that the metal is smoothed and whiter at the point directly opposite the shelled spot on the defective wheel. This shows that the wheel has been slid on the rail, but not enough to produce a flat spot; in time this wheel would also, in all probability, shell out. The amount of service required to shell out wheels after sliding varies with different wheels, as conditions are not always exactly identical.

If the above analysis is true, we would expect to find this defect most frequently under equipment which is

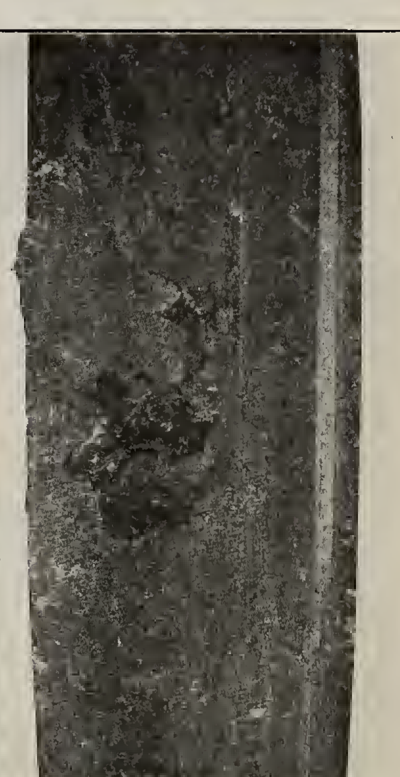



Fig. 7. Fig. 8.

required to make numerous quick stops and under empty cars, or where the live load is small compared with the dead load, such as engine and tender wheels in passenger and interurban service. It is a matter of record that a large majority of wheels with this defect are removed from such service.

In the colder climates where the rail is covered with frost, the coefficient of friction is reduced from 25 to 10 per cent as a result of which the wheels are skidded more frequently and there is, therefore, a corresponding increase of shelling.

The tendency of wheels to shell in pairs or in larger numbers under the same car is well illustrated in an analysis of the results in service under 500 refrigerator cars representing a total of 4,000 wheels. Of this number, 189 were removed for shelling out. A summary of the relation of this defect to the mate wheel is shown in the following: 174 shelled in pairs; 15 shelled singly; under 8 cars, every wheel was shelled; under 10 cars, 4 wheels were shelled.

This is very effective proof that the foregoing conclusions are correct in regard to the cause of shelled out spots. This is that the shell out will occur at the point where skidding against the rail or shoe occurs, and not because of any inherent defect in the wheel. The cases just cited indicate that like causes produce like effects. If the trouble were in the wheel primarily, shelled out spots would occur at random, and the mate wheel would be very unlikely to show the same defect in the same plane. Skids, shelled out spots and comby spots are all developed from the same cause, and the exact type that is ultimately found depends on circumstances. The defect bears no relation to high or low chill, and there is no known way whereby the manufacturer can in any way control the number of these spots.

That the metal is not at fault is demonstrated by the development of this defect in both the rolled steel wheel and the cast steel wheel. From these facts it is self-evident that the cause of the failure is the same for the steel wheel as for the chilled iron wheel, and that the effect is similar. Here we have three distinct types of wheels with a wide variation in the composition of the metal in the tread and yet they have identical defects arising from the same causes.

Expediting Preferred Freight Cars

Not long ago, at a meeting of the Niagara Frontier Car Men's Association held at Niagara-on-the-Lake, Mr. M. J. O'Connor, of the New York Central Lines, brought out some valuable suggestions on the question of ways and means of expediting the movement of cars loaded with preferred freight. Among other things, he pointed out that one of the foremost questions before the transportation officials of the railroads today is the prompt and safe movement of freight trains. It is a well-known fact that the car department is a prime factor in making this possible, and he endeavored to describe, from a car inspector's, or, rather, from a car department point of view, what the contributing elements are as far as they can be looked at in a comprehensive way.

The inspection of air brake apparatus and the adjustment of brakes in the receiving yard, also the marking out of all cars on which the air brakes are not in good order, very materially assists when making the final air brake test after the road engine is coupled to train in the classification yard. This is an important feature of the inspection and it should be given special attention, for it is an acknowledged fact that where this practice is followed out carefully it has been the means of reducing the number of burst air hose en route. and also the consequent damage to equipment, not to say how much serious delay to trains was avoided.

Treating the journal boxes of cars after they have all been assembled in trains will show whether the packing and contained parts are in the best possible condition, and where this work is done conscientiously it has reduced the trouble with hot boxes to a minimum.

Co-operation with train crews is a very valuable asset to the car department and considerable importance must be attached to this branch of the service, from the fact that when cars are moving over the line they are beyond the jurisdiction of the car inspector. This cooperation can be better established by having inspectors, in a special capacity, travel on the important freight trains, as this not only brings to light any irregularities but is a means of educating the train crews with the nature of defects on cars, and should a slight defect develop en route they are then much better qualified to judge if the car is safe to move to a terminal. This kind of knowledge will prevent the cutting out of cars unnecessarily when carrying preferred freight.

The discussion of the paper brought out the fact that several prominent roads, such as the Lehigh Valley, the New York Central and the Pennsylvania Railroads, have a competent car man who can be sent out with special or preferred shipments of important freight as occasion may require. Mr. O'Connor, in answer to a question concerning the duties of such a man, gave an example from his own experience. It was this, and he explained it by saying: What I was referring to were defects that develop en route, such as a chipped or broken wheel rim where there is still sufficient metal on the tread to keep it within the M. C. B. limit, which is measured at a point ⅝ in. above the tread, not less than 3¾ ins. in width is safe to run. Recently I was advised by one of our train crews of a car being cut out en route on account of the wheel rim being slightly chipped. Next time, they took the car through.

On the New York Central that road has accomplished most satisfactory results in this respect. It has brought the car department and the transportation department in closer touch. The older conductors realize that the traveling car man is working for the road's and the conductor's interest when he gets cars through, and the car department man will go the limit to get them through, and that is what has been accomplished by having special men riding on the trains.

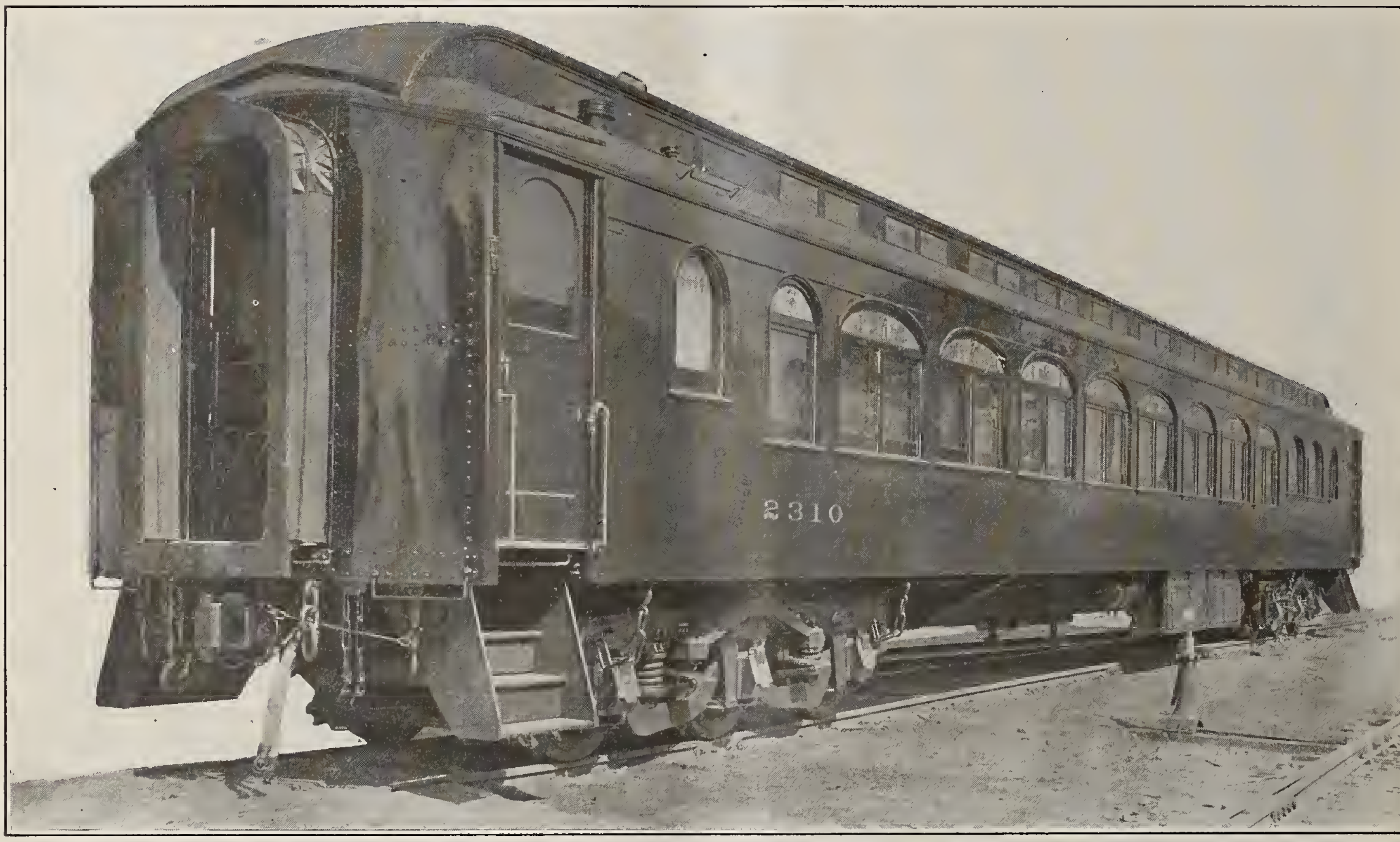
In answer to an inquiry as to what the speaker meant by saying that the practice of having a traveling inspector brought to light "irregularities," it appears that it referred to inspection at the originating point. Something might have escaped the notice of an inspector and a defect developed en route.

Recently the N. Y. C. had some trouble with hot boxes on cars loaded with steel. A detailed report came from the superintendent's office and a man went to the point where these cars were placed in the train and told the foreman to give these cars, loaded with steel, particular attention, as they were the only cars giving trouble. Since that time this trouble has been reduced to a minimum.

Concluding, Mr. O'Connor remarked that another thing in connection with the subject is to impress on the train crew that car men want everything right. A conductor made the complaint that he had a fast train out of a certain yard early in the morning, about half past four, and he was having trouble, but he did not say anything about it, but thought it was going to cease, but it did not. The matter was taken up with the local foreman at the yard in question, and he in turn interviewed the conductor who made the complaint, with the result that the men at fault were reprimanded and an improvement was readily noticeable to the conductor. This is another sample of the missionary work done by inspectors, and it also shows the moral effect it had on the car department staff. That is the spirit of co-operation.

Steel Frame Passenger Cars on the G. T. R.

The Grand Trunk Railway system has recently acquired some steel frame first-class passenger equipment with wood finishing, designed mainly for suburban traffic. The cars have each a seating capacity of 96 persons, and weigh, complete with trucks, 137,000 lbs. They are 83 ft. 3¾ ins. long over buffers and 74 ft. over body end sills. The framing is of steel construction, with all-steel vestibule and the exterior and interior finish is of wood. The primary object in designing these cars was to insure the greatest comfort and safety possible for the traveling public, and a number of novel features and modern appliances have been introduced with this end in view.



Perspective Outside View of Steel Coach for the Grand Trunk Railway

The introduction of a locking device for rigidly holding the trucks to the car body helps to prevent telescoping; it also lowers the center of gravity by adding the weight of the two trucks (40,000 lbs.) to the car body, thus resisting any tendency of the body of the car to turn over in case of derailment. The cars are lighted by the Stone Company's axle system, the generator being arranged to cut in at a speed of about six miles per hour. The cars are heated by the Chicago Car Heating Company's vapor system of steam heat.

The interior finish is mahogany, and rattan seats are used, thus rendering the car sanitary and eliminating, as far as possible inflammable material.

By adopting the composite construction the cars are claimed to be warmer in winter and cooler in summer, on account of the provision made for insulations; also they are more easily repaired at points where special machinery is not available.

The center sills are built up "fishbelly" type and extend from buffer beam to buffer beam. The web plate is 5/16 in. thick and has 5 x 3 x ⅜-in. top and 3 x 3 x⅜-in. bottom angles with a top cover plate 30 x ⅜ ins. extending the full length. The depth of the center sill is 26 ins. in the center of the car and 16 ins. at the bolsters. The body bolster is of built-up construction, composed of eight ⅜-in. pressings as side members and a heavy cast steel center brace, which accommodates the locking device. A top cover plate 5 ft. 6 ins. wide by 5/16 in. thick extends across the bolster. Two 7 x ⅜-in. reinforcing plates extend from side sill to side sill.

Two crossbearers are placed 14 ft. 3 ins. either side of the center of the car and are made from ⅜-in. pressed diaphragms back to back with 10 x ⅜-in. top and 7 x ⅜-in. bottom cover plates. The side girders consist of 1⅜ x 4 x 7/16-in. dropper bar, ⅛ x 35-in. web plate, 2 x 2½ x 3/16-in. intermediate angle and 5-in. 11.6-lb. Z-bar side sill. The side plates are 3½ x 3½ x ⅜-in. angles and side posts 3 x 2 x ¼-in. angles. Wood

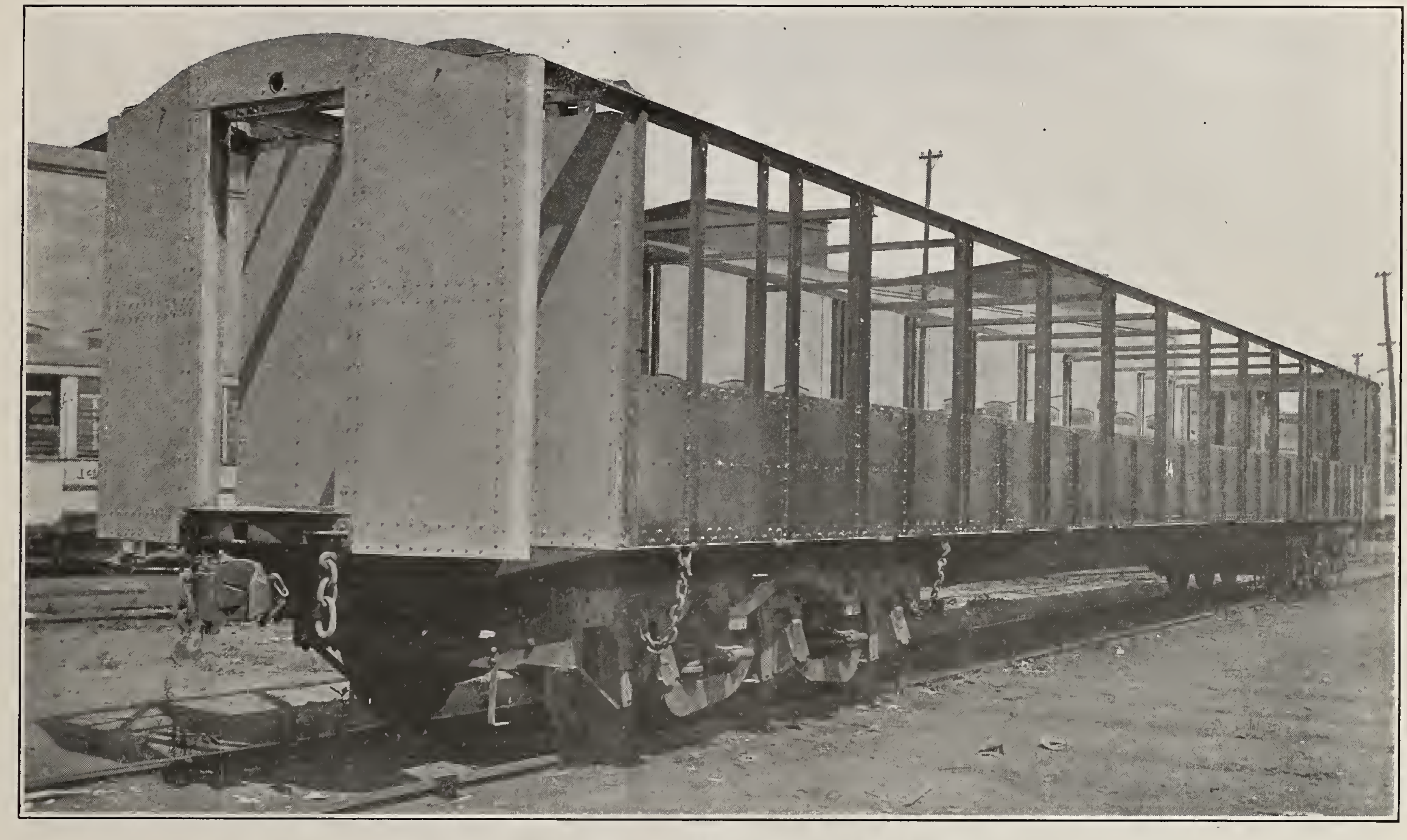
Interior of G. T. R. Coach

reinforcement is employed with the steel construction of the side girders.

Wrought iron carlins 2 x ⅝ ins. on edge are riveted to the steel side construction. Canvas duck is used as a final roof covering, and Agasote headlining is employed. One layer of ¾-in. salamander is applied outside the ⅛-in. side girder plate. Two layers of salamander and one layer of Neponset paper are applied between the upper and lower floor courses.

The end posts are 4-in. 8.2-lb. Z-bars with wooden reinforcing and the end plate is a 4 x 3 x 5/16-in. angle.

The platform end sill is of built-up construction, consisting of 7-in. channels, while at the top the I-beams are connected to the body of the car by 6-in. channels running longitudinally, also 3 x 3 x ¼-in. angle diagonal braces from the ends of the I-beams to the corners of the car body. The braces themselves are attached to the vestibule corners by 2½ x 2½ x ¼-in. angles. The vestibule end plate is a 3½ x 3½ x ⅜-in. angle and 2 x 2½ x 5/16-in. angles brace this plate to the end of the car body between the I-beam and the outside of the car. The vestibule sheathing is of ⅛-in. steel plate.



Steel Construction of Grand Trunk Railway Coach

Looking Toward South America

The vice-president of the Southern Railway at Atlanta, Ga., Mr. H. W. Miller, has recently issued notice that the Southern are going after the South American trade. With the view of extending their efforts to promote the sale of goods in the South American countries, the Southern Railway, Queen & Crescent Route, and the Mobile & Ohio Railroad, intend to send their South American agent, Mr. Charles L. Chandler, on a tour through South America this summer. He will leave in July and visit Brazil, Argentina and Uruguay, where the opportunities are now particularly bright for extension of American trade.

Mr. Chandler will interview the merchants and buyers of the three republics and investigate trade opportunities generally, in order to be able to advise southern merchants and manufacturers where and how to place their products with advantage. While on this trip, his services will be at the disposal of Southern firms who are anxious to have specific trade opportunities investigated for them, and will also be glad to assist and promote their trade there in any way possible. Firms desiring Mr. Chandler to represent them should address him at 322 James building, Chattanooga. No charge will be made for this service, the work being part of the Southern's general scheme for developing the South.

We have only to say to our friends, the railway supply men, that if they desired to have their own lines exploited, it would not be amiss to get in touch with Mr. Chandler. We have no doubt that the Southern Railway, although interested in the merchants in their own section, would not be averse to carrying freight originating in the Northern States. In order to secure orders from the developing railway lines below the equator, no stone should be left unturned to secure a share of the trade for this country.

Boiler Code of the A. S. M. E.

The A. S. M. E. boiler code committee has received recognition by the code being used in technical schools as a reference book. The Stevens Institute of Technology at Hoboken, N. J.; the Sheffield Scientific School of Yale University, and the boiler design students at the Rensselaer Polytechnic Institute at Troy, N. Y., use the code. At Rensselaer the code supplements the text and lecture notes, and in the design work the code is complied with for all requirements.

The Roberts & Schaefer Co.

The Roberts & Schaefer Co., engineers and contractors, Chicago, were recently awarded a contract by the Pittsburgh & Lake Erie Railway Co. for the building of four reinforced concrete automatic electric counterbalanced bucket locomotive coaling plants and four electrically-operated cinder handling plants, for immediate installation at Monessen, College, Aliquippa and at Newell, Pa.

Annual Meeting of the Southwestern Car Men's Club

Synopsis of Some of the Papers Read on That Occasion. Review of the Year. Promoting Acquaintances. Necessary Things for Club Success. Efficiency, What Is It?

Several very interesting papers were read by members of the Southwestern Car Men's Club at Kansas City, Mo., at their annual meeting, which has just recently been held. In the review of the year's work Mr. W. G. Hiel, a former president, said among other things that he had noticed that most of the discussions are carried on by a certain few members, the others having to be called upon for their opinions. This always results in lost time or flagging interest. The fact that all are not fluent speakers need not embarrass anyone as an opinion in simple words is sufficient. When it is necessary to call on a member it narrows the working of the club, as it makes it necessary for a few members to keep up the interest.

The subject committee provided subjects which were all interesting and instructive, and for the past year this committee has been the best the club has ever had, because of the interest they have taken, and caused others to take, in the work of the club. The committee of welcome and introduction has performed its duties in a very commendable manner and has done much to promote the social side of the club, but this is a committee that is handicapped in not having any set time to give its work the best possible attention, and perhaps a ten-minute recess before starting a paper, for the use of this committee to welcome and introduce any new members or visitors, would be good, and have a beneficial effect on the success of the club.

The increase in membership during the year has not quite come up to expectations. It is therefore the duty of each foreman and inspector to put up every inducement to his fellow worker to get him to join the club as the experience and knowledge to be gained in such an organization is practically unlimited.

How to Promote Closer Acquaintanceship Among Members of the Club

In dealing with this subject, Mr. F. W. Trapnell, the secretary, said in effect, that the matter of acquaintance is the first requirement for the advancement of any undertaking and the membership of the club has taken on new life and new life means more work for the committee of introduction and welcome. "It has been my privilege to be at all the meetings and to have done my best to make the members fully acquainted with each other. Acquaintance makes the business side of life more endurable, as if one knows the man that one is doing business with, there is more freedom in expressing an opinion. Not knowing the man, one is apt to look upon him as a green-eyed monster, ready to force his own opinion whether right or wrong. Social acquaintance changes all this."

"The method employed by this committee has been to introduce each new member to the other and to make them feel at home together and feel that they are part of the club. This has been very successful in the past. There must be other methods employed besides the dry discussion of rules, there should be more social features, such as a "smoker" and lecture by some prominent person and it should be relative to car work. Keep the committee on introduction and welcome busy, is a motto worth heeding."

Some of the Things That Are Necessary to Make a Club of This Kind Grow

Mr. H. G. Aughinbaugh contributed a paper on the subject mentioned above and practically spoke as follows: "Having served as president of the club and one year as chairman of the subject committee, I have been in a position to know the active part each individual member has taken in the meetings and also in the welfare of the club. Some of the members attend regularly and occupy a front seat and take an active part in the discussion of the subjects, while others attend a meeting now and then, and when they do come they do not take part in the discussions. Every chair in the room ought to be filled each meeting, and every member in the room should be anxious to express his opinion, and he ought to get up and express it freely. I cannot refrain from mentioning the good work the president and secretary have done in the past year. They have been at their posts practically every meeting during the year. The secretary is an adept at writing up a good resumé of the discussions on each subject.

"There is, in my opinion, no field that affords a better opportunity for men to become more thoroughly familiar with car department work than by being a member and attending the meetings of a club of this kind. While this club has grown considerably in the past two years, yet I believe that a larger membership could have been rolled up and we could have had better meetings if all of the members had spoken up for the club.

"There are, no doubt, many men who are connected with car department work, who would be glad to join the club if some member would give them an application blank and ask them to sign it. Whenever you hear of a member making it a point to meet a friend and engage him in conversation relative to the club and tell him so many good things about the club which will be of benefit to him in his line of work that he will probably want to become a member. Do not hand him an application blank, then, with the remark, "Well, if you decide to join, fill out this application blank and mail it to me." A traveling salesman would never get an order from a prospective customer if he talked this way. What you want to do is to do as the salesman does. When you get the prospective member up to the right point, present the application blank and get him to put his name on it then and there and then insist on his coming to the next meeting. This is one of the things that is necessary to make a club of this kind grow. It costs money to print the minutes of the meetings and meet other incidental expenses, and at the present time the only way of meeting such expenses is through the membership dues.

Efficiency: What Is It?

A paper in which the meaning of the oft-repeated term, Efficiency, was discussed, was read by Mr. Geo. H. Cook in the course of which he said in effect:

We hear so much of late about efficiency that it has almost become a by-word and a slang expression. Efficiency means able, causing effect, producing results; according to Webster.

To many it is synonymous with speeding up, and, in fact that is the conception some foremen have of efficiency applied to a railroad shop. Nothing could be further from the real intent of this much abused expression. To simplify and systematize work, to avoid unnecessary movements, and reduce the time and labor to produce a given result, should be the object of any able and efficient foreman.

If material is not convenient and accessible to the work, if the tools, such as jacks, blocking, heavy wrenches, etc., are not of the most approved pattern, or if the means of carrying heavy jacks, wheels, etc., are not up to date and thereby consume the time and energy of the workman, then the repair plant is not efficient and the best efforts of the workmen cannot make it so.

Doubtless the first and most important requirement is a clean, alert and sympathetic manager, or, if you please, an efficient foreman. The old saying "like prophet, like people" applies to a car shop of today quite as well as to affairs in old times. By clean, we imply not only to be clean in person and physical surroundings, office and shops, but what is of even greater importance, morally clean and upright. If a manager or foreman is a grafter or for various considerations shows favoritism among the men or if consanquinity and business or political bias warps his judgment or if he gives attention to favorites, there is every probability that the morale in that shop will be about zero.

We should be alert to take every advantage of the work. One cannot make the weather, but can often arrange work in large measure to conform to the weather or to other conditions. The alert and wide-awake foreman will use good judgment in selecting men for various lines of work. Because a man does not make good in a certain line is not conclusive evidence that the man is no good. Sympathetic judgment is required.

By sympathy we mean that a person in charge of men must be thoroughly in sympathy with them. If he is not, it would be unreasonable to expect to get their best efforts and it is quite certain that he could not infuse any degree of enthusiasm into the man in the shop under his control. There must be sympathy for the workman in the shop, if the foreman expects to obtain the best results, for men may be lead, but not driven. One must have the good-will and co-operation of the workman in order to get the best results. Satisfied honest men who have confidence in the management are the ones who will push the work along.

By co-operation, I mean working in harmony and sympathy with one another, each assuming a proportion of responsibility.

Friction results in the loss of power and energy. This is true in mechanics and equally true mentally or physically. We must eliminate friction to have efficiency. Some men are looking only to what they can get out of the job with apparently little thought of what they should put into it.

Possibly one of the greatest opportunities for efficient co-operation in railroad work today is in the car inspector's work. He must be competent to determine whether the car is safe and serviceable to move to destination and if it will protect the lading. Here comes in the importance of carding cars, showing the commodities that they are carrying as well as their destination. The inspector must know more about law than the proverbial "Philadelphia lawyer" to pass correctly on all United States safety appliances, besides many other things. All employes must work harmoniously to expedite the forward movement of freight, and of almost equal importance is to see that empty cars are promptly moved homeward.

A concrete example of lack of co-operation may be here given; "a box car placarded linseed oil switch and couple with care," was kicked down the yard and struck some other cars rather hard and immediately oil began to leak. The car was at once carded "Bad Order," for the repair track. The car was handled without attention to contents and offered to a connecting line which refused it on account of leaking oil. The car was again offered to this line and again refused, but they finally took it to their platform and transferred the load with a loss of about 200 gallons, which was selling at about $1.35 a gallon. If the transferrence of the load had been done immediately after the damage occurred, the loss would have been trifling. Too often we hear the expression "The company is rich." We believe that all will readily concede that there is room for improvement in the careful, conscientious and honest management of the car department in railroad work.

Letters to the Editor

Curious Wear of Journal

Editor Railway Master Mechanic:

Sir—I am enclosing a good snapshot of a journal which I think is something of a curiosity. This pair of wheels came to us under a car loaded with flour. The journal, as can be seen in the illustration, has been spun from the original dimensions of 5 ins. by 9 ins. to $2\frac{7}{8}$ ins. smallest diameter in the center by $13\frac{1}{4}$ ins. long. The journal is perfectly straight and there is no visible seam or crack in it and the journal on the other end of the axle has not been disturbed at all.

Journal Spun from 5 x 9 ins. to $2\frac{7}{8}$ x $13\frac{1}{4}$ ins.

I have never before seen a journal spun in this manner, have you; or have you ever heard of a case of that kind? C. E. Slayton,

Master Mechanic St. Joseph & Grand Island Ry.

St. Joseph, Mo.

Cause of Slid Flat Wheels

Editor, Railway Master Mechanic:

Sir:—I am sending you enclosed a table on the cause of slid flat wheels, and trust that you may see fit to print it in the Master Mechanic. Frank J. Borer.

Roselle Park, N. J.

The Cause of Slid Flat Wheels—Brake-Shoe Friction Exceeding Rail Friction

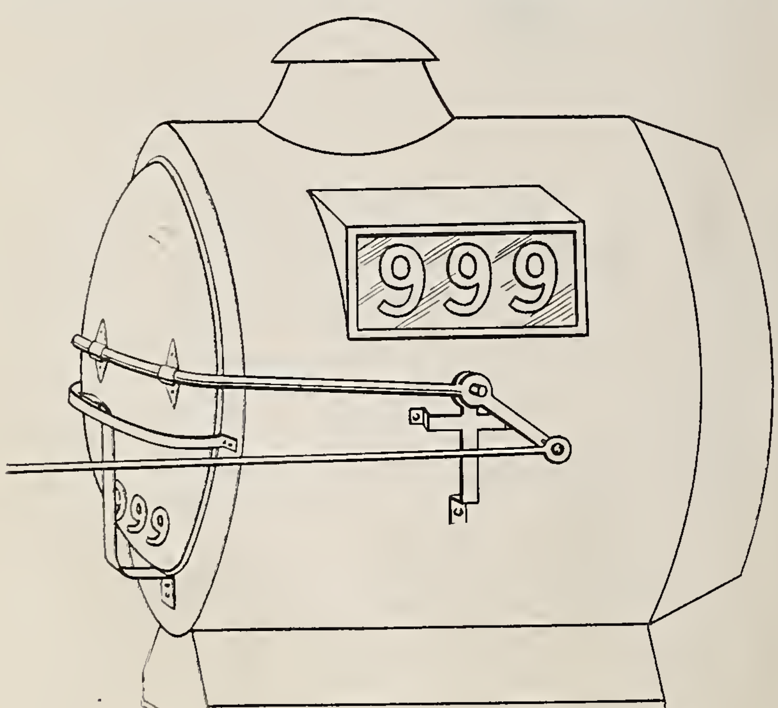
By FRANK J. BORER
Air Brake Foreman, Elizabethport Shops, Central R. R. of New Jersey

Unequal Distribution of Braking Ratio or Non-Uniform Retarding Power.	*Dragging and Improper Manipulation of Brakes.*	*Inability to Release Brakes from a Light Service Application.*	*Insufficient Rail Adhesion.*
Loaded and empty cars in same train.	Sliding from a standstill (chiefly in yards) due to hand brake remaining set.	Excessive train pipe leaks.	Oil on wheel tread or rail.
Unequal piston travel.	Using engine brake alone to stop train, or vice versa.	Too short piston travel.	Moist, slimy or frosty rail.
Variable Braking ratio between engine and cars.	Undesired emergency application, with engine using steam during part of the time stop is made.	Too high triple piston packing ring leakage.	Depression in rail.
Cut-out brake leaky, brake cylinder or its connections.	Brake shoes frozen to wheels.	Too high differential of pressure required to move triple piston to release position caused by gummy slide valve and triple piston, or too tight packing, etc.	Chipped or skidded rail.
Pressure retained or retainer pipe stopped up.	Applying hand brake in addition to air brake.	Leaky emergency valve rubber seat.	
High Speed pressure reducing valve or safety valve, respectively, set either too low or too high.	Sudden shocks or blows, due to rough handling or caused by poor design or defective draft gear.	Insuffcient excess pressure.	
Equalizer springs on passenger car trucks too weak.	Moving brake valve handle too soon from release to running position.	Defective feed valve.	
Brake shoes hung too low with clasp brake.	Improper use of sand.	Train pipe strainer almost stopped up.	
Too obtuse angle of brake beam hangers: brake beam safety chain wedging between brake beam and sand plank.		Overcharging of brake pipe pressure.	
Flanged brake shoes used in connection with brake beams having too much deflection.			

Locomotive Headlight Cover

Editor, Railway Master Mechanic.

Sir:—I am sending a sketch of an automatic headlight cover which has been in use on local night passenger service for 12 months and has given very satisfactory results, the parts being simple, have caused no repairs since they have been in operation. It meets with the hearty approval of the crews, as there is no trouble from resparking of the electrobe or the throttling of the turbine as when the switch system is used. The arch is burning all the time and gives passing crews an opportunity to see the number in front cover and side number in the casing, giving positive identification of engine in a siding. Many wrecks have been charged to the cause of not identifying an engine.



Headlight with Cover for Night Service

A bracket attached to side of headlight casing. A crank journaled on bracket. A rod carrying the cover, cover riveted rigidly to it. The cover is made of light sheet metal, the rod of 1/4-in. gas pipe bent to form a crank. The crank is journaled on the bracket with lugs extending to clutch carrying rod on cover. The crank lifts the carrying rod on cover past center on top of headlight casing and falls by gravity to position required. A 1/4-in. rod passing through 1/2-in. gas pipe from cap to crank shifts it readily, as the crank only moves through 45 degs. to shift the cover past the top center, having a leverage equal in amount to that by which crank does not parallel the rod.

The number of the locomotive should be cut into the cover backed by frosted sheet mica or any translucent material to bring out the number plainly, making identification of the engine number easy at night, clips on front and lens holder to catch cover as it falls to the front; a bracket is made as is illustrated to receive cover on the back of the casing.

Memphis, Tenn. Julius Robbe.

Bessemer & Lake Erie Blacksmith Shop

Construction and Dimentions of the Shop. The Ventilating System Employed to Secure a Clear Atmosphere. The Tools and Machines Used. Class of Work Turned Out

The Bessemer & Lake Erie Railroad Company has completed at Greenville, Pa., in connection with its general repair shop, a blacksmith shop which is a good example of what can be done in this direction.

The building is constructed of steel frame and brick, 120 ft. wide by 128 ft. 6 ins. long, center to center corner of columns, with a height of 21 ft. under the trusses.

On account of the swampy nature of the ground in the Greenville locality, it was found necessary to use 88 first-class piles, 32 to 38 ft. lengths, which were driven as near to the cut-off elevation as possible by the use of a follower. These piles were distributed so as to bring two under each end column of intermediate trusses, three under end column of end trusses, four under each pedestal supporting center columns of intermediate trusses, two under each center column of end trusses, and forty additional piles, spaced about 12 ft. center to center, under end and side walls. These piles were cut off at an elevation of 1 ft. above the bottom of the foundation and a single string of 60-lb. rails laid on top of them, excepting under columns, where short rails were laid at right angles to the center line of foundation walls.

The roof trusses are of Pratt type, 128 ft. 6 ins. center to center of end columns, with a supporting column under center. These trusses are of extra heavy construction, as specifications called for sufficient steel to carry one vertical concentrated load of 10,000 lbs. applied at any point on lower chord of any truss, and one horizontal concentrated load of 12,000 lbs. acting in any direction and applied at panel points on the lower chord of any truss. This was to take care of the swinging cranes. The lower chord is 21 ft. above the floor level, which is on top of the foundation. The trusses are 7 ft. deep at the ends and 15 ft. in the middle, giving the roof a slope of 1½ ins. to 1 ft. All the steel was furnished by the American Bridge Co.

The Walls are of common red-shale building brick, 13 ins. thick, excepting pilastrs, which are 17 ins. thick. The brick are laid in cement mortar, clean river sand, Universal Portland cement, and just enough lime to make it work smooth; 168,000 bricks were used in this building.

The windows in the sides and end of the building are made up of nine sashes, each of 16 lights, 12x14 ins; are 16 ft. high and are placed 3 ft. 10 ins. above the floor level. There is a total of 3,211 sq. ft. of glass in the lower walls, or 23 per cent of the wall surface below the square. In addition to the above there are two monitors, each with 38 sashes of 9 lights, 12x14 ins., or a total of 798 sq. ft., or a grand total of 4,009 sq. ft. of glass, giving almost perfect light and ventilation.

A special effort has been made to make this shop complete in ever detail. The windows are of the three-sash type, the upper sash being swung on pivots, so that the top swings in and the bottom swings out. There are 4,475 sq. ft. of window space in all in this shop. Ventilators are also provided at the roof of the building, which gives exceedingly good ventilation, preventing direct draughts. All the lintels and sills in this building are of reinforced concrete, made on the ground and placed when the bricks were laid.

General View of Bessemer & Lake Erie Blacksmith Shop at Greenville, Pa.

The roof is four-ply, Warren-Ehret built-up type, on 2 ins. S. 1 S. T. & G. yellow pine sheathing. The inside finish is white, three coats of special paint, manufactured by the Illionis Steel Co., being used on the walls and two coats of white-lead paint on the underside of the roof. All steel work in the trusses is painted black.

The blower lines are of vitrified sewer tile laid with standard points. Special care was taken to have all joints watertight under a pressure of 10 lbs. per sq. in. These joints were made by packing a strand of oakum, of a size not to exceed one-fourth of the available space in the bell, dipped in a neat cement grout, tightly around spigot end, taking care to have spigot well seated. After this the remainder of the bell was filled with a stiff cement mortar and neatly beveled. The sewer tiles vary from 4 to 15 ins. in diameter, and were tested by putting up a 6-in. pipe in the manhole. This pipe was filled to a height of 23 ft. above the blower line.

The exhaust line, which is necessary on account of down-draft forges, is also of vitrified sewer pipe laid in

Down-draught Forge, B. & L. E. Smithy

the same manner as the blower line, but tested under water pressure to 3 lbs. per sq. in. This line is from 12 to 36 ins. in diameter.

This building was erected entirely by the company's forces, under the supervision of the engineering department of the railroad.

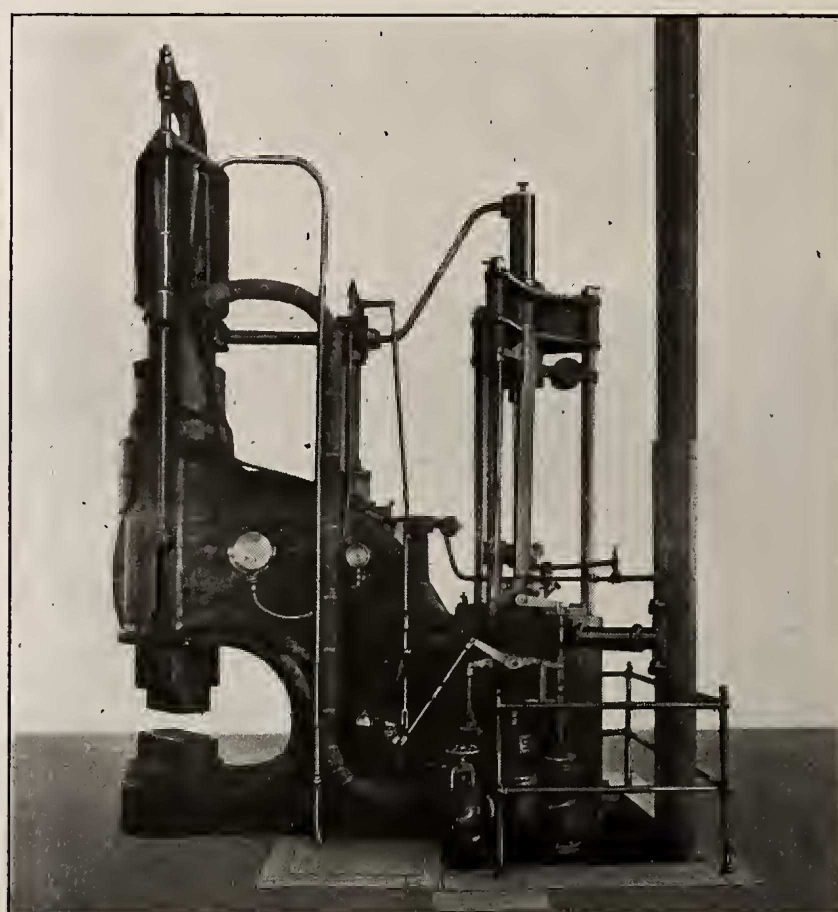
Upon entering this shop one cannot help but be agreeably pleased at the absence of smoke and gas, due to the use of the down-draft forge system. The interior of this shop is painted white, except the roof trusses, which are painted with a special preparation to avoid corrosion. All the tools and machinery are painted black. The white interior helps to reflect and distribute light during the day and greatly assists in the diffusion of the rays from nine electric arc lamps suitably suspended from the roof trusses. Large doors are on all four sides, making it convenient to enter or leave on any side; also giving direct connection to the erecting shop, machine shop, boiler shop and roundhouse. Entering from the south side, through large doors, one finds a standard-gauge track extending the length of the shop, which connects with the main lead track, by the use of which the handling of all machines and heavy material is taken care of by a locomotive crane.

Our illustration of the down-draft forge shows how the smoke is carried away. There are fourteen of these forges in the shop. The smoke and sulphur fumes pass up into the hood, and then pass through the suction pipe into the fan and up through the stack. The fan not only draws smoke and fumes into the hood, but also air from the vicinity of the hood, which air is naturally replaced by air coming in through the doors and windows, resulting in a constant change of air throughout the whole shop.

The master blacksmith's office is placed near the west entrance, and is 10 by 16 ft. by 14 ft. high. The office is built of concrete, the outside finish being white plaster while the interior is painted white with glazed finish. The floor is raised 1 ft. above the shop floor level, and large windows are installed, so as to afford the master blacksmith a commanding view of the entire shop.

The forges are of the latest down-draft type. The exhaust fan is direct connected, and is a 15-h.p. motor, 825 r.p.m. being used. The blower fan is also direct connected, and has a 30-h.p. motor running at 2,000 r.p.m. All other power tools are direct connected, motor driven, no shafting or belting being used.

The tool equipment consists of the following: One 300-ton high-speed hydraulic forging press; one 2,000-lb. steam hammer; one 600-lb. steam hammer; one 200-lb. power hammer; one 125-lb. power hammer; one No. 6 double-ended bulldozer; one 1½-in. bolt-heading machine; two 2-in. triple-head threading machines; one 8-in. alli-



300-Ton High Speed Hydraulic Press, Made by United Engineering Co., Used at B. & L. E. Shops, Greenville, Pa.

gator shears; one 12-in. alligator shears; six gas-heating furnaces; sixteen forges; one hot saw; one electric grinding machine; also numerous forming tools, such as eye benders, riveters and benders operated by compressed air. Ample provision has been made for the handling of heavy material at the forges, furnaces and hammers by the use of numerous jib cranes suitably placed in the shop. Special attention has been given to the "safety-first" idea, all moving parts of machinery being enclosed where possible. The forges are arranged along the east side of the shop, with the exception of two, which are near the center and are used for heavy work.

The hammers are convenient to all the forges and furnaces, and the jib cranes are placed so as to reach all the tools. The forging press is in the center, near the north end of the shop. The 2,000-lb. steam hammer is at the center of the shop. Midway between and a little to the east the 600-lb. steam hammer stands. South of the large steam hammer are the 125-lb. and 250-lb. power hammers. The furnaces are located near all of the above-named machines where it is necessary to heat material. Natural gas is used for fuel in all the furnaces.

A case-hardening furnace is situated at the west side near the center of the shop. The material to be case-hardened is packed during an evening and placed in the furnace. The gas flame is then regulated to give a uniform heat and the material is left over night. In the morning it is taken from the furnace and is quenched in a vat of water. With a furnace of this kind, the cost of a man to look after and regulate it is eliminated, the only expense being for the gas consumed and for the carbonizing compound. A concrete vat 4 by 4 by 6 ft. is placed near the case-hardening furnace, and it has an inlet valve and an outlet valve, in order to keep the water cool. This vat is not only used in connection with the case-hardening furnace, but is also used for cooling heavy material which could not be cooled in the small cooling vats at the forges.

The bulldozer stands south of the case-hardening furnace. Just south of the bulldozer is the 1½-in. bolt-heading machine and furnace, and directly south of this machine are the two bolt-threading machines, and east of these machines is the 6-in. and 12-in. alligator shears, with a track between them. This affords a handy arrangement, because material does not have to be moved any great distance to reach the bulldozer, bolt header and the threading machines.

The installing of a forging press has simplified the making of many forgings, with a great reduction in their cost, also giving a good quality of forgings. With a machine of this description, adjusting yokes for locomotive driving brake connections are made from solid stock, the center being punched out. Jaws for outside valve gears and boiler brace anchors, main reservoir heads of ½-in. material, spade ends for side rods, channels bent in U-shape for side stakes of steel cars, arch bars and angles of all shapes are made on this machine. Steel ties, which were badly bent and were heretofore considered as scrap material, are being straightened cold with dies of gray iron, which were designed for that purpose at a low cost. Seventy-five per cent of the dies used on this machine are made of gray iron, which are made at a low cost and require very little machine work. Dies made of this material could not be used on steam-hammer work, and the work turned out on this forging press, with the use of gray iron dies, requires very little machine work.

We show in one of our illustrations the 300-ton United Engineering Co. high-speed hydraulic forging press. The photograph from which our engraving was made was taken during working hours in the shop, under normal conditions, and shows the clearness of the atmosphere.

The shop organization is as follows. One master blacksmith, one master's assistant, one master's clerk, one tool dresser, one tool dresser helper, one forging press smith, one forging press helper, one forging press heater, one forging press driver, two steam hammer drivers, one bulldozer operator, one bulldozer operator helper, one bolt maker, one bolt heater, one shearman, twelve blacksmiths, fifteen blacksmith helpers; total in all, 43 men.

A bubbling drinking fountain situated near the center of the shop furnishes pure drinking water from a drilled well 187 ft. deep. Ample steam heat radiation has been provided to insure sufficient heat for the comfort of the employes during the winter months. The welfare of the employes, which is one of the policies of the United States Steel Corporation, which controls the B. & L. E. has been given special attention. The design and erection of the shop, as well as the arrangement and installation of tools and machinery, was executed entirely by company forces, who are all proud of the results.

Safety Arch Inculcating Safety Always

A unique safety arch is in use at the Buffalo, N. Y., plant of the Lackawanna Steel Company. It is a serious attempt on the part of a large industrial concern to conform to the spirit of kindly interest in the welfare of the worker, which has been abroad, and is growing throughout the country at large. The arch will no doubt interest many railroad men engaged in locomotive and car work in the various repair and construction shops in our broad land. It is impossible to enter the establishment where these arches have been set up, without at least seeing them, and although it is often said that familiarity breeds contempt, or perhaps more

"Safety Always" Arch, Lackawanna Steel Co.

correctly familiarity leads to disregard, the character of the sign is such that disregard is probably removed to a great extent from the minds of those who see the arch and to whom its appeal must always be of vital importance.

There are two so-called safety arches, one just inside each of the entrances to the works. These are so placed that the men pass under the arches to and from their work. The arches are away from buildings and structures and are in view for a considerable distance and from many directions. The picture and the lettering appears on both sides alike and the entire arch is illuminated by eight 100-watt tungsten lamps equipped with effective metal reflectors. The arches are 30 ft. 6½ ins. high over all. Both the columns and signs are 18 ft. 4¾ ins. wide.

On the sign or large display view the artist has painted a huge picture of a man in workman's clothing, with the notice, "Use your brains, eyes, ears, hands, feet to prevent injuries to yourself and fellow workmen." Arrows point to the part of the body referred to in the notice. Each of the thirty-six departments and shops in the establishment are represented by a steel plate 21 ins. long by 15 ins. wide bearing the name of the department or shop, and appended to the outer end of the plate is a representation of the American flag properly colored and made of steel. These plates are arranged one above the other on each side of the sign. The men can read them at a distance of about one hundred feet.

Each day at noon a black metal slide, representing a black flag, is placed over the flag of any department having had a personal injury during the previous twenty-four hours. This black flag remains up until the following day at noon. A daily exhibit of the personal injury record of each department shown up in this manner has caused a desirable and very beneficial rivalry among the superintendents and foremen at the plant. This friendly rivalry tends to keep down the number of employes injured.

The safety arch notice bears the name of Geo. F. Downs, General Superintendent. There is a department of safety in this works, of which Mr. N. B. Ludlum is chief. A rough idea of the size of the arch may be had by observing the relative height of the two watchmen shown in our illustration, as compared with the arch and the colossal proportions of the "painted workman," who stands there whole of body and limb, to be judged by the same standard. Our railways have taken up the matter of "safety first" in earnest, yet this slogan almost implies the presence of some emergency and consequent prompt action, but the more persistent idea of "safety always" is exemplified by the arch, and the suggestion it contains may be found useful at the large shops of many of our iron roads.

Standardization of Chilled Crane Wheels

At a meeting of the A. S. M. E. not long ago Mr. F. K. Vial of Chicago pointed out that in the earlier stages of crane construction wheels of the general design as were used on railroads were adapted to crane service by adding a second flange of about the same section as that of a railroad wheel. This worked well enough while the wheel loads did not exceed those used in railway service. In the heavy types of bridge cranes concentrated wheel loads five times greater than in railroad service loads are required.

The most common troubles with crane wheels are: Wheels becoming out of round on account of unequal wear; breaking down of metal on account of loads exceeding its bearing power; distortion and binding of flanges on account of irregularity in gauge of track. These defects in wheels produce heavy strains throughout the structure, including worn and broken propelling gears.

All of these defects are expensive as they interrupt the service of important machinery.

The Griffin Wheel Co. undertook an investigation into these matters by testing to destruction a large number of full size wheels of various designs in the R. W. Hunt & Co.'s 300,000-lb. Riehle testing machine. Use was also made of a considerable number of tests made at Purdue University and at the University of Illinois.

It was evident that the vertical load carried on any wheel is not limited by the capacity of the wheel, but by the carrying capacity of the rail. The bearing power of chilled iron is far in excess of that of a steel rail. The tests show that under like loads the ratio of depression in the rail is inversely as the diameter of the wheel. The larger diameter of wheel makes a larger area of contact, which reduces the pressure per square inch.

Tables show that on a new A. S. C. E. rail the safe maximum limiting load for a 12-in. wheel is 23.000 lbs. and for a 33-in. wheel, 38,150 lbs. If the top of the rail is flat, 2 ins. wide, the limiting load on 12-in. wheels is 78,300 lbs. and on 33-in. wheels, 130,000 lbs. It was also brought out that the power required for locomotion decreases as the diameter of wheel increases. A 24-in. wheel requires 25 per cent more power than a 33-in. wheel. A 16-in. wheel requires 68 per cent more power than a 33-in. wheel.

The strength of flanges increases with the increase in diameter of wheel. With the same dimensions of flange and tread the flange on a 33-in. wheel is from 26 to 34 per cent stronger than the flange on a 24-in. wheel and from 62 to 92 per cent stronger than the flange on a 16-in. wheel. The tests also show that the relation of flange thickness to tread thickness should be as 2 is to 3. Assuming the strength of a flange which is 1¼ ins. thick with tread thickness of 1⅞ ins. as 100, a flange having a thickness of 1¾ ins. and tread thickness of 2⅝ ins. would be 200. Every ⅛ in. added to flange thickness with the relative increase in tread thickness increases the flange strength 25 per cent. Chilled iron flanges were tested to above 1,000,000 lbs. horizontal pressure without breaking.

Various designs of 12 to 36 ins. double flange wheels were made, from which the maximum safe vertical load and the maximum safe flange pressure for each design were ascertained.

Altering Locomotive Front Ends

When a locomotive is reported as not steaming the first move made in the roundhouse is to examine the front end, and if there are no leaks or other plain indications of the cause of the trouble either the nozzle is reduced or the diaphragm is shifted. It is well known where such indiscriminate "fooling" with front ends leads. There are many roads on which it is doubtful if two locomotives of the same class have the same front end arrangement. The engines have been changed in one way at one terminal and in another way at another terminal. A bridge is put in the nozzle at one enginehouse and is taken out and the diaphragm shifted at the other end of the run. Some of the roads that have gone into an extensive programme of fuel economy have found it necessary to re-standardize the front end arrangement of practically all of their locomotives. There should be some kind of prohibition placed on the indiscriminate front end alterations, if this work is to have any satisfactory results. The tendency should be toward standardization, within reasonable limits. There was a time when little or nothing was known about front end design, and it may have been justifiable at that time to let every master mechanic and enginehouse foreman work out his own ideas about the drafting of locomotives; but now that there is sufficient definite information available to guide the designer in determining on a satisfactory front end arrangement which will result in a free steaming engine, this information should be put to use. Whatever adjustments or alterations may afterwards be found necessary should be made under the direction of a mechanical department officer who can investigate matters sufficiently to be sure what condition needs correcting and then to have that correcting done in a manner that will not tend to demoralize the front end arrangement of all the locomotives on the system.

Some happy talent and some fortunate opportunity may form the two sides of the ladder on which some men mount, but the rounds of that ladder must be made of stuff to stand the wear and tear.—David Copperfield.

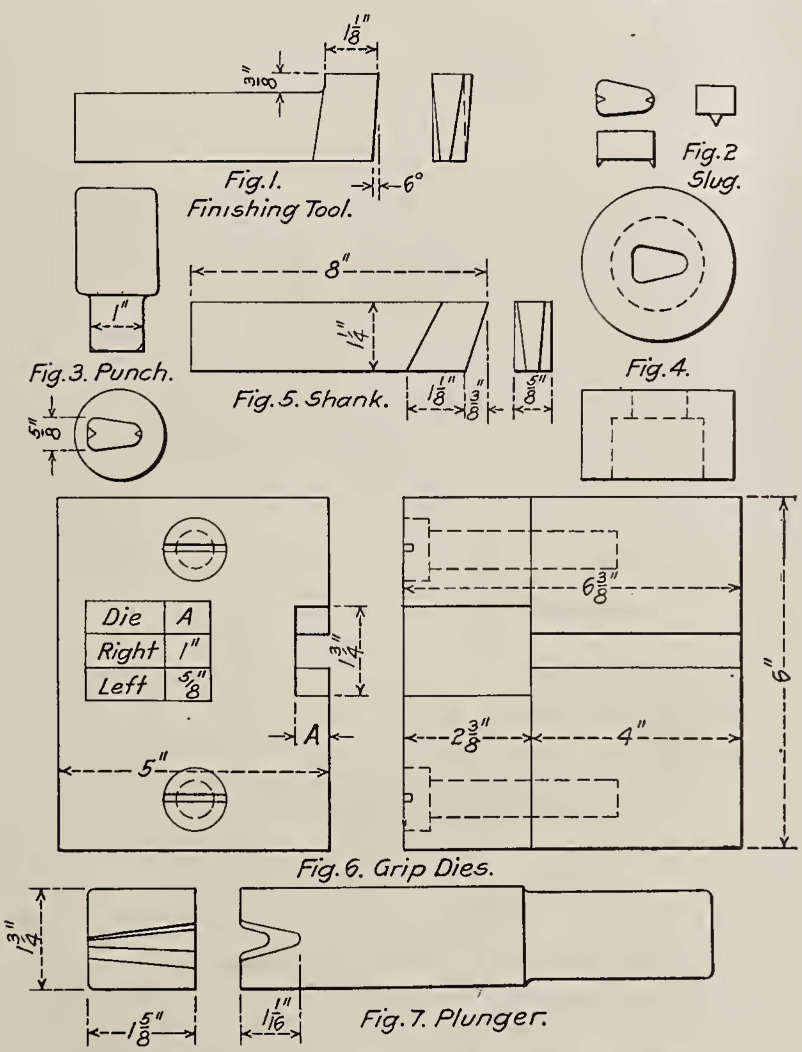
High Speed Points on Soft Steel Shanks

By HECTOR HARRIS, Rock Island Lines, Horton, Kan.

Method of Forming Tools with Cutting Portion Renewed from Time to Time. Roughing, Finishing, Side Tool and Parting Tool Methods Explained and Illustrated

A method of applying high speed steel tips or points to soft steel shanks for roughing, finishing, side and parting tools for lathes, planers, sharpers, tire turning machines, etc., is in use at the Horton, Kan., shops of the Rock Island lines.

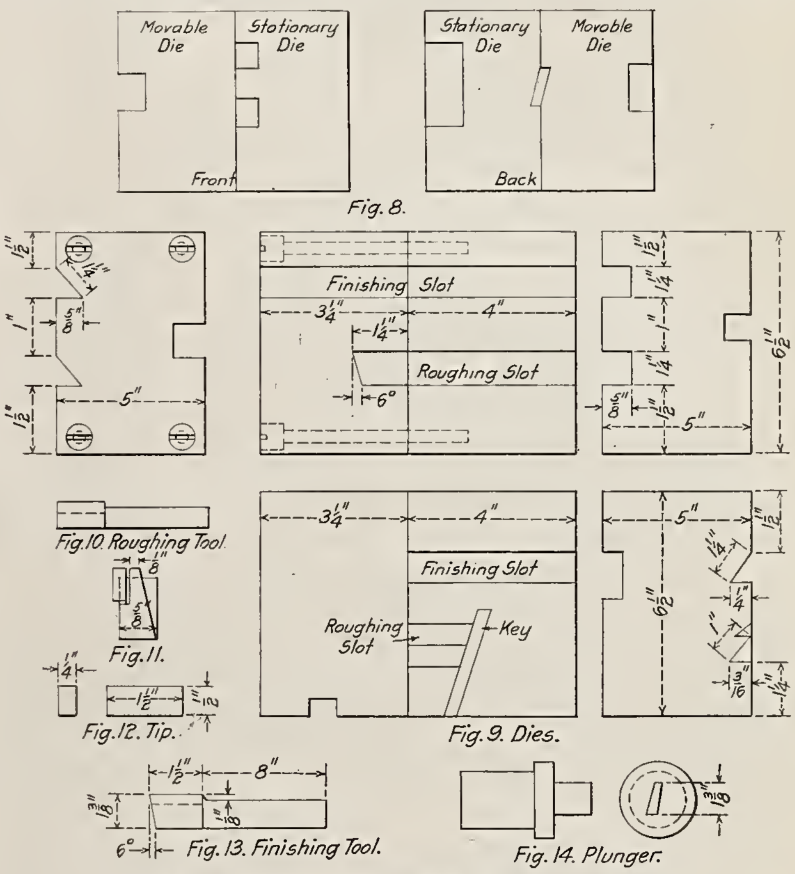
Fig. 1 shows a finished tool. Fig. 2 shows the slugs punched hot from high-speed steel, varying in size from ⅜ to ⅞ in. in thickness, according to the size of the tool to be made. Fig. 3 shows punch used for this operation. The size shown in the drawing is for a roughing tool ⅝ x 1¼ ins. Other tools of different size are made on the same plan. The punch shown in Fig. 3 and die shown in Fig. 4 are used on the punch press. Attention is called to the manner of making the shear-



Figs. 1 to 7. Pointing Steel Tools

ing edge of the punch whereby a small fin is formed and later used in holding the slug in place during welding. However, hundreds of tools have been made without the fin, the operation being merely drawing out the high speed steel to proper width and thickness, then knicking and breaking off and applying.

Soft steel shanks, Fig. 5, are tapered about the shape of high speed steel tips. They are then heated to a white heat in an oil furnace. They are covered with welding compound, the high speed steel tip is applied cold, with a light blow from a hand hammer, then re-



Figs. 8 to 14. Dies and Plunger Used

turned to the oil furnace and heated to the welding point, inserted in an Ajax forging machine, in dies as shown in Fig. 6. One revolution of the machine completes the work and forms the tool. Fig. 7 shows the plunger which is used after the tool is placed in the die.

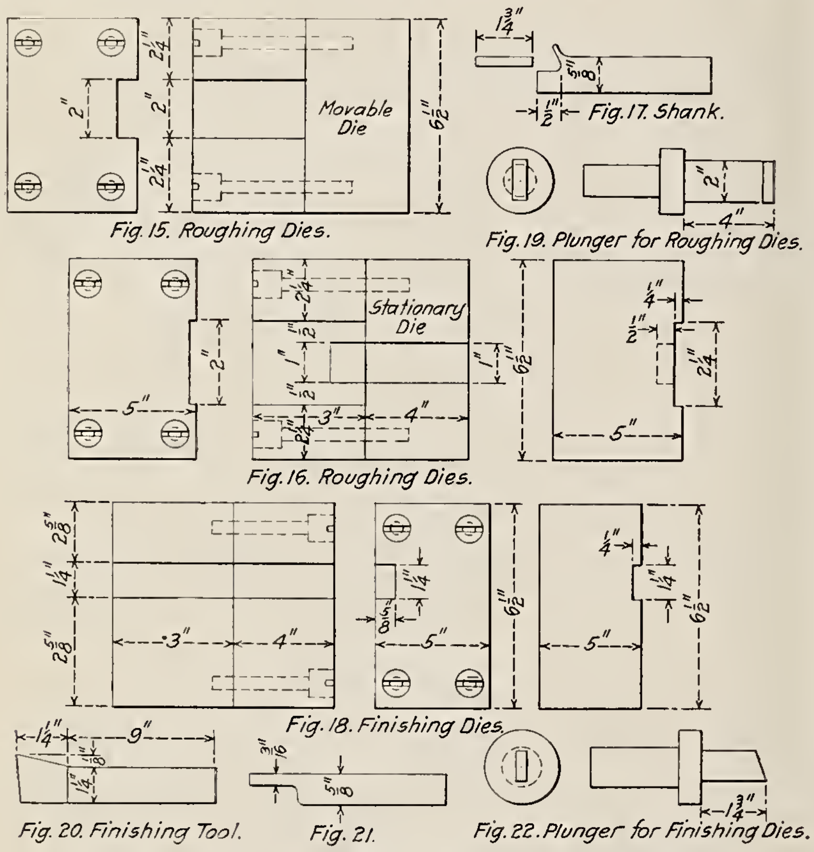
In the side tool method the soft steel shank is first forged to the size of a tool; it is next heated to a white heat, then inserted into dies, Figs. 8 and 9, marked roughing slot, thus forming the tool in the shape shown in Figs. 10 and 11. The welding compound is next placed upon the tool where the tip is to be placed, and tip is next added, Fig. 12. The tool is then returned to the oil furnace, where it is heated to a welding heat, then inserted into dies, Figs. 8 and 9, in the finishing

No. of tool= No. on tracing.	Size of tool.	Weight —in pounds.	Cost— forging shank.	Weight of tip— ounces.	Cost H. S. steel at .64,	Cost forging tip.	Cost forging point.	Welding and Temper-ing.	Scrap axle, at 1¼c. lb.	Overhead charge.	Total— new tool.	Labor only.	Labor to re-dress.
1	1½x2⅜	17.	.255	9.	.36	.015	.015	.06	.2175	.345	1.2675	.345	.09
2	1 x2	8.5	.15	5.	.20	.01	.0125	.055	.1275	.2275	.835	.2275	.07¾
3	¾x1½	3.5	.07	2.	.08	.01	.01	.05	.0425	.14	.4025	.14	.07
4	¾x1½	3.5	.07	2.	.08	.01	.01	.05	.0425	.14	.4025	.14	.07
5	⅝x1¼	2.25	.0475	1.5	.065	.01	.01	.045	.0275	.1125	.3175	.1125	.065
6	1 x1	2.25	.0475	1.7	.07	.01	.01	.045	.0275	.1125	.3225	.1125	.065
7	1 x1	2.25	.0475	1.7	.07	.01	.01	.045	.0275	.1125	.3225	.1125	.065
8	¾x1	2.5	.0625	2.	.08	..	.01	.045	.03	.1175	.3475	.1175	.055
9	⅝x1¼	2.25	.0475	1.5	.06	..	.01	.04	.0275	.0975	.2825	.0975	.05
10	⅝x1¼	2.25	.0475	3.5	.14	..	.015	.045	.0275	.1075	.3825	.1075	.06

slot, and one revolution of the machine completes the tool as in Fig. 13.

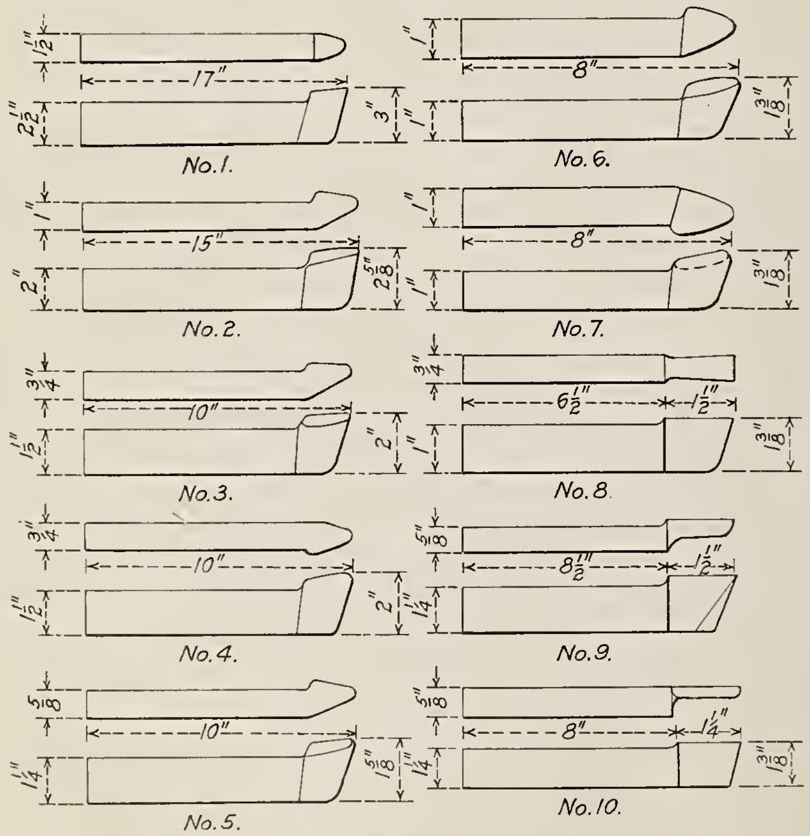
The plunger, Fig. 14, forms the end of the tool, making it more nearly the correct shape of the tool. The key in die, Fig. 8, is placed in there so as to form a square and a more perfect edge on the end.

The parting tool dies and method is similar in treatment to the others. The soft steel shank is first heated



Figs. 15 to 22. Finishing Dies and Plunger

and then inserted in the roughing dies, Figs. 15 and 16, which makes the shank into a form which is shown in Fig. 17. A welding compound is then added and the high-speed steel tip is next applied, and the tip is knocked down as shown in Fig. 17. It is then heated to



Nos. 1 to 10. Various Styles of Tools

a welding heat and put into the finishing die, Fig. 18, and with a revolution of the machine the tool is completed.

After the tools are taken from the forging machine they are thrust into a tank having about 6 to 8 ins. of oil on top of water, with the soft steel shank in the water and high speed steel tip in the oil. This tank is made with a drain to draw off hot water while cold water is running in at the bottom, thus keeping oil and water cool.

If a tool should be a little too cool for tempering or hardening when taken from the forging machine it should be reheated and then inserted in the tank. Any flashes that are found thereon are knocked off when cold. After grinding the tools are ready for use.

By making these tools this way there are several advantages. By using the forging machine the work is done more economically, particularily when the tools are made in large quantities. The intense pressure of the forging machine results in a very dense, close-grained tool being formed. And again the forging machine method produces a better weld and a more uniform shaped tool, and it is superior to the hand-made tool.

These tools have stood the most severe tests in the Rock Island shops at Horton, Kan. These dies are made of scrap driving axles, and the plungers are made from scrap tires. The making of the dies and the handling of the tools is done by Harry Harris, blacksmith foreman at the Rock Island shops at Horton, Kan.

Evolution of the Wedge Type Packing

Discussion of Effective and Non-effective Areas in Packing. The Importance of Closing Components. The Utility of the Wedge

The efficiency of any metallic piston-rod packing depends upon the kind of metal used and on the design of the packing. The ideal packing metal should have anti-friction qualities and should be sufficiently malleable to deform itself readily and thereby continue to constantly make a steam-tight fit on the piston-rod, as wear takes place. It should have sufficient tensile strength not to break during this process and should have a sufficiently high melting point to withstand the temperatures to which it may be subjected.

In design, metallic piston-rod packings may be divided into two general classes. First, those with a wedge-shaped cross-section, in which spring pressure and the steam pressure tend to force the packing rings into a cone-shaped cup, thereby closing the packing tightly on the rod; and second, those of square-shaped cross-section, in which a circumferential or tangential spring tension, in addition to the steam pressure, closes the packing on the rod.

In the first mentioned case the amount of closing effort depends on the angularity of the cone, the angularity of the individual rings and the intensity of the spring and the steam pressures. By angularity, as here used, the slope of the rod-packing where it enters the vibrating cup is meant. This slope, whether great or small, is the main reason why this type of packing is effective. The packing ring, when pushed into the vibrating cup, being beveled or wedge-shaped, causes a pressure to be exerted on the rod. Mathematicians would speak of this as the vertical component of the horizontal pressure of spring and steam.

The effort of spring and steam is to push the packing along the rod, and this is opposed by the vibrating cup. Using what is called the "parallelogram of forces," the horizontal push of spring and steam may be "resolved" into a force acting up and down, or at right angles, to the length of the rod and also a force approximately parallel to the rod. These two "resolved" forces, together balance the horizontal thrust resulting from spring and steam. That portion of the spring and steam force which bears vertically on the rod is the only effective force for keeping the rod steam-tight. The other is here practically thrown away.

The metal used must be capable of grasping, but not seizing, the rod, and it must also have the ability to "flow," that is, it must maintain its grasp of the rod, sustain or take up wear and still keep tight. It is quite possible to make packing tight at first, but it may not remain so when the effects of wear become pronounced. The latch of a door may be tight when it is new. It has the regulation wedge-shape, but as it has no ability to take up wear the latch eventually becomes loose, and allows the door to rattle.

Looking at our illustration Fig. 1, it will be seen that the packing has a single closing component. In this figure the portion of the packing within the vibrating-cup is wedge-shaped and the contour of the back end of the packing is a quadrant, with its centre on the piston-rod surface. The vibrating-cup is the closing agent, and the packing outside the vibrating cup is not acted upon in any way tending to close it on the rod. If the back end of the packing was flat, that is, 90 degs. to the longitudinal axis of the piston-rod, there would still be only one closing component. It is immaterial whether the packing is made in two or three or more individual flat rings. The angular face of the vibrating-cup projected down on the rod is readily seen to be the total bearing A. B. C. of the packing on the rod. Only the portion A. B. is actually performing the work of "packing" the rod, the portion B. C. does not help to secure a close steam-tight fit.

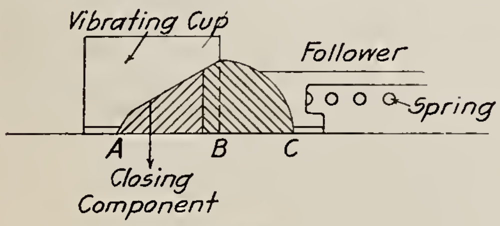


Fig. 1

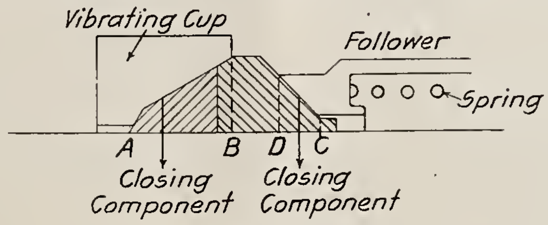


Fig. 2

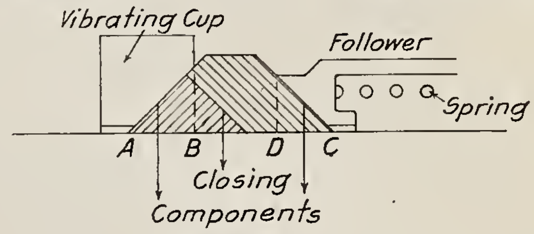


Fig. 3

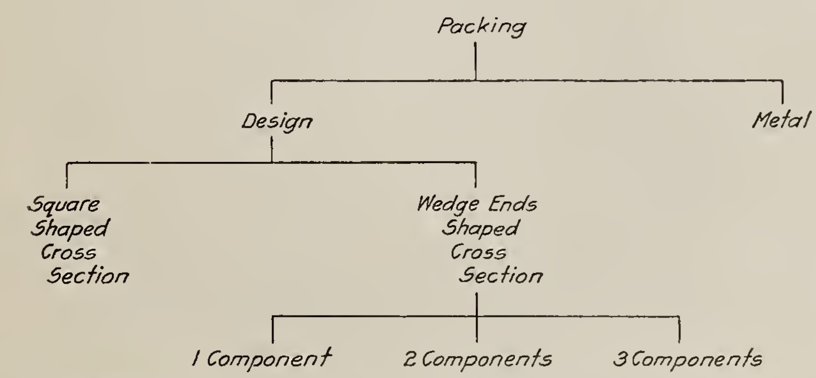


Diagram Showing Elements in Metallic Packing Design

In Fig. 2 the back end of the packing has been beveled off to give this portion a closing component. This form of packing has now two closing components and the effective bearing of the packing on the rod has been increased by the addition D. C., so that the total effective bearing is A. B. plus D. C., with a non-effective bearing B. D., on the rod.

In Fig. 3 the angularity of the cone-shaped or triangular packing-ring has been changed from 90 degs. to the longitudinal axis of the piston-rod, to 45 degs. This produces a third closing component, which bridges over the non-effective bearing B. D. of the packing rings on the rod, as in Fig. 2. In Fig. 3 the entire bearing of the packing on the rod becomes effective and the aggregate closing effect of the packing is better distributed than is possible with other designs of wedge-shaped packing. The actual results accomplished are that a lighter spring may be used and a more uniform closing component is obtained, which has less intensity per unit of area of bearing. Both of these conditions tend to lessen the inevitable wear of the packing and the rod.

An illustrative diagram, Fig. 4, exhibits the packing as the starting point. It has two qualities, design and metal. Supposing the metal to be all that is desired, the design branches into those rings which have square cross-sections, and those which have wedge-shaped sections. The wedge-shaped group may have one, two or three closing components, according to the number and bevel of the rings. In this simple analysis of packing rings of the wedge type it becomes evident that the vertical component of spring and steam pressure is the really effective factor. The horizontal thrust of spring and steam must be here ignored as producing no "packing" effect, and the greater the vertical component can reasonably be made, the better it is, as any increase in it reduces the non-effective work of spring and steam.

The more extended the bearing area of the rings, which follows as a consequence on an increase of the closing components, reduces the amount of wear on any one piece in a given time. The closer the packing can be made to encircle the rod, with a reduction of spring pressure, has the practical effect of putting off the day of trouble, when the packing must be renewed, and if, during this time of successful service, the packing remains tight, one may say the packing has given good service and that it owes us nothing. The metallic piston-rod packing, in common with every other mechanical device used on locomotives, is like a strong fort, not intended to be everlasting or to permanently resist continuous and long-continued assault, but to stand a seige for a considerable time, or hold out until relief comes. To work a thing effectively and delay renewal is one of the secrets of good design.

Specializing Enginehouse Work

Many people writing on enginehouse subjects lay stress on the value of having specialists for the different classes of work in the enginehouse. There can be little doubt as to the value of organizing an enginehouse force in this way, particularly if the terminal is a large one. The man or gang of men who attend to, say, nothing but electric headlight repairs, soon become expert in the determination of what is wrong with this equipment and what should be done to remedy it. Air brake work has long been specialized and it is probable that the desirability or even necessity of having experts in air brake work led to the extension of the practice as terminals increased in size and the locomotive became more complicated. One class of work that should be taken care of by specialists, where possible, is the reducing and fitting of main rod brasses. If this work is assigned to men who do nothing else, except in cases of emergency, they become so apt at the job that it will be found that trouble from heating at either end of the rod will be greatly reduced, if it is not entirely eliminated. While the practice of specializing the work is not so readily carried out in the small enginehouse, it is possible even there to obtain very satisfactory results by assigning to one man two or three lines of work that are closely allied.

New Trade Literature and Appliances

The National Machinery Co.

Tiffin, O., have recently issued National Forging Machine Talk No. 9, describing a new design for grip slide alignment by which the weight of the gripping slide in their forging machines is carried by bearings above the scale and water-line. By this construction the slides are not subject to excessive wear and sagging and consequent development of "fins" are eliminated.

Westinghouse, Church Kerr & Co.

37 Wall street, New York City, have recently issued a 16-page illustrated circular tracing the progress of the construction of the new Taylor-Wharton plant at Easton, Pa., consisting of 5 buildings, an office building, pattern shop, a foundry, a blacksmith shop and the main or finishing shop, together with yard facilities, fire protection, water supply, sewers and lighting. The size and completeness of this plant illustrates the wide scope of W. C. K. service.

The Roberts & Schaefer Co.

engineers and contractors, Chicago, have been awarded a contract by the Chicago Great Western Railway Company for a Counterbalanced Bucket Locomotive Coaling Plant at Hayfield, Minn., a duplicate of one recently erected at Red Wing, Minn.

The Ingersoll-Rand Co.

The Ingersoll-Rand Co., of 11 Broadway, New York, N. Y., have recently issued three new bulletins. The first is Form 3036, on Turbo Blowers. These blowers are suitable for any air service where the capacity requirements range from 3,000 to 35,000 cu. ft. of free air per minute at pressures of 1 to 2½ lbs., and are particularly adapted to such work as foundry cupola blowing; atomizing oil for oil burners; supplying blast to various kinds of heating and annealing furnaces; blowing air for water gas generators; pneumatic conveying systems and for ventilating purposes.

Form 3029 describes the "Ingersoll-Rogler" class "ORC" Corliss steam-driven air compressors of the familiar duplex type, with the steam cylinders next to the frames and separated from the air cylinders by open distance pieces. This type of machine is offered in four different combinations of cylinders. Catalogue gives sizes and capacities.

Form 4120 describes the Leyner-Ingersoll water drills, both the No. 18 and No. 26 type. Catalogue explains the construction in detail and illustrates the different types, including numerous installation views. Copies of these bulletins free on request to the nearest branch office.

Acme Supply Co.

The Acme Supply Co., of Chicago, announce the appointment of Mr. Franklin M. Nicholl as sales representative, with office at the general sales office, Steger building, Chicago. Mr. Nicholl has been for the last seven years Eastern and Canadian sales representative for the Dayton Manufacturing Co. Previous to that he was for five years sales representative with the O. M. Edwards Co., and before that he was sales representative for the Curtis truck. Mr. Nicholl has sold railway supplies for twelve years.

Metals Production Equipment Co.

The Quigley Furnace and Foundry Co., of Springfield, Mass., and 105 W. 40th street, New York, has recently added to their business a brass rolling mill department for the production of flat brass. The stockholders decided at the last annual meeting, held in January, to adopt a new and more comprehensive name for the company. The new name is Metals Production Equipment Co. No change has been made in general policy or management. The furnace, foundry and powdered coal departments will be continued as heretofore, and the Quigley Furnace and Foundry Co. hope to continue to serve the public under the new name.

The Searchlight Co.

A folder has recently been issued by the Searchlight Co., of Chicago, in which the difference between what is called dry and wet acetylene is explained. The company set forth the use of dry acetylene in the operation of welding by the oxy-acetylene flame. Searchlight acetylene is the trade name for the dry acetylene handled by this company. Among other things, the folder gives information as to the storage of this material in cylinders.

Quigley Furnace Specialties Co.

Announcement is made that the Quigley Furnace Specialties Co., Inc., of 26 Courtlandt street, New York, N. Y., is the new name of an old concern. The new company of which Mr. W. B. Quigley is president, are doing business by specializing in the fuel and furnace line. Their furnace specialties department manufacture and deal in furnace materials, equipment and appliances for the improvement of furnace construction, operation and methods.

The engineering and contracting department handles comparative statements of operating costs of powdered coal, hand or stoker-fired coal, gas and fuel oil. This department also contracts for industrial furnaces.

National Tube Co.

The April issue of the National Tube Co.'s publication for April deals with autogenous welding of "National" pipe. The word autogenous means self-producing or independent. The systems employed commercially are electric welding; blow-pipe welding; and thermit welding. These may all be classed under the term autogenous. The pages of this issue are devoted to an analysis of the whole process and there are many illustrations to make clear the letter press. The subject matter deals exclusively with the welding of "National" pipe.

Lodge & Shipley Machine Tool Co.

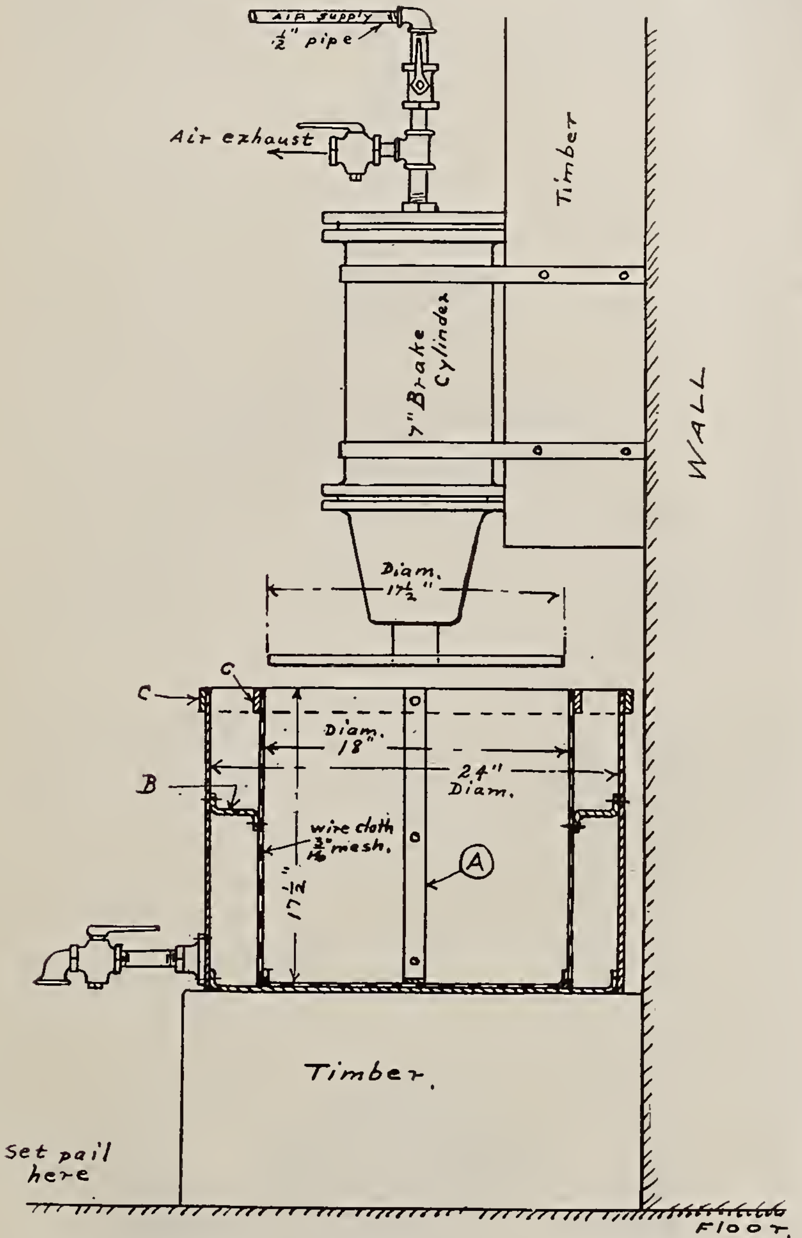
The Lodge & Shipley lathes are the subject of a bulletin issued by the Lodge & Shipley Machine Tool Co., of Cincinnati, O. It is practically a manual for operating these tools and is of standard catalogue size. The erection and oiling of the machines, the accuracy of the work, the "manufacturing" lathe, tool grinding and many other details are the topics to which a few pages, on each, is given in the manual. The company will be happy to send a copy to anyone interested.

Practical Suggestions from Railway Men

Oil Press

By V. T. KROPIDLOWSKI
C. & N. W. Shops, Winona, Minn.

In connection with renovating old journal packing, when the oil-soaked waste is picked over, the short and soggy waste that is considered unfit for another renovating is thrown to one side and afterwards burned up to reclaim whatever babbitt it contains. In so burning the waste there is a loss of oil, which has gone up in the flames instead of preserving journal brasses. We have now made a press, illustrated in the accompanying drawing, whereby we reclaim this oil, by squeezing it out of the waste before burning it. The drawing ought to be self-explanatory, but a few words will help to make it still clearer in the matter of its construction.



OIL PRESS
Arrangement for Squeezing Waste, C. & N. W. Ry.

The outer vessel is made of No. 16 galvanized iron, and the inside one is composed of No. 20 wire cloth, having 3-16 in. mesh and an annular separator marked "B" of No. 16 galvanized iron is riveted to both vessels to keep the inner one rigidly in place. Reinforcing bands "C" of ⅜ x 1¼-in. iron are riveted to each vessel. Two ribs "A" of ¼ x 1 in. iron are riveted to the inside of the inner vessel, being a continuous piece from the top, down one side, across the bottom and up along the other side to the top. These two ribs are at right angles to each other, and act both as reinforcements and as guides for the piston, the ends being chamfered so that the piston has not a chance to engage in them; the rivets holding these ribs are countersunk so the piston cannot strike them.

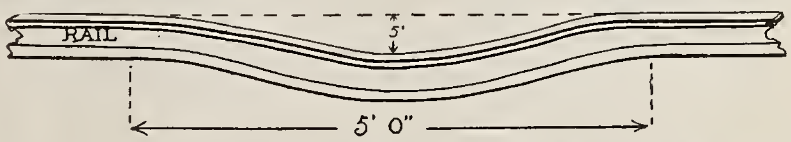
The device is fully worth the cost of construction, as it is not at all expensive, and practically everlasting, and therefore will pay for itself in a short time.

Taking Weight Off Springs

By M. J. McCABE, Machine Foreman Mo. Pac. Ry., Sedalia, Mo.

Putting springs in locomotives without using jacks to take the weight off of springs when engine can be moved by her own steam is an improvement on present methods. No doubt many of the readers of this article have raised engines by running the drivers up on frogs, and thus taking the weight off of the springs, and the device I speak of is along the same lines.

On one of the tracks in the round house make a depression in the rails of about five inches, on an incline both ways from this depression for a distance of five feet, as shown. For example, take a 2-6-0 engine and to remove main spring place main drivers over the depression in the track and block up between top of box and frame, move engine and place front pair in depression, or hole as we term it, block on top of box, move main pair to hole, and the saddle will be down on the frame. If springs have much draw, it may be necessary to put a chain around end of spring and around a spoke of the wheel, moving engine carefully until the gibb is loose.



Depression in Rail for Removing Springs

In most cases it is only necessary to raise one side, but in many cases it is advisable to raise both sides, keeping the engine up level, just as sometimes when raising with jacks, we use one at each end on one side, and sometimes it is advisable to use a jack at each end on both sides. You can remove front or back spring in the same way, and also the truck springs.

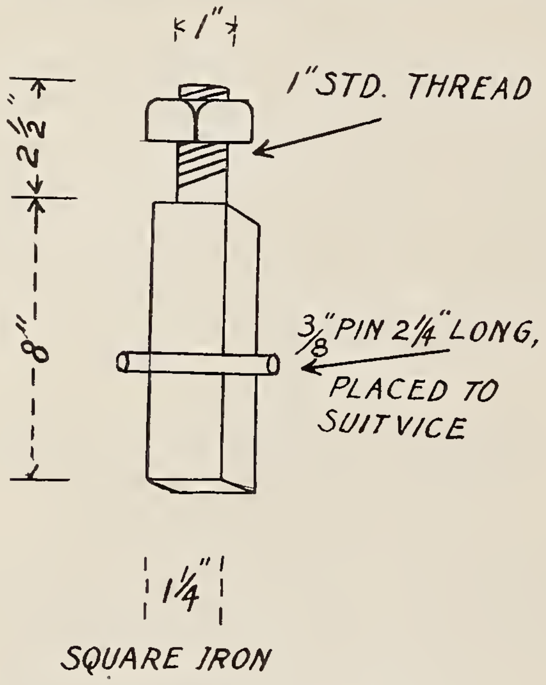
This simple device has been used in the Missouri, Kansas & Texas round house for the past seven years. It can be used on almost every class the M., K. & T. have; the idea was conceived by Mr. G. P. Letts, foreman for twenty years at that point. The writer was employed there for fourteen months as machinist, and found this device very convenient, having changed a spring quite often in from twenty to thirty minutes, counting time for raising and lowering the engine, removing and replacing the spring. The only spring we changed by using jacks were the springs on a four-wheel engine truck.

Scrap nuts and washers are used and in some cases a small wrought plate may be required. If I had charge of a round house I would have one such track.

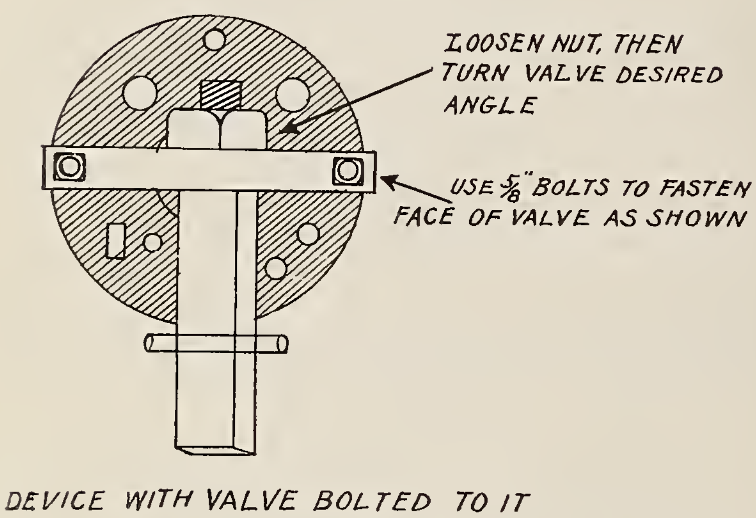
Device for Holding Distributing Valves

By E. H. WOLF
Air Brake Machinist, A. C. L. Waycross, Ga.

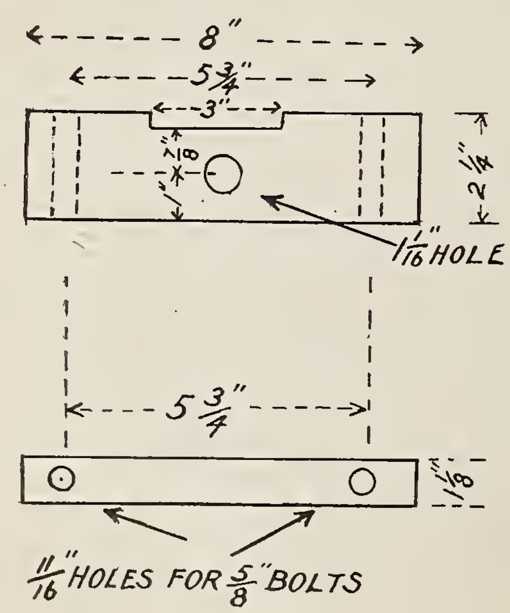
The stop-pin shown rests on top of the vise and the valve is then bolted to its face. By loosening the 1-in. nut the valve can then be swung round so as to get the



Stud for Distributing Valve Holder



Jig for Holding Distributing Valve



Clamps for Jig

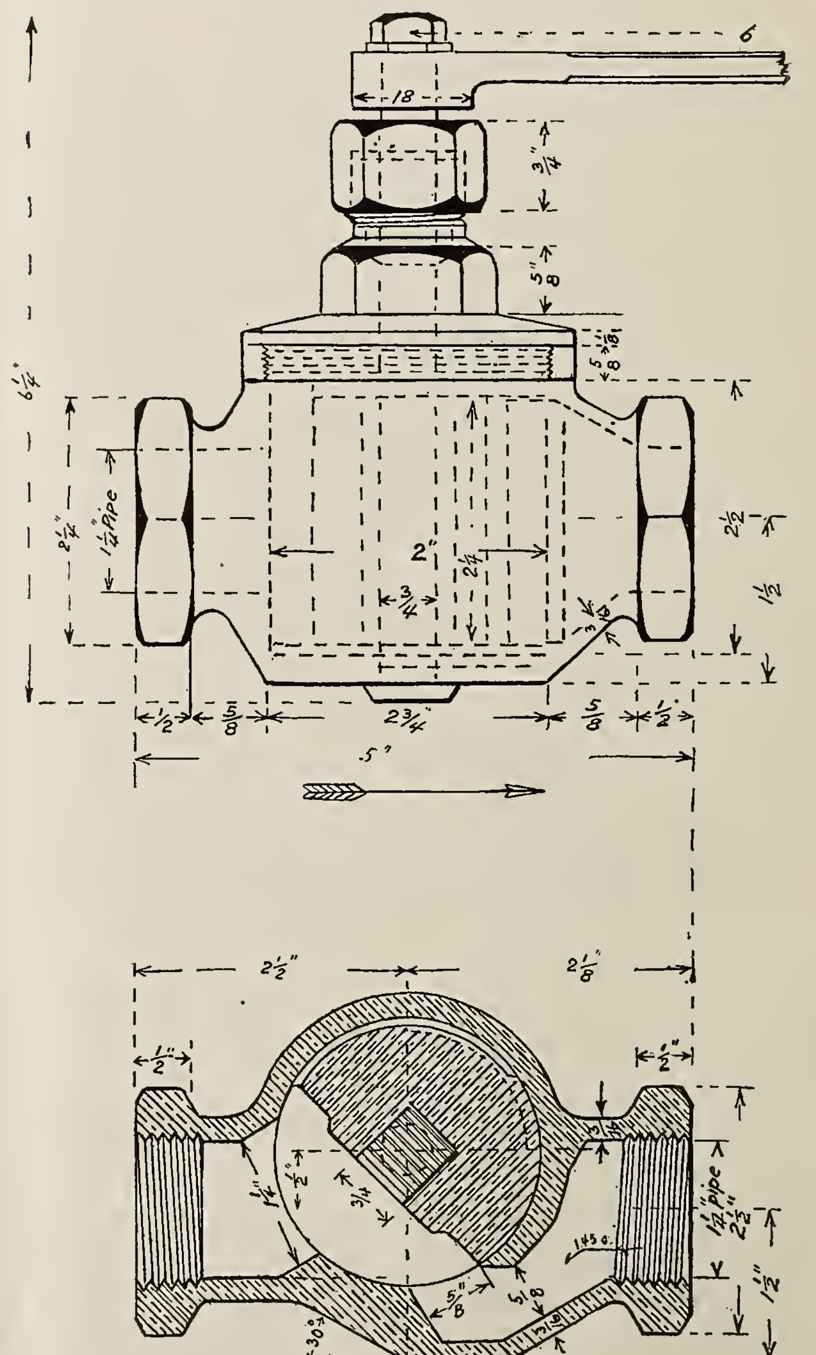
best light on the seats, when grinding or fitting the packing rings. The valves are held firmly by this method and better work will result because the workman can see his work more clearly. This jig can be made of thrown-away pieces of iron and will prove useful in many places where good light is needed in doing this class of work.

Segment Valve

By C. W. SHANE
Erie Railroad, Huntington, Ind.

Attached sketch is of Yergens quick-acting valve, patented by W. F. Yergens, master mechanic on the Erie Railroad at Huntington, Ind.

The Yergens Valves are used for any purpose, such as the conveyance of steam, gas and water, and are used as main valves. The print shows a special valve for steam, and is a quick-acting blower valve, which is applied and operated in the cab, attached to the blower line with lever for engineman and fireman, so from either side a simple and easy movement by hand will open valve quickly. This valve constitutes an improvement, and is maintained more cheaply than other valves, as you note by sketch this valve is simply constructed



Elevation and Plan of Segment Valve

and easily made. It has a segment valve which opens a port at 45 degs.; it has two working parts, one a shaft, the other a segment valve which continuously forms its own seat.

Among all these valves that have been installed not one has had to be removed for repairs, and some of them have been continuously in service for eight months.

Personal Items for Railroad Men

Mr. W. E. Belter has recently become assistant superintendent of locomotive performance on the St. Louis & San Francisco, with headquarters at Oklahoma, Okla. Beginning as a fireman, he had four years on that work and was twelve years employed as a locomotive engineer. He succeeds Mr. Bates, transferred to other territory in the same service.

Mr. N. B. Corbett has been appointed shop superintendent at Denison, Tex., on the Missouri, Kansas & Texas Railway. On December 1, 1915, he was transferred from roundhouse foreman at Denison, Tex., to general foreman at Smithville, Tex., and recently he suceeded Mr. B. C. Nicholson, assigned to other duties.

Mr. Herbert R. Craswell, Jr., has been appointed locomotive foreman on the Great Northern at Sioux City, Ia. He has been employed by the Great Northern Railway for almost thirteen years, starting as an apprentice machinist on June 1, 1903, at Sioux City, Ia., and has been employed at this point ever since. His predecessor, Mr. Herbert R. Craswell, Sr., was promoted to the position of master mechanic on the same road, with headquarters at Sioux City, Ia.

Mr. Oscar Culbreth has been appointed and is to assume the duties of road foreman of engines for the entire Cairo division of the Cleveland, Cincinnati, Chicago & St. Louis Railway, with headquarters at Mt. Carmel, Ill.

Mr. M. A. Gleeson has been appointed general foreman on the B. & O. at Grafton, W. Va. He entered railroad service April 1, 1902, as machinist apprentice on the Baltimore & Ohio Railroad at Piedmont, W. Va. Served four years' apprenticeship and was out April 1, 1906. He then worked as machinist at Piedmont, and later at Keyser, W. Va., to which point the shops were moved, until September 1, 1914, at which time he was appointed day engine house foreman at M. & K. Junction, W. Va. He served in that capacity until February 1, 1916, at which time he was transferred to Grafton, W. Va., Monongah division of the Baltimore & Ohio Railroad, to fill a vacancy caused by the promotion of Mr. M. E. Mullen, transferred to Brunswick, Md., as assistant master mechanic.

Mr. E. H. Hall has been appointed general car inspector on the Chicago Great Western at Oelwein, Ia. Prior to his present appointment he was in the service of the Chicago & Alton as traveling car foreman, with headquarters at Bloomington, Ill., for the past four years. He was also in the service of the Santa Fe at Albuquerque, N. M., as head car inspector, for two years, and prior to that time was assistant chief joint car inspector at St. Louis for the American Association of Railroad Superintendents for two and one-half years, and six years prior to this he was in the employ of the Terminal Railroad Association of St. Louis as car repairer, then inspector, and later was promoted to assistant M. C. B. clerk in the office of superintendent of car department. He succeeds Mr. T. M. Baughan, resigned on account of ill health.

Mr. H. P. Hass recently received the appointment of engineer of tests on the New York, New Haven & Hartford Railroad, with headquarters at New Haven, Conn. He was born at Newport, R. I., March 6, 1885; graduated from the Sheffield Scientific School of Yale University in 1907, having completed the course in mechanical engineering. Since graduation he has been in the employ of the New Haven Railroad, beginning by entering the railroad shops at New Haven July 1, 1907, as a special apprentice. Later he became connected with the department of tests as a material inspector, August 1, 1909, and was appointed chief inspector, department of tests, November 1, 1911. He was lately appointed engineer of tests. Mr. E. H. Raquet, his predecessor, left the service of the railroad company to enter that of the Lundin Co., New York, N. Y.

Mr. J. A. Hutchins has recently been appointed general foreman on the Southern Railway at Winston-Salem, N. C. He was first employed in railroad service with the Southern Railway Co. at Spencer, N. C., on April 3, 1908, leaving there on August 1, 1910, to accept a position as machinist with the Central of Georgia Railway at Macon, Ga. He later left Macon on September 1, 1910, and returned to Spencer, N. C., with the Southern Railway as machinist, at which place he remained until promoted as general foreman at Winston-Salem, N. C. His predecessor was Mr. W. J. Murrian, who resigned his position with the Southern Railway Co. to accept a position with the Interstate Railway Co. at Stonega, Va.

Mr. W. E. James has recently been appointed general traveling fireman and assistant traveling engineer on the Denver & Rio Grande at Grand Junction, Col. He entered the service as fire cleaner for the D. & R. G. at Tucker, Utah, in February, 1907, and was later promoted to the position of locomotive fireman, September, 1907; then promoted to the position of locomotive engineer, September, 1911; and in October, 1912, he was made traveling fireman of D. & R. G. system (new office), holding this position up to November, 1915. He was then appointed to the position of general traveling fireman and assistant traveling engineer for the system.

Mr. M. Jefferson, who has been assistant master mechanic of the New Jersey and Lehigh division on the Lehigh Valley Railroad at Easton, Pa., has been promoted to the position of master mechanic, vacated by Mr. T. Lewis' promotion.

Mr. Harvey Jeffrey has recently returned to his former position as car foreman on the Great Northern at Grand Forks, Dak. He had been appointed valuation inspector July 1, 1915, and went back to the car department February 22, 1916, having completed the valuation with the I. C. C. inspector and the taking of an inventory of the rolling stock for the road.

Mr. John Jacob Kelker has been appointed superintendent of shops on the Oregon Short Line Railroad, with headquarters at Pocatello, Ida. He was born at Effingham, Ill., July 21, 1874. From July 21, 1891, to

May 30, 1903, he was machinist apprentice, machinist, machine shop, roundhouse and general foreman D. & R. G. at Pueblo, Col.; from June 1, 1903, to February 1, 1904, he was utility foreman C., R. I. & P. at Horton, Kan.; from February 10, 1904, to March 10, 1905, he was general foreman D. & R. G. at Salida, Col.; from March 16, 1905, to October 14, 1909, he held the position of assistant master mechanic and superintendent of shops C. H. & D. at Lima, O.; from October 20, 1909, to March 2, 1911, he was assistant master mechanic D. & R. G. at Salt Lake City, Utah; and from March 5, 1911, to March 15, 1916, he was master mechanic Southern Pacific Co., Oakland, Cal. His predecessor was Mr. E. E. Crysha, who has left the service.

Mr. Thomas Lewis, master mechanic of the Auburn division on the Lehigh Valley Railroad, with headquarters at Auburn, N. Y., has been appointed general boiler inspector for the system, with headquarters at Sayre, Pa.

Mr. J. H. Lynch has been appointed road foreman of engines on the Chattanooga, New Orleans & Texas Pacific, with jurisdiction on the second and third districts, which lie between Danville, Ky., and Chattanooga, Tenn. He was born January 13, 1883, at Sherwood, Tenn. At the age of 15 he began service on the N., C. & St. L. Ry. as fireman helper on the "pushers" used on Cumberland mountain between Sherwood and Cowan, Tenn. After three years of service there, he resigned and went to the Southern Railway at Knoxville, Tenn., and was employed as switchman. Later he was promoted to yard conductor. After one and one-half years in yard service, he was transferred to the road again, and began firing June, 1902. He was promoted to engineer in 1905, continuing as such until July, 1905. Resigned and came to C., N. O. & T. P. Ry. and entered the service as fireman in November, 1905. In January, 1906, he was promoted to engineer; continued in that capacity until December 25, 1915, when he was appointed as road foreman of enginemen. He succeeds Mr. J. W. Heath, transferred.

Mr. G. C. McGill has recently been appointed general foreman, car department, on the San Antonio, Uvalde & Gulf Railroad, with headquarters at North Pleasanton, Tex., his predecessor, Mr. J. H. Macha, having died. Mr. McGill has held a number of railroad positions previous to his present promotion. Car foreman on the Great Northern, general car foreman Fort Dodge, Des Moines & Southern, also a similar position on the C. C., C. & St. L. in their Union station in Des Moines.

Mr. W. J. Murrian has been appointed master mechanic on the Interstate Railroad, with headquarters at Stonega, Va. On July 1, 1907, he began railroad work, with an apprenticeship as machinist, and he served at this work for four years, ending July 1, 1911. From July 1, 1911, until September 5, 1913, Mr. Murrian worked as machinist and inspector of new engines for the Southern Railway. September 5, 1913, he was promoted to be night roundhouse foreman at Citico, Tenn., and served in this capacity until December 20, 1915. He was then promoted to general foreman at Winston-Salem, N. C. He resigned this position March 1, 1916, to accept his present position as master mechanic with the Interstate Railroad Co. He succeeded Mr. A. E. Fisher, who had been looking after the Interstate Railroad Co.'s interest jointly with the Stonega Coke and Coal Co. Mr. A. E. Fisher continues as master mechanic for the Stonega Coke and Coal Co.

Mr. E. A. Pettit has been appointed general foreman on the New York Central lines at Elkhart, Ind. He began railroad work as a machinist apprentice July 14, 1892, at the Lake Shore & Michigan Southern Railway shops at Elkhart, Ind., and completed his apprenticeship July 1, 1896. Since then he has worked as journeyman, until December, 1904, at which time he was promoted to be assistant foreman of the erecting side. Then promoted to the position of foreman of the erecting side October 22, 1906, and later appointed to his present position of general foreman. He succeeds Mr. H. E. Warner, now transferred to superintendent of shops, Elkhart, Ind.

Mr. John Poffel has been appointed locomotive foreman on the Great Northern Railway at Melrose, Minn. From 1891 to 1902 he worked as machinist at Willmar, Minn., for the Great Northern; from 1903 to 1906 he performed the duties of houndhouse foreman at Melrose, Minn., and from 1907 to 1908 was locomotive foreman at Breckinridge, Minn.; from 1908 to 1916 he was night locomotive foreman at St. Paul, Minn., until appointed locomotive foreman at Melrose.

Mr. Carl Scholz has been appointed manager of the mining and fuel department of the Chicago, Rock Island & Pacific, with headquarters at Chicago, Ill. He will report to the chief operating officer. He will have charge of all mining operations and the purchase, handling and use of company fuel.

Mr. M. C. Smith has been appointed master mechanic by the Oregon-Washington Railroad & Navigation Co., with headquarters at Walla Walla, Wash. He was appointed master mechanic of the third division of the O.-W. R. R. & N. Co. February 1, 1915, and previously had been with this part of the Harriman system for the last twenty-four years as general foreman, division foreman and master mechanic. There was no master mechanic on this division, as this is a newly established division.

Book Reviews

Coal. By J. F. Cosgrove. Published by the Technical Book Publishing Company, Philadelphia, Pa. Price, $3.00.

The object of this work on coal is to teach a man to know about coal, and to know how to apply the laws of combustion to the actual burning of coal. It teaches the fundamental differences in the various kinds of coals that are found throughout America, and how to handle each kind of coal so as to burn it efficiently and smokelessly.

The coals of the country vary greatly, consequently the proper method of burning the different coals must vary also. It is obvious that the grate, firebox, and draft proportions and arrangements must be suitable for the kind of coal that is burned, and vice versa. If the coal is not suitable, a locomotive cannot develop its rated power. A man who has a thorough working knowledge of coal and of its combustion can make a good showing, whereas the man who is not informed may often have to accept blame.

A man should know how best to burn the various kinds of coal. Also he should have a knowledge of how and why clinkers form and a knowledge of what causes smoke and how to prevent it or how to reduce the amount produced. If conditions are such that smoke cannot be prevented, a well-informed man can defend himself if called up for smoke violations.

Every traveling engineer, traveling fireman, roundhouse foreman, and master mechanic must know something about coal. The greater their knowledge on this subject, the greater their success may be.