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WESTINGHOUSE AND ELECTRIC TRACTION

The recent death of George Westinghouse removed from the world a personality which has indirectly but powerfully affected the progress of electric traction. The history of the Westinghouse Electric & Manufacturing Company exhibits the application of the principles which he impressed upon it when the company's operations were simple and few and when he could personally know what his engineers were doing in technical lines. Electric traction began to command attention at about the same time as the alternating-current transformer and soon after the invention of the incandescent lamp. At that time Mr. Westinghouse had completed his pioneer and monumental work on the air brake and was busily engaged in building up a successful organization to manufacture electric lighting and power apparatus. When this work was finished an extension of the activities of his company into the traction field came as the next logical step. A motor of the then temporarily standard bipolar type was designed in 1890, and a few months later an inclosed motor with four salient poles was developed and successfully marketed. This was followed by one successful type of motor after another, produced to meet the rapidly expanding requirements of the field. In all of this work the characteristic feature has been the Westinghouse pioneer spirit, and this has been true even in those lines in which the founder was not primarily interested. Just as the transformer, the induction motor and many other electrical devices were taken up in incipient form and developed in spite of great obstacles, so in later years the series a.c. motor, the high-voltage d.c. motor, and latest of all the phase converter, have been carried intrepidly through the experimental stage. The company is famous for its ability to commercialize an idea promptly and effectively. In this is reflected the spirit of the pervasive personality who so long dominated the organization.

HEATING NON-BULKHEAD CARS

The present trend in the construction of city cars is to make wider use of the non-bulkhead car. The advantages of this car over one with bulkheads are so pronounced that some companies have even gone to the point of rebuilding platform prepayment cars to the non-bulkhead type. As some operating men believe that such a car is much more difficult to heat, it may be of interest to mention the experience during the very severe weather early this March of a large Eastern city railway which operates both classes of prepayment cars. It was thought that the non-bulkhead cars would require much more heating current, but this belief was easily put to the proof since both types of cars were equipped with exactly the same capacity in heaters. Temperature readings, therefore, were taken at the rear, middle and front of a large number of cars of each type. Much to the surprise of all concerned, the non-bulkhead cars were found to be generally warmer than those with bulkheads. This paradox finds its solution in habits of the motormen and conductors which are contrary to the rules. The motorman nearly always keeps the side exit door partly open, and drafts get into the body of the car because the bulkhead doors are so far behind him that he does not turn around to close them every time some departing passenger leaves them open. In like manner, the conductor, who does not stand on a fully vestibuled platform, likes to keep the rear bulkhead doors open far enough to secure a warm draft from the car. Thus, in practice, such a car may not be as comfortable as a fully vestibuled, non-bulkhead car the doors of which are always closed while it is in motion. Of course, this condition would not be likely to hold on an interurban line where bulkheads are desirable to cut off the drafts inevitable in high-speed operation. It is worth adding that the doors of the non-bulkhead cars on the system mentioned extend slightly below the platform level so that door drafts are excluded even after the cars have been in service for a long time.

THE NEW HAVEN ELECTRIC LOCOMOTIVE SHOPS

The electric locomotive shops for the New York, New Haven & Hartford, which have just been built at Van Nest and are described elsewhere in this issue, are novel not only on account of the size but also on account of the general plan of design. Generally speaking, the arrangement of the main shop building impresses the observer with the idea that it has been designed more along the lines customary for steam locomotive repairs than for the lesser needs of the electrically operated unit. This is evidenced by the longitudinal arrangement of tracks in the erecting shop with 60-ton transverse cranes overhead. Undoubtedly the overhead crane is an invaluable piece of equipment in any modern shop, but the necessity for two cranes of such large capacity for electric locomotives with easily removable cabs and with articulated frames is not readily apparent. On the other hand, it is reasonably safe to say that, no matter what changes in the design of electric locomotives may come up within the next decade, these shops will be prepared to handle them. But one point of marked difference from steam locomotive practice will be noticed in the absence of pits. Only

one of the three longitudinal tracks in the erecting shop is thus equipped, and in this case the pit extends for only about one-third of the total shop length. The advantage of this innovation obviously lies in the fact that a continuous floor is afforded and that the transportation of material and the movements of the workmen transversely with the shop are greatly facilitated. On the other hand, it is difficult to see wherein the electric locomotives can differ from their predecessors in obviating any necessity for going underneath to dissemble and assemble equalizers, binders and brake rigging. In fact, the practical omission of pits can hardly be considered as an obviously satisfactory experiment. In the matter of equipment the shops are remarkably complete, and the arrangement of tools shows that an exceptional degree of thought has been devoted to this important feature. This indication is borne out also by the fact that an unusual number of novel and ingenious labor-saving devices of all kinds have been provided, and the brief descriptions of these are well worthy of perusal by anyone interested in economical maintenance.

This applies also to the design of the pits in the inspection shed. A depth of 5 ft. for inspection pits is certainly a novelty, but the ease with which one can walk through them is ample evidence of the value of the scheme as a time-saver for inspectors, and this innovation is one which appears well worthy of consideration.

MAINTENANCE AND DEPRECIATION

One of the most striking facts apparent to the close observer of electric railway reports is the great variation in maintenance and depreciation charges made by different companies operating under more or less equal conditions. The evil is an old one. As long ago as 1901 T. S. Williams, now president Brooklyn Rapid Transit Company, read a paper before the Street Railway Accountants' Association pointing out the danger of charging ordinary maintenance expenses to capital account, and a modern instance of this practice on a steam railroad recently brought down scathing criticism from the Interstate Commerce Commission. While we recognize these delinquencies and would not be considered as attempting to offer any extenuations for them, yet we believe that part of the past and existing variation is due directly to the confusion among public service commissions, experts and railways as to the best accounting treatment to be used.

Strange as it may seem, on this question and upon the dividing line between "maintenance" and "depreciation" accountants are greatly divided. According to Halford Erickson, of the Wisconsin Railroad Commission, depreciation, defined as a lessening in value, includes maintenance or upkeep as well as the general decrease in value usually termed "depreciation." Others claim that maintenance includes depreciation. Most accounting systems, however, keep these outlays apart, but there is an undesirable variety of practical treatment of the two in view of the popularity of standardization at the present time.

The recently issued tentative Interstate Commerce Commission classification for electric railways provides the usual maintenance expense accounts. Depreciation accounts are also provided in order that carriers who are required by the state authorities to do so may create reserves to meet or reduce the amounts otherwise chargeable to operating expenses or to profit and loss to cover the cost of the property retired. According to the accounting directions, repairs go to the maintenance expense accounts, but if the depreciation account is used, charges for renewals must be excluded from all accounts affected by the depreciation account and must be charged directly to an appropriate reserve which is maintained by the charge to the depreciation account.

The Public Service Commission of Montana understands the depreciation expense account to cover "all expenditures for ordinary repairs, renewals or replacements resulting through wear and tear and incidental casualties, such expenditures being necessary to keep the productive capacity of the plant to its original state of efficiency." Yet this commission orders a depreciation expense account sufficient to set up a depreciation reserve, by a periodic charge in operating expenses, of an amount equal to the total original cost. The practices of the Railroad Commission of Wisconsin and the Public Service Commission of Indiana are similar to that followed by the Montana Commission.

On the other hand, the Board of Public Utility Commissioners of New Jersey and the Public Service Commission of Maryland deduct the amounts charged to the maintenance accounts for repairs from the amount estimated to cover the wear and tear, obsolescence and inadequacy for the period and credit only this difference to the depreciation reserve. The Public Service Commission for the First District of New York makes a similar deduction of actual repairs from the estimated deterioration based on the life of the property, but it goes one step farther in that in the case of assets not capable of satisfactory individualization, such as tracks, all renewals and replacements are considered repairs, so that little depreciation reserve need be carried. In the case of individual structures, a depreciation reserve must be set up sufficient to equal the original cost less salvage at the end of the estimated life. As a final variation, we might mention Mr. Erickson's recent statement that it is quite possible that the best way to deal with the subject is to determine the total cost of both repairs and renewals, set into a reserve the entire amount and charge to the reserve all expenses for repairs as well as renewals.

These examples are sufficient to show the lack of concerted action on the part of public service commissions in accounting for repairs, renewals and replacements—in short, for "maintenance" and "depreciation." We believe that the abstruseness of the subject would be greatly lessened if the accounting technique in regard thereto were standardized. This is a subject which the Accountants' Association could well consider. By taking a definite standpoint on this question that body could do much to clear up the present hazy situation.

GOVERNMENT OWNERSHIP AND OPERATION

Theodore N. Vail's discussion of government ownership and operation in the annual report of the American Telephone & Telegraph Company, referred to elsewhere in this issue, will prove to many the most interesting part, because of its discussion of the advantages and disadvantages of government ownership of public utilities.

Nothing truer can be found than his statement that "government and administration is more or less a game of politics, and while with government operation it may sometimes be possible to have efficiency, it will always be impossible to have economy." Any government report upon government operations that does not disclose wasteful and unscientific methods is rarer than Halley's comet, and while in theory there is no reason why government operation should not be as economical as private operation, in actual performance it is impossible to overcome the effect of the political favoritism, dilatory action and finished mediocrity that exist in our governmental departments. In European countries, where there is a more conservative trend of mind and where even the minor public offices carry with them a certain honor and prestige not only for the holders but also for their families, it has generally been considered that conditions more favorable to successful governmental operation exist. Hence, even more impressive is the statement made by Mr. Vail that nowhere in Europe under governmental operation are the rates so low and the service so good as under the privately operated Bell system in this country.

This fact is highly illuminating in itself, but its importance is further emphasized by the statement that in the foreign countries in question there are two sources of revenue to the governmentally operated companies—the payment of those who use the service and the payment of the deficit of operation out of the general revenue. It is absurd, of course, to use as a criterion of the success of government ownership the part payment made by a citizen as a user of the service and to eliminate the part payment made by him as a taxpayer. The total cost is the determinative element, and if advocates of municipal ownership were to take this into consideration, their use of foreign analogies would be doubly untenable.

The crux of the whole question of government ownership and operation in our country is this, that the narrow margin existing between economy and waste cannot be traversed properly without a responsible organization with individual initiative, watchfulness and permanency of interest. Successful operation requires superior methods, expert executives, heavy responsibility and undisputed directive authority—attributes that cannot be found under governmental ownership in a country where, as James Bryce says, "there are imperfect powers of control over the administrative departments, and the nation does not always know how or where to fix responsibility for misfeasance or neglect, no one acting under the full sense of direct accountability." What, then, would we advocate for this country? Simply governmental regulation. This is not an administrative function, but rather a judicial review, having for its purpose the conservation and protection of the interests of all. Our government is far better qualified to perform this service than that of administration, and we believe that commissions of high standing would be a greater protection to public interests against private exactions than government ownership with its inevitable lack of economy.

RUSH-HOUR FALLACIES

Electric railway managers are so concerned with the handling of the rush-hour traffic that they do not always place a fair value on the importance of midday traffic. If a transportation man is asked what is the proportion between the two kinds of travel, he will be pretty sure to state it in terms of one-way movement. But it is a serious mistake not to remember that, while a rush-hour car is overloaded one way, it is practically empty the other way, while the midday cars usually carry a fairly equal number of passengers in both directions. The reason for this is evident. The rush-hour travel is between home and a fixed place of employment, while midday travelers are agents, house mechanics, shoppers, school children and others, some of whom are traveling in one direction and some in the other. It is likely, then, that the construction of two-way traffic curves would show some really astonishing figures in favor of inter-rush-hour travel.

This question has a most important bearing on the maintenance of good relations with the public. It is not hard to convince a fair-minded man that it is always financially impossible and frequently technically impossible (as in cases of limited track capacity) to have a seat for everybody during the rush hour. But the same excuse cannot be offered for making people stand in the middle of the day when fewer cars are run. In some cities women will postpone their shopping until late in the afternoon since they prefer to return when cars are plentiful instead of waiting a long time for a car which will be crowded anyway. Another good reason for giving adequate service throughout the day is that it reduces the extra list, which in turn will make more and better men available during the peak periods. The platform expense will, of course, be in a larger ratio than during the heavy hours, but the service will be given under conditions which tend to more economical operation and greater safety.

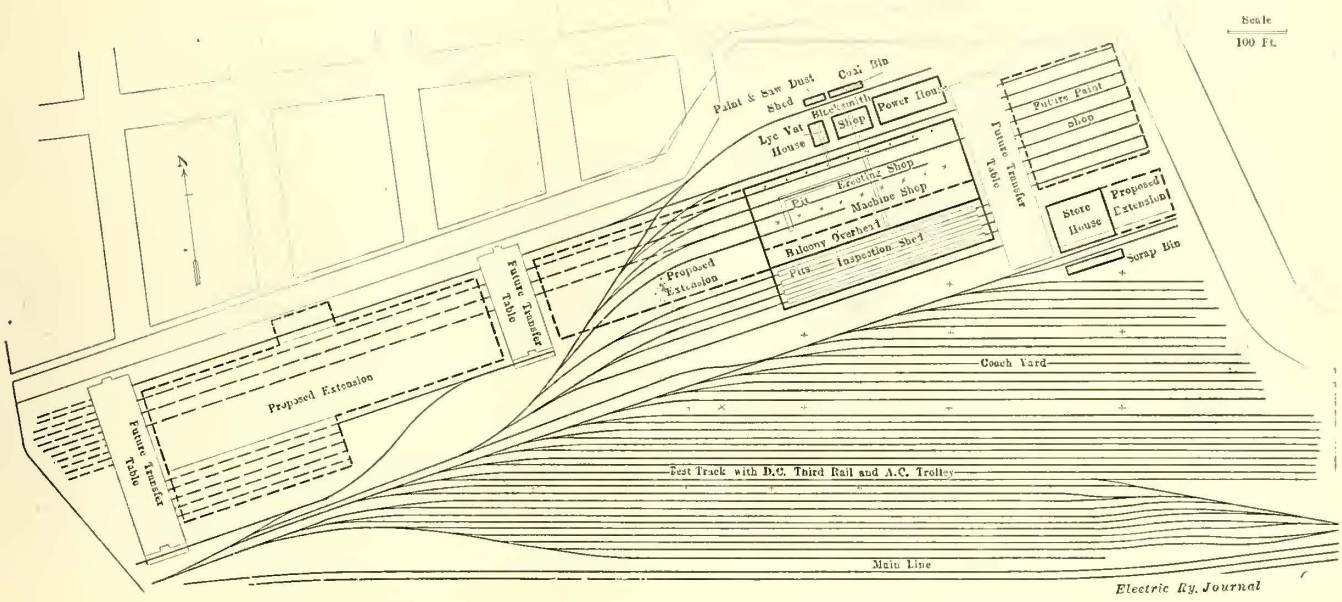
The foregoing remarks are not based on theory but rather on the observation of a line in a large city on which a splendid midday traffic has been built up from small beginnings through a recognition of the principle that such riding is better balanced than rush-hour business and because it has been found that more riding will follow a more frequent service. It is worth emphasizing that this result was obtained in a city of more than 350,000 population, for it is commonly assumed that in communities of such size the distance between business and home is too great to encourage lunch-hour travel in addition to the other sources of traffic.

New Haven Shops—General View of Erecting Shop Bay in Main Building

Electric Locomotive Shops for the New Haven

The Largest Electric Locomotive Shop in the Country Has Just Been Placed in Service by the New York, New Haven & Hartford Railroad Company and a Description of the Arrangement of Buildings and Their Equipment Is Given

Since the installation of single-phase electrification on the New York, New Haven & Hartford Railroad in 1907 all of the repairs to the equipment on the electrified zone extending between New York City and Stamford, till within the last few months, have been made at a small shop in the latter place. With the plans for the extension of the electrified zone to New Haven, however, the necessity for a larger shop became obvious, and a remarkably complete plant has just been constructed at Van Nest, some 4 miles from the New York terminal of the Harlem division at 133d Street and Harlem River. This location was selected for the reason that the Harlem division of the road handles practically all of the freight originating in New York City, and within the next few months, when the electrification is completed to New Haven, a majority of the locomotives will pass the shop on their regular runs. In addition to this, a large number of switch engines are operated in the freight yards along the Harlem division, and their requirements, together with those of the multiple-unit cars for the commuting traffic out of New York, make the location of the shop peculiarly advantageous.



New Haven Shops—General Arrangement of Existing and Future Buildings

The facilities of the original shop at Stamford have been inadequate for several years past, as the extraordinary growth of passenger traffic on the New York, New Haven & Hartford since electrification has exceeded all of the estimates. In fact, the a.c.-d.c. locomotives operating over the present electrified zone and over the tracks of the New York Central to the Grand Central terminal in New York are very heavily overworked, being required to handle trains approximately 390 tons in weight, although they were designed for a load of but 250 tons. The old shop will, of course, be replaced absolutely by the new Van Nest plant for heavy repairs, but it will be continued in use as an inspection shed for engines and multiple-unit cars on the local trains terminating at Stamford.

Although the new shop is just beginning operation, it is already being heavily worked on account of the desire of the management to overhaul spare equipment, such as trucks, driving wheels, motors and the like, so that it may be kept on hand ready to install quickly upon disabled locomotives without involving the necessity for holding the engine out of service. At present the shop has to take care of forty-eight a.c.-d.c. locomotives and fifty-two straight a.c. locomotives. The multiple-unit cars number twenty-seven, of which twenty-one are a.c.-d.c. and six straight a.c.

GENERAL ARRANGEMENT

The shops, as shown in the accompanying line cut, are situated to the north of a large coach yard alongside of the six-track main line. The southern part of this yard is used by the transportation department for a freight yard, but its northern part is to be used as a coach-cleaning yard and storage yard for multiple-unit cars and trailers. In the middle of the freight yard there is to be a test track having standard third-rail charged with direct current at 600 volts and also a New Haven standard overhead a.c. trolley wire carrying 11,000 volts. On this track all locomotives and multiple-unit motor cars will be tested out as soon as they leave the shop, the third-rail being provided so that a.c.-d.c. locomotives and multiple-unit cars which are obliged to run over the tracks of the New York Central Railroad in New York City may have a thorough trying out before being placed in service.

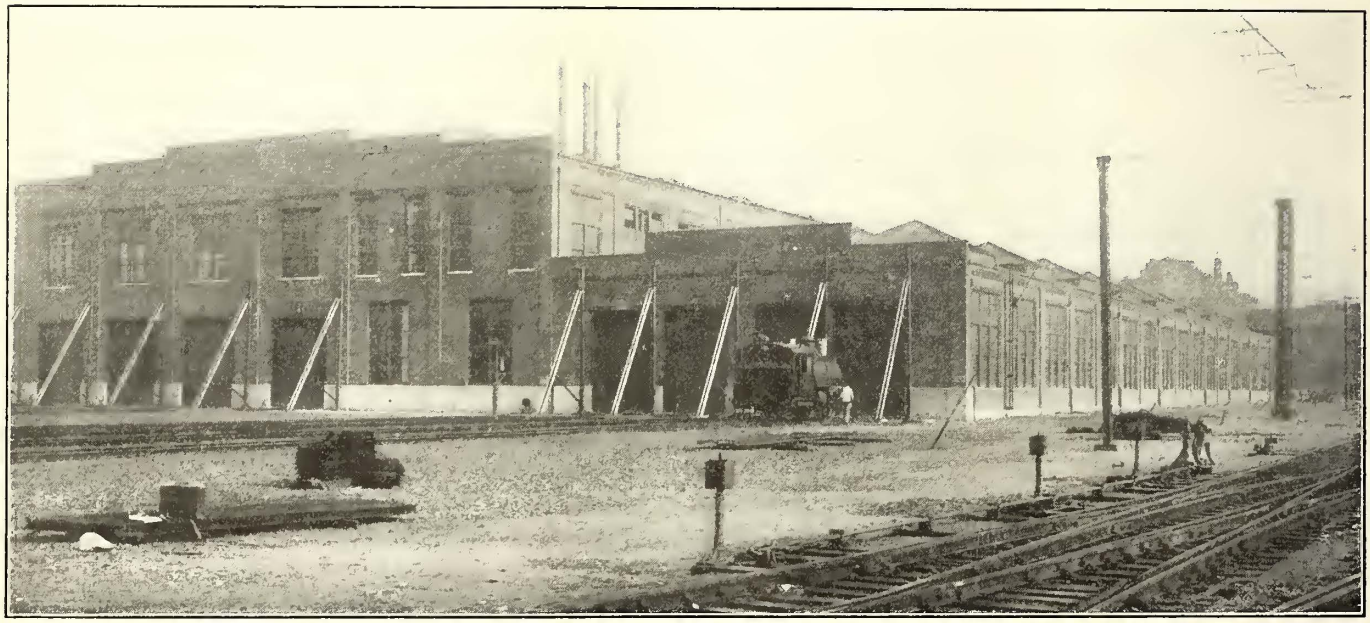
The present buildings consist of a main structure which covers the erecting shop, machine shop and inspection shed; a storehouse at the rear, reached by a track alongside of the coach yard, and, at the side of the main building, a power house, a blacksmith shop and a small structure covering the lye vat. The three last-named buildings contain no inflammable materials and are of strictly fireproof construction, so they are set very close to the main building to reduce work of

transporting pieces of apparatus to and from the latter.

As shown by the lay-out diagram, ample provision has been made for an extension of the present shops when future requirements of the road demand it. The extension that will have the earliest consideration, according to present plans, is the future paint shop shown at the east end of the main building and separated from it by a transfer table. The need for this, however, is dependent largely upon the growth of the commuting traffic on the division. The painting of the locomotives is carried on at present in the erecting shop as no special attempt is made to produce a high finish on the locomotive cabs. The extension of the main shop building will be made toward the west at such time as this may prove necessary, because in this direction the opportunity exists for 100 per cent additional shop space.

All of the buildings are of a characteristically simple style with brick walls and steel roof trusses. Permanent construction has been carried out to a most complete degree, all structures resting on heavy concrete foundations and having concrete floors, except in the blacksmith shop and lye vat house, where cinder floors are laid down. One of the ingenious features in this regard is the fact that the pipe tunnel used for carrying the exhaust steam and return for the heating system of the storehouse from the corner of the inspection shed is made of concrete, and as the trench is comparatively shallow, the top is made flush with the level of the top of the rail and serves as a walk between the storehouse and the main shop building.

The yard outside of the building is, of course, equipped throughout with 11,000-volt single-phase overhead construction. The conductor wires are single and are carried by single overhead cables strung between latticed steel posts in accordance with the New Haven standard construction for slow-speed or switch-yard service. No high-tension wires are taken into any of the buildings, and all switching of dead locomotives and multiple-unit cars is done by a steam switch engine which is kept at all times ready for service in the shop-yard.



New Haven Shops—West End of Main Building with Dead-End Supports for High-Tension Trolley Wires

MAIN SHOP BUILDING

The main shop building is approximately 375 ft. long by 175 ft. wide, exclusive of the inspection shed on its south side. It includes an erecting-shop bay, a heavy-machine-tool bay and a light-machine-tool bay, the latter having a balcony over it for the manufacturing department. There are three longitudinal tracks in the erecting shop which extend practically the entire length of the building, the center one being extended through the east wall to provide connection with the future transfer table in the back of the main building. There is also a longitudinal track in the heavy-machine-tool bay which extends half the length of the building and serves as a repair track for engines that come in for breakdowns or for special repairs. This track, in addition, provides the means for bringing in heavy pieces of apparatus on freight cars so that they can be lifted off and carried to any desired part of machine shop by the overhead crane. Overhead cranes are provided in the erecting-shop bay and in the heavy-machine-tool bay. In the light-machine-tool bay 1½-ton electric hoists are provided, and these run upon a system of I-beam rails hung from the ceiling and provided with switches so that material can be transported to any desired part of the space served. Similar electric hoists are provided in the balcony.

All of the main doors are of the rolling steel type, one of them being provided with small entrance doors for individuals to pass in and out when the main doors are closed. The high-tension conductors, as mentioned above, are stopped off outside of the building, being dead-ended with insulators attached to uprights made of heavy angle-iron not in contact with the building wall.

All of the buildings are heated by the indirect hot-air system, three sets of steam coils with centrifugal fans being provided. The coils take exhaust steam from non-condensing air compressors and auxiliaries in the power house. Lighting is accomplished by numerous 500-watt Mazda lamps in the two main bays and 250-watt Mazda lamps in the balcony and underneath it. No arc lamps are installed anywhere in the shops, but both the artificial and the natural lighting are surprisingly good. Liberal skylight area is provided in the roof.

No shafting is to be seen anywhere in the shop, as all tools are driven by individual induction motors, auto-transformers for starting them being mounted on angle iron stands by each machine. Even the grindstone is run by a small induction motor. Another of the novel features of the shop is the fact that no direct current is used in it, since every motor is of the constant-speed induction type. Speed changes, where required, are effected by mechanical means.

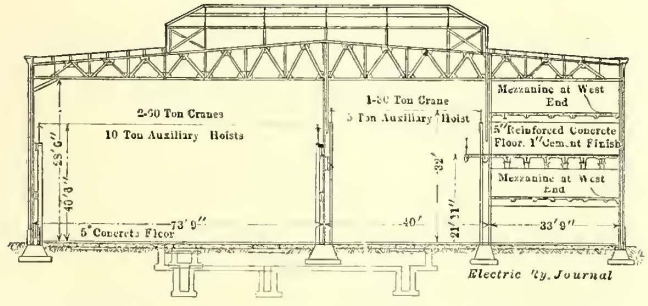
ERECTING SHOP

The three tracks in the erecting shop are served by two 60-ton transverse electric cranes with 10-ton auxiliary hoists on each trolley. Only one of the tracks is equipped with a pit, and in this case the pit only extends for about one-third of the track length. At each one of the building columns and in the pit in the erecting shop, and also in the machine-tool bays, is a male connection for air-hoses and a lighting plug. The couplings on the air-hoses are of novel construction, as they are made with an unusually coarse thread cut back at the outer edge so that dragging on the floor will not hurt it. The couplings are made of cheap malleable iron so that there is no incentive for any one to steal them. The lighting plug is supplied with single-phase current at 110 volts, the connections being made from different legs of the three-phase power line supplying the shop. These plugs also supply power for small portable tools such as electric drills, taping machines and portable commutator slotters.

Two of the erecting-shop tracks are served by a drop pit which extends across the shop and includes the short track in the machine bay, making a total of three tracks furnished with drop-pit facilities. There are hydraulic jacks in the pit at the center of each track. The jacks are operated by high-pressure water supplied by an electric pump from the main floor. This is started whenever pressure is required so that the strain on the hydraulic fittings as well as the use of current is reduced to a minimum. In the pit are three cars equipped with roller bearings which may be pushed along a narrow-gage track in the center of the pit to transfer wheels from under engines, after they have been dropped, to a point between the tracks where they can be picked up by the crane.

The drop pits are used for all wheel repairs not requiring the removal of the cab from the engine, the latter being lifted off only for the purpose of general overhauling. It should be noted that all except one of the New Haven locomotives are equipped with articulated frames so that they have to be picked up at four points longitudinally, each truck being raised as a unit. Therefore it is impossible to lift the engine off its wheels complete as in steam locomotive practice, because the transverse cranes have but one trolley each.

With engines brought in for general overhauling the procedure is, first, to take off the cab and rest it upon horses in another part of the erecting-shop bay. Then the trucks are lifted from the wheels and moved



New Haven Shops—Cross-Section of Main Shop Building

to one side, after which the driving wheels are taken to the driving-wheel lathe for tire turning.

In the erecting shop portable, steel-topped benches are placed along the walls. These have vises at each side and are equipped with lockers formed by wire netting fastened between the cast-iron feet upon which the benches are supported.

The lye vat takes up two-thirds of a separate building just outside of the erecting shop and having dimensions of 43 ft. x 30 ft. It is of concrete waterproofed on the inside. The building connects by a transfer track to the erecting shop so that material may be handled with a minimum of labor between the two points. The lye vat is especially necessary on account of the free use of graphite grease on the gears and bearings of the locomotives and also because of the fact that a considerable amount of carbon dust from the brushes is con-

New Haven Shops—Stub Track in Machine Tool Bay

tinually blowing around. This makes it difficult to clean the various parts of the locomotive and makes the lye vat even more useful than it is in a steam locomotive shop.

The transportation of material for immersion in the lye vat is accomplished by 2-ton storage-battery trucks. In the lye-vat house the various parts are picked up by a single I-beam crane with an air-operated hoist and then they are immersed in the solution of lye, after which they are washed off with cold water. Driving wheels are cleaned by hand outside of the shop building.

In the erecting shop are several of the heavier machine tools especially intended for work that seldom requires handling or else involves but one machine operation. These include driving-wheel lathes, of which one is installed at present with space for a future machine; a large vertical boring mill for tires, wheel centers, etc.; a 600-ton wheel press, and a car-wheel lathe. There as also a novel portable electric riveter for truck work and the light framing of car bodies and cabs. This consists of a frame, such as is used with the ordinary gap-riveter, having a hand-operated rivet set, the two sets being supplied with alternating current of large amperage through a pair of heavy leads. The machine has a bail so that it may be moved by the overhead crane to any desired place in the shop, power being obtained from one of the numerous large-capacity junction boxes and transformed to the desired voltage at the machine. Another desirable novelty in the erecting shop is a portable sand-blast outfit for cleaning parts that are covered with old paint or rust. A large oil filter with a capacity for 275 gal. of oil per day is installed at one side of the shop. This is used for reclaiming motor oil, and it is installed in the erecting shop rather than the inspection shed, because in the latter the bearings are refilled but the oil in them is seldom exchanged for new.

MACHINE SHOP

The machine shop, which as usual is not separated from the erecting shop by a wall, has a heavy-machine-tool bay, served by a 30-ton overhead crane equipped with a 5-ton auxiliary hoist, and a light-machine-tool

New Haven Shops—View of Armature-Winding Department, with Baking Oven at the Rear

bay with a balcony over it. As shown by the accompanying line cut, the two bays are respectively 40 ft. wide and 34 ft. wide, the former extending for the full length of the shop.

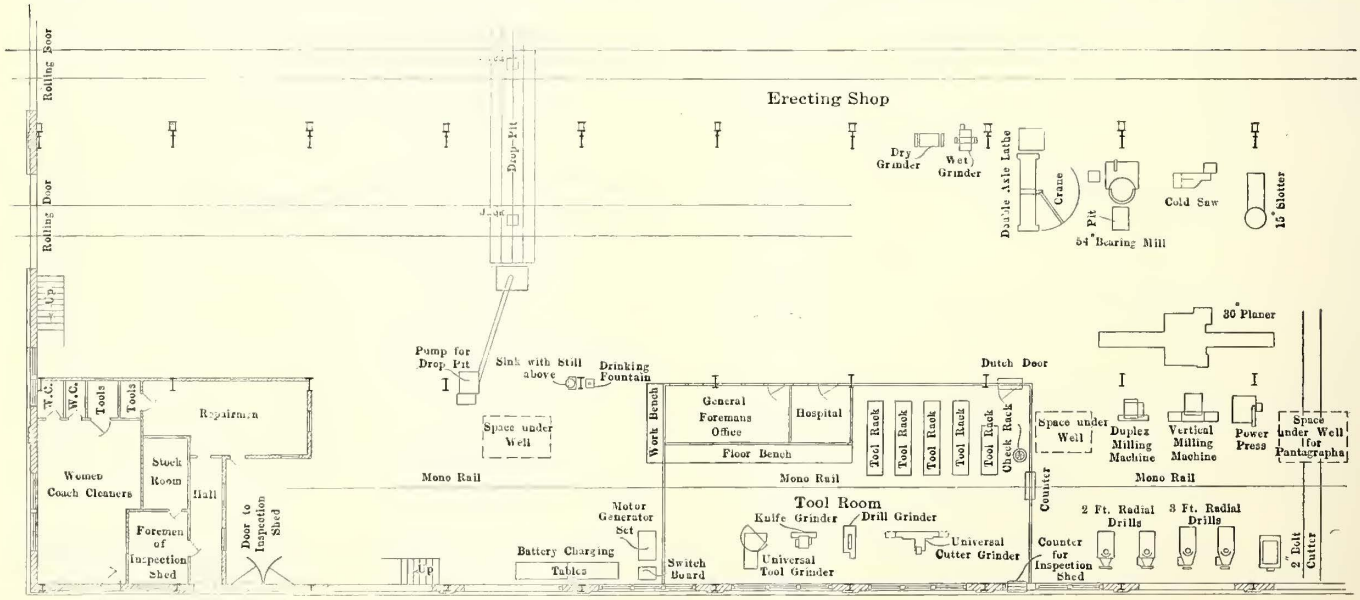
As mentioned before, the heavy-machine-tool bay is served by a track that extends for about half the length of the shop and there are no machine tools in this end of the bay. The list of tools installed and the manner in which they are distributed over the east end of the shop is in accordance with the arrangement shown on the two accompanying line cuts.

One of the features in the tool equipment will be found in the large baking oven at the extreme east end of the heavy-machine-tool bay. This is built of brick, and it has a removable roof of transite board in addition to doors in the side, the removable roof permitting the heavy pieces to be placed in the oven by means of the 30-ton overhead crane. The floor is made up of a strap-iron grating with the strips set on edge, and underneath it are coils supplied with high-pressure steam from the boiler plant, giving a temperature of over 200 deg. in the oven. Racks for small pieces of material are installed along the sides of the oven.

Adjoining the baking oven is a dipping vat capable of holding armatures for the largest type of propulsion motor in use. In consequence a complete armature and fields can be dipped at once. Armatures for propulsion motors of the direct-connected type are dipped at present by rolling them in a pan containing baking varnish so that only the coils are immersed.

The practice in the baking and dipping process is, first, to heat the pieces in the oven at from 90 deg. to 115 deg. C. for a period ranging from twelve hours to seventy-two hours, or long enough to drive out all moisture. Then the pieces are immersed in baking varnish until all air has left the interstices in the material, as indicated by a complete stoppage of the rising stream of bubbles from the piece in the dipping vat. After saturation the pieces are drained for half an hour, and then they are again placed in the oven and baked at the correct temperature for seventy-two hours, the temperature being determined by a pyrometer. On the armatures for the locomotives of the latest type, in which there are two motors geared to each driver, there is no canvas hood at the ends of the armature, and after the clips are on the coils and soldered in place the whole is sealed up with Bakelite cement and baked for seventy-two hours at about 100 deg. C.

The front or west end of the light-machine-tool bay is occupied by the offices and quarters for the employees in the inspection shed. Next to this comes a space used for storage battery charging and testing, and next to this, approximately in the center of the shop longitudinally, are the tool room and general shop foreman's office. One of the interesting features of this section of the shop is a completely equipped emergency hospital with a cot, stretcher and small operating table in addition to a remarkably complete outfit for first aid to the injured.



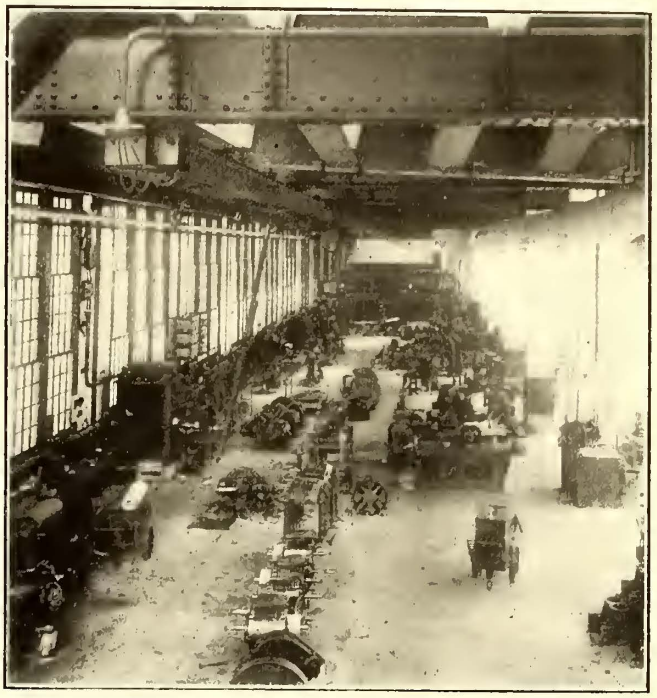
New Haven Shops—West End of Machine Shop

which are kept in the tool room and not by the men. Each man, however, has a number, with which the numbers on the checks correspond. When a man draws a tool a check is taken from the board upon which they are all kept and left in the rack in place of the tool, thereby showing that the tool is in the possession of some particular workman.

An elaborate testing system is installed for auxiliary apparatus. This is installed along the wall at the south side of the light-machine-tool bay and consists of a 175-kva auto-transformer and a motor-generator set, the latter supplying direct current at 550-volts for testing d.c. relays and the operation of auxiliary motors under d.c. conditions. The auto-transformer is equipped with taps for 643 volts for the motor-generator and for a.c. relays in the a.c.-d.c. control, for 360 volts for air-compressor motors, and for 300 volts for blower motors. Taps for 500 volts, 250 volts and 125 volts are installed in case their use is demanded on account of apparatus requiring these voltages. All of the taps are led to a single switchboard and connected to one side of two-position feeder switches, which are also supplied from the motor-generator. Therefore, when the switch handle is thrown in one direction direct current is obtained in the feeders, and when it is thrown in the other direction single-phase current is obtained. The d.c. terminals of the motor-generator set are connected through an adjustable grid resistance, and the d.c. voltage is controlled by a hand wheel on another panel of the switchboard. On the switchboard is also a ground connection, as all circuits are brought back at ground potential.

The 362-volt taps and the 300-volt taps for air-compressor and blower motors respectively are connected to separate busbars so that a number of these auxiliaries may be tested at one time. These busbars, on the outgoing side, are connected through additional two-position switches to feeders that extend out to different points along a testing bedplate upon which may be bolted the auxiliaries to be tested. Ten outlets are provided along the edges of this bedplate and with the outlets are also provided air connections to four receiving tanks along the wall, so that air compressors may be operated under actual service conditions. Each tank is equipped with a standard electro-pneumatic governor mounted near the bottom of the switchboard which automatically cuts off current when pressure in the tank reaches any predetermined point. The testing bedplate is made of cast iron and is equipped with key slots for bolting the auxiliaries to it while they are under test.

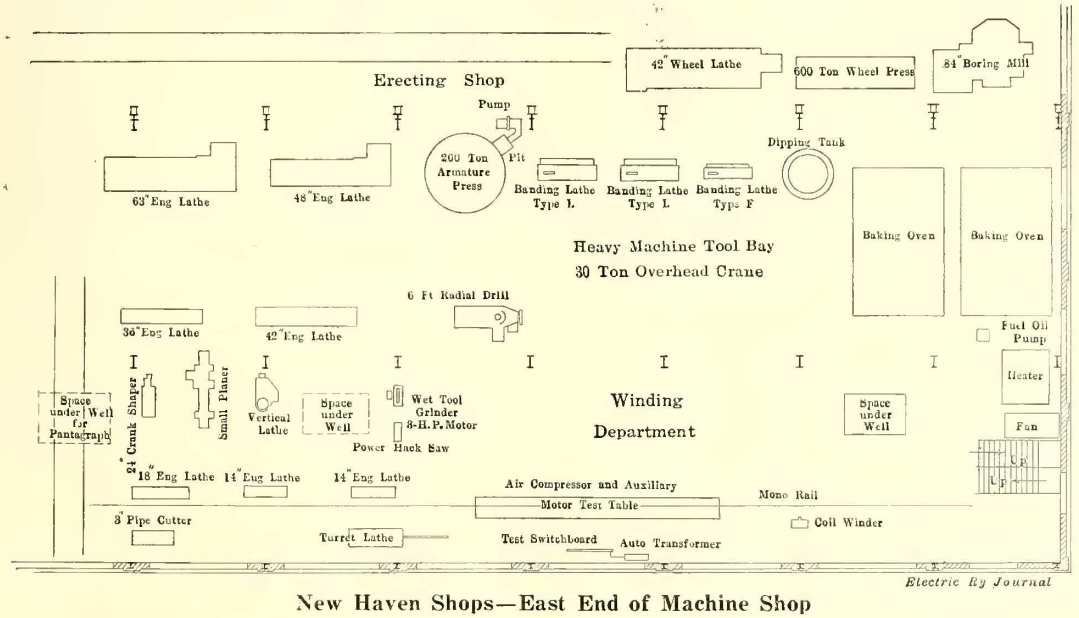
At the extreme west end of the light-machine-tool bay is a mezzanine floor containing offices, lockers and toilet rooms for the men on the ground floor.



New Haven Shops—East End of Light Tool Bay

MANUFACTURING DEPARTMENT

In the balcony over the light-machine-tool bay is the manufacturing department. This is one of the most interesting features of the shop. It is served by 1½-ton traveling electric hoists operated by pendent cords and running longitudinally on I-beam tracks with switches at several traverse tracks to serve all sections of the balcony floor. There are several wells in the balcony floor so that material may be handled by the hoists to and from the main floor with a minimum of physical effort. In addition to this the balcony is extended out beyond the line of columns on the heavy-machine-tool bay side so that material may be picked up by the auxiliary hoist of the 30-ton crane in the heavy-machine-tool bay and landed at any desired point along the edge of the balcony.



New Haven Shops—East End of Machine Shop

Starting at the extreme east end of the balcony, there is a babbitting department where brasses and bearings are rebabbitted. In this department are four babbitt-melting furnaces operated with crude oil, the babbitt being melted in heavy crucibles. Hoods with doors of sheet iron completely inclose the top of each crucible to limit oxidation. In addition, there is a furnace for

melting babbitt out of old journal brasses, and this has a fire-brick-lined chamber set on a cast-iron table. There is a hole in the table at the center of the furnace, and grooves are cut in the top of the table so that the babbitt, when it is melted out of the old brasses, will flow through the hole into a mold on the floor. The waste gas from the furnace passes through the hollow top of the table and keeps it hot so that after the babbitt has been melted out the brasses can be laid on it and thus kept at a high temperature for tinning. There is a canopy with a stack leading to the roof over the oil furnace and also an air hoist which travels the full length of the table. This hoist serves in addition another table which stands beside the first one and which is used for babbitting the brasses. A third table is also provided for extra babbitting work. All three tables are of heavy cast-iron construction with gas-pipe legs.

Adjoining the babbitting department is an electric welding outfit with motor-generator set and switchboard. This is served directly by the electric traveling hoists. It is planned to handle at this point all light material requiring electric welding. Leads will be run to other parts of the shop to provide electric welding facilities on parts too cumbersome to be transported to the balcony. Next to the electric welding department comes a small woodmill for making doors, steps and floor boards, third-rail shoebeams for the a.c.-d.c. locomotives and other light woodwork.

At about the center of the balcony in a longitudinal direction is the pantograph department. In the middle of the space devoted to it is a well over one of the transverse tracks in the shop so that the complete pantographs may be lowered through the well onto a truck standing on the transverse track beneath it and from there pushed across the main shop floor. From the trucks, of course, the pantographs are picked up by the cranes in either the machine or the erecting shop bay and placed upon the locomotive roofs. Near this bay is the department for third-rail shoes and direct-current overhead collectors. There is also a small assembling department for the springs used on the geared locomotives to hold the driving-wheel quills in place. Adjoining this there is a space for tinners. It is equipped with the usual tinner's tools for repairing and rebuilding headlights, gear cases, sirocco blower runners and the like, and next to this space is a large area devoted to the manufacture and repair of small electrical parts, the grinding of burnt contact fingers and the assembling of brush holders, contacts and other pieces of brass or fiber. A large amount of work is done here, as practically no replacements of small parts are made by the purchase of new ones.

All of this material is manufactured on store order and then turned into the store department, from which it is drawn as needed. Old pieces are turned in in the place of the new ones drawn out as required by the erecting-shop men.

At the west end of the balcony is an air-brake department and next to this a locker and washroom, the latter being kept in spotless condition by a janitor. There is a mezzanine floor for the balcony as well as for the ground floor, and this contains the general office, the telephone exchange and the draftsmen. Another novelty in this repair shop is the presence of a shop specialist to design jigs and templets.

New Haven Shops—Manufacturing Department in West End of Balcony

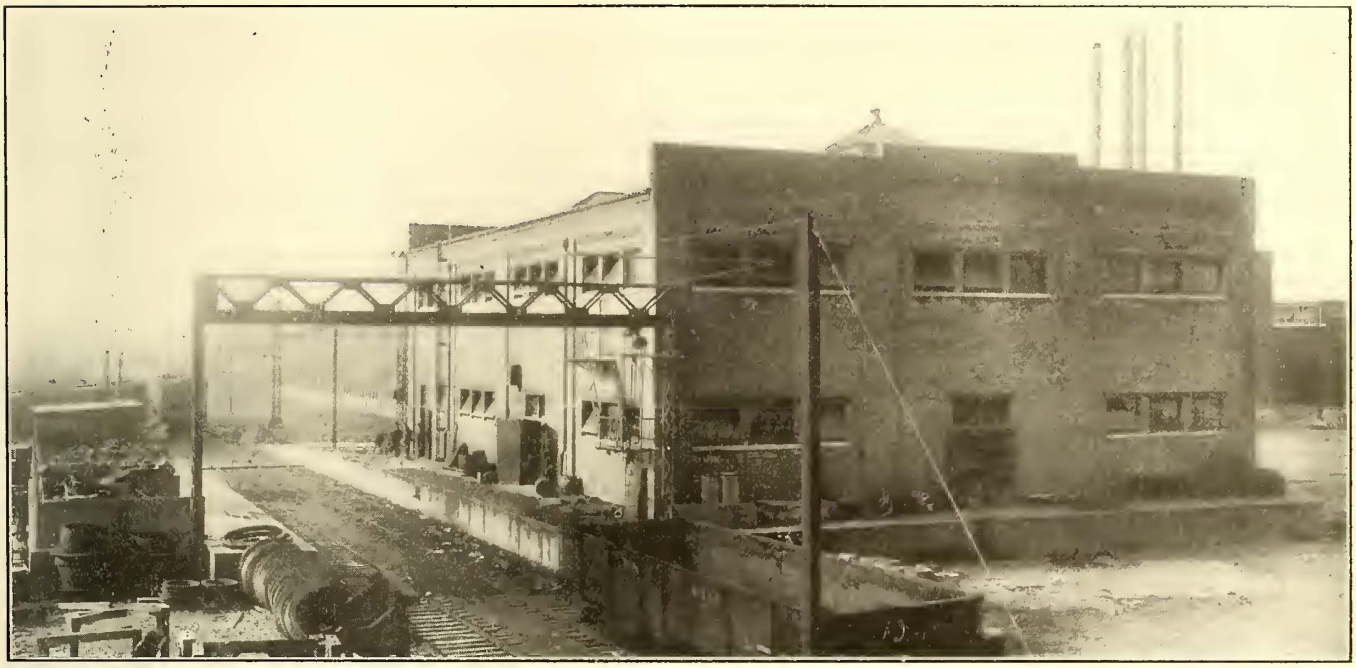
STORE HOUSE

The storehouse, which is just back of the main shop buildings, is two stories in height, the first being at the level of the car floor. A platform is built along the building wall at one side, and this is paralleled by two railroad tracks. The second story is reached by a freight elevator. Pressed-steel bins are used throughout for the storage of practically all material. These bins are numbered in accordance with a filing scheme and a record of the location of each piece in the stock is kept in the office.

The oil is stored in tanks in the basement, oil pumps being provided on the main floor along the wall next to

the two supply tracks. The tanks may be filled from barrels or tank cars as desired, a connection being made outside of the building and distributed into any of the tanks desired from tank cars. Gasoline, which cannot be kept in the building on account of fire risk, is stored in an underground tank some distance away from the building, and a pipe is laid from it to a pump inside of the building so that it can be drawn as needed.

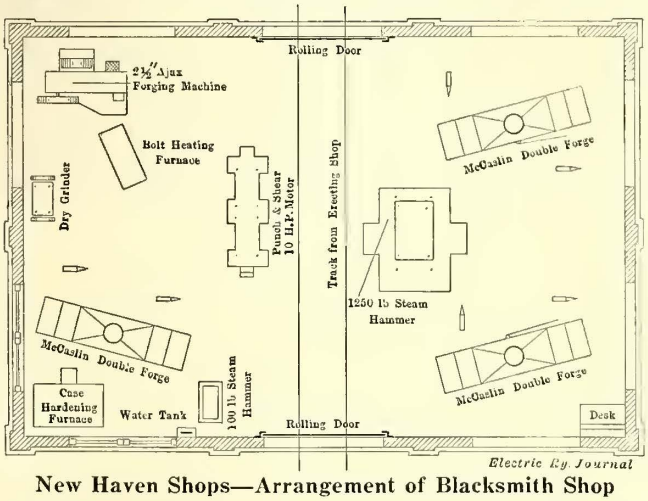
A bridge carrying a triplex hoist spans the two tracks alongside of the storehouse and also the platforms of both storehouse and scrap bins. This is used for handling very heavy material between the storehouse platform and the scrap bin or for handling material out of cars to the storehouse or to or from the bins. At the east side of the storehouse is a fixed crane with a triplex hoist for handling material from wagons, which



New Haven Shops—View Looking West from Back of Storehouse to Show Scrap Platform and Bridge for Traveling Hoist

One of the features of this department is the fact that brass castings and copper are kept in bins locked up in a heavy netting inclosure, so that no opportunity exists for stealing even if the door of the storehouse should be left open.

These scrap bins are built with much more care than is usually found on railroads. They are constructed on a concrete platform at car-floor level, and the separation between the bins for the different materials is



New Haven Shops—Arrangement of Blacksmith Shop

made by 3-in. planks bolted to old rails set up in the concrete floor of the platform. Brass and copper scrap is kept locked up in a house over the two bins. As the scrap bins are at car-floor level they are reached by means of a ramp from ground level, a concrete walk being provided for trucking material to the scrap bin either from the main shop building or from the storehouse.

are brought in at this side of the storehouse when they make deliveries of material purchased locally.

BLACKSMITH SHOP

The blacksmith shop is a plain brick building well lighted by high windows. The work done here includes forgings of the heaviest type, and provision for this is indicated by the installation of a 1200-lb. hammer and two cranes with triplex blocks serving it from each of the two forges near by. The shop is also equipped for tool dressing with a small steam hammer, this being installed instead of the usual power hammer so that it can be used for general light welding and other small forgings. With the Ajax forging machine will be manufactured the spring hangers and other pieces peculiar to the electric locomotives. Bolts are also to be reclaimed, although the standard work is all done in the main shop of the New Haven Railroad at Readville.

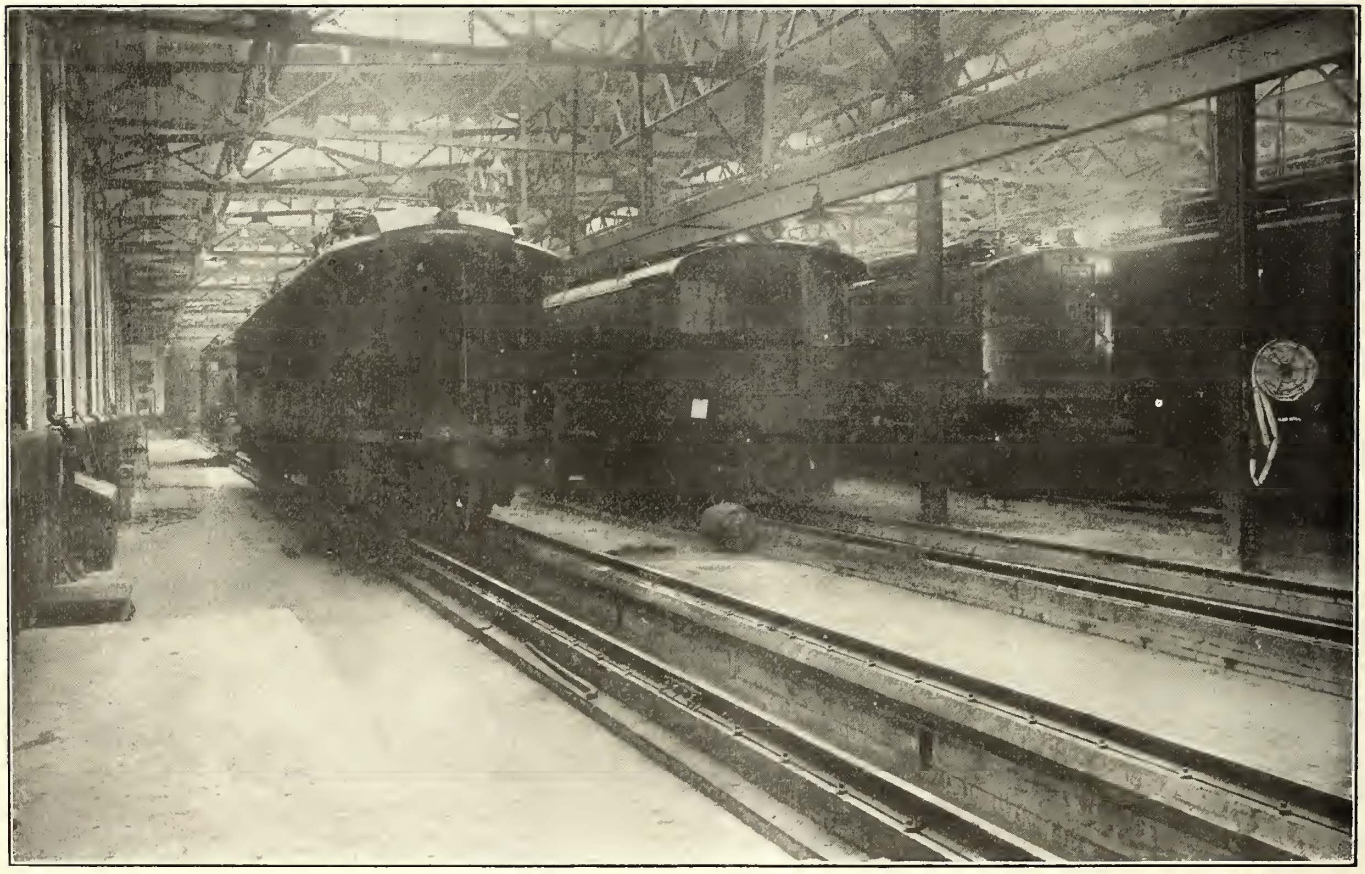
A large case-hardening furnace, burning crude oil, is installed, and alongside of this is a concrete quenching vat which takes the place of the unsightly tubs used for that purpose in a great many cases. A considerable amount of case-hardening of material such as pins and bushings is done at this point, and this accounts for the liberal provisions for the work. One of the transverse tracks from the erecting shop extends across the narrow space between the main building and the blacksmith shop, and over this heavy material is handled on 2-ton storage battery trucks. The tools installed in the shop are shown in the accompanying line cut showing the floor plan of the buildings and the arrangement of the various tools.

INSPECTION SHED

The inspection shed, which is on the south side of the main shop building, has four longitudinal tracks extending the whole length of the building. Doors are pro-

vided at each end. These tracks will connect to the future transfer table at the rear of the building. The floor of the inspection shed is depressed about 1 ft. to permit easy inspection of multiple-unit car trucks and journals from the outside. There is a pantograph gallery for the use of men working on the roof of the cars between each pair of tracks, and this is set at the level of the car roof, hanging from supports from the roof trusses.

Pits are provided for all tracks, the rails being carried on 8-in. x 12-in. timbers with screw spike fasteners. The pits are of the unusual depth of 5 ft., but shelves 18 in. high are provided on each side of the pit so that the workmen when engaged in repair work or inspection underneath cars can stand with one foot on each shelf and raise their heads to the level best adapted for their work. On the other hand, when a man wishes to walk through the pit the depth provides practically clear head room and thus eliminates the great difficulty of movement in the ordinary shallow pit.



New Haven Shops—Interior of Inspection Shed

The building is well lighted by skylights spanning two tracks each. Plug connections for portable lamps and small tools are provided along the walls of the building together with drop pipes from overhead compressed air mains. Lighting plugs are also provided at short intervals in each pit. The building is heated by the indirect system, the heating ducts opening into the pits at intervals so as to provide hot air under the cars where it is most needed for melting ice and snow in winter.

POWER HOUSE

The power house is installed to provide steam for heating and other uses and also compressed air to the shop for portable tool operation. It contains four 250-hp Babcock & Wilcox boilers installed in one end and set with their fronts parallel to the long dimension of the building. Coal is shoveled direct from the track at the rear of the building into the storage hoppers. The boilers are equipped with Taylor stokers in order to avoid smoke, as the power house is in a residence district. For this reason also each boiler is equipped with a stack 125 ft. in height to prevent gas from the boilers being discharged at such a low level that it might enter the windows of nearby dwellings.

There are two 2000-ft. Laidlaw-Dunn-Gordon cross-compound, two-stage air compressors operated non-condensing so that the exhaust steam may be used in heating the shops. These are equipped with a novel outside air cooler which is composed of small vertical pipes on two manifolds with a by-pass for use in case of emergency. The compressed-air and live-steam exhaust pipes between the power house and the main shop building are carried overhead at a height sufficient to clear a man standing on a car roof. A novel intake for the air compressors has been installed. This consists of a bonnet over the end of the intake pipe, the top 18 in. of which is fitted with a screen under the bonnet. Dry air for the compressors is by this method always assured.

High-tension current in three-phase form is brought into the power house through outside switches. These are controlled from the inside switchboard, where the voltage is reduced to 550 volts for shop use.

A novel muffler for the exhaust from the large steam hammer has also been designed. This is made up of a length of 5-in. pipe, slipped over the 3-in. exhaust pipe from the hammer and provided with slots to permit air to be drawn into it by the action of the exhaust. The result of the admixture of a large volume of air is very successful in cutting down the noise of the exhaust. Another feature of the power equipment of the shop is a boiler blow-off tank 6 ft. in diameter and 12 ft. long, with an overflow to the sewer and a 3-in. vent to the roof of the main shop. No baffles are installed in the tank, but no water is thrown from the exhaust.

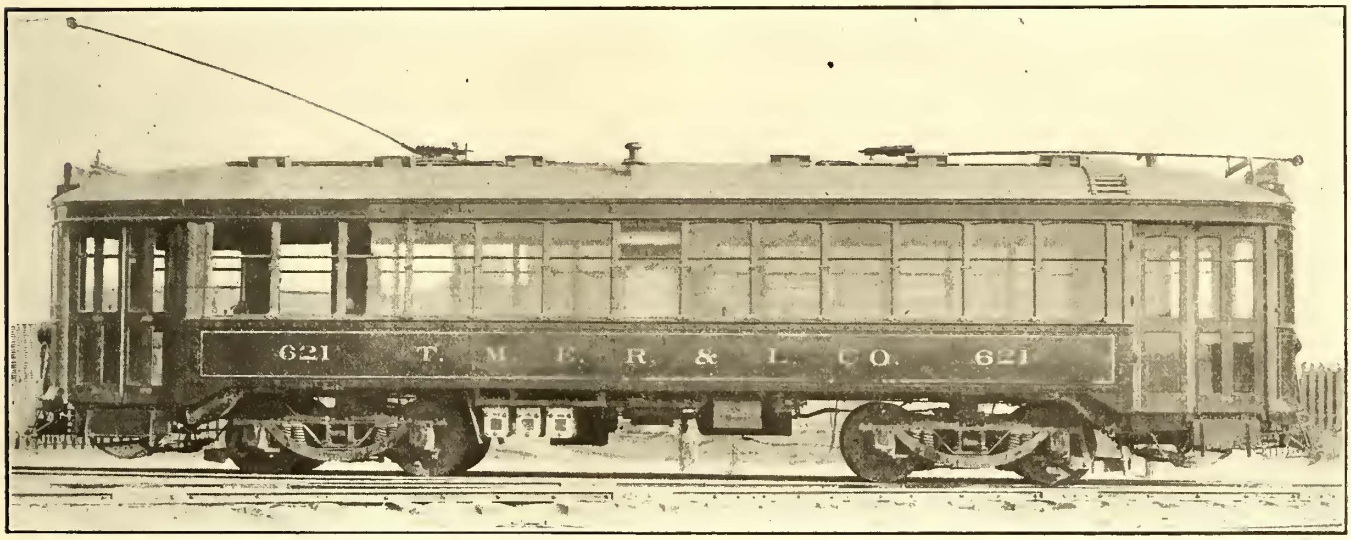
Efficiency Engineering in the Shops of the Milwaukee Electric Railway

An Account of the Shop Practices and Accounting Methods Employed by This Company in Conjunction with the Operation of Its Planning Department and Premium System of Paying Shop Employees

Efficiency engineering in the shops of The Milwaukee Electric Railway & Light Company is pursued along two definite lines. One includes the work of checking the wearing life of materials and equipment as compiled by the engineer of equipment. The other covers the methods developed by the shop accountant in the planning department and forms a part of the premium system of paying employees. Excellent work is done in each field and many shop economies have resulted.

The work under the direction of the engineer of equipment is largely that of compiling equipment records. Forming a part of records are photographs of each of the different types of car in service. These include three views, a front, an interior and a full side view, the latter giving briefly a description of the car, its number, type, the name of the builder of the body and the trucks and the year purchased. These photographs are of a standard size and are prepared by the company's photographer when the different types of cars are built. In order that duplicate photographs may be obtained easily, each photograph of a car has a plate and file number which may be used in referring to it.

Another set of photographs is being developed, and these will be distributed among the offices of the several stations and stores. The set includes photographs of various equipment parts such as contactors, trucks, control details, stoves, fenders, etc., of such size and in such position that the correct name of each part may be shown. In many instances the department heads and the storekeepers have different names for the same part of a car's equipment, consequently more or less difficulty has been experienced. Under the new scheme all departments, as well as the storekeepers, will be supplied with these charts, so that there can be no question as to just what it desired. As a result, quicker as well as more accurate delivery is anticipated, and as fast as repeated errors occur with other parts of car equipment, similar charts will be prepared to remove the difficulty.



Milwaukee Efficiency Engineering—Side-View Type of Car Built for Which Standard Time Is Shown in List of Operations

PULL-IN AND DEFECT RECORDS

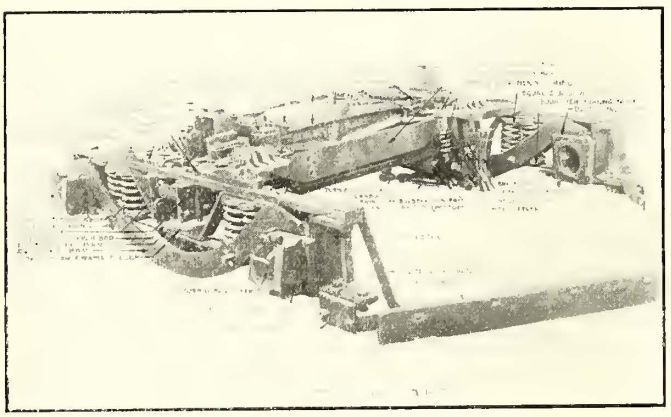
The manner of compiling pull-in and defect records conforms to that generally adopted. The defect system includes a triplicate report from the motorman in charge of the car on which various forms of defects are shown, so that he can check off all car defects as they develop on a car in service. One of these reports is given to the station foreman and is an immediate notification of existence of trouble. Another is sent to the office of the superintendent of rolling stock, and the third is sent to the transportation department. The back of the station foreman's copy of this report contains space for his explanation of the defect as reported by the motorman. The purpose of this is to check the motorman's ability to discern and properly locate the car trouble, and at the same time it serves as a record of repairs made.

After the station foreman's repair report has been checked against the motorman's defect report, all reports are forwarded to the claim department for its record. Each station foreman also keeps a record of car pull-ins on a daily report form, setting down each pull-in against a classified record of causes. This report in turn serves as the basis for a daily pull-in report which the office of the superintendent of rolling stock prepares for the general manager.

While the pull-in report serves in a general way as a check on various types of equipment, it is not sufficiently specific to produce the desired results, and other report forms have been prepared by the engineer of equipment. One, on electrical failures, covers the period of a month and gives a list of the various types of motors and controllers in service. This list of equipment is repeated five times on a sheet, and a blank

space beside each complete list is filled in by the equipment engineer. If it is desired to check brush holders, short-circuited armatures, grounded armatures or field trouble, he indicates it in the blank space, and it is checked against the various types of motors. From the foregoing check it is possible to locate exactly the trouble with any particlar type of equipment and take such steps as are necessary to remove the cause. In order that this report may be accurate, the actual defect checks are made in the armature room at the time repairs are made. Similar checks and tests are made on all other new material and devices, as well as that in regular use, when the pull-in records indicate an unusual number of failures.

In order to carry further the problem of explaining car defects and recording pull-ins, a monthly report of pull-ins is made on the thousand-car-mile basis. This indicates the number of pull-ins for the current year compared with those of the year previous, a similar comparison of the total car miles run, the pull-ins per 1000 car miles, the number of cars operated and the average mileage per car. All of these items are charged against the five carhouses and thereby to a certain extent serve as a check against the efficiency of the repair and inspection force at each station. A similar report is kept to compare the car defects for each month. This distributes them against each carhouse and classifies them under six headings, namely, carbody, air-brake and hand-brake, truck, controller, motor and miscellaneous troubles. In addition to indicating the number of cases of trouble, the record also shows the per cent increase or decrease for each class of trouble in each carhouse.



Milwaukee Efficiency Engineering—Typical Correct-Name Chart for Shop Use

The foregoing reports are somewhat general and are used primarily for the information of the general manager in the monthly report. A more detailed report of car pull-ins also is compiled for each month, taking the various classifications shown on the general report and charging them against the particular class of trouble, as well as against the other departments, namely, transportation and track and roadway, which also contribute to the total number of pull-ins. This detailed classification also is compared with the corresponding month of the year previous, and the per cent increase or decrease is indicated. This information is tabulated again on a second report form, charging the various classes of defects against the different carhouses. The latter record form is sent out to the various carhouse foremen, and their record of efficiency is shown in the net pull-ins per 1000 car miles operated. The moral effect of this report is materially to increase car station repair and inspection efficiency.

That part of the efficiency work relating to increased cost of production with particular reference to the introduction of shop kinks and jigs to increase the output of the various machines and at the same time reduce the cost of various mechanical operations is under the direction of the shop production foreman. Considerable time is devoted to this particular work and much good has been accomplished. Descriptions of the various kinks and jigs used in the shops of The Milwaukee Electric Railway & Light Company are described and illustrated in another article in this issue.

PLANNING DEPARTMENT AND PREMIUM SYSTEM

Payment of labor in the company's shops is largely made upon the basis of a premium or bonus system, although piece-work had been previously given several years' trial. The strongest objection to the piece-work system was the belief that it was unjust to the best men. For instance, if a particular job cost $2.25 and a good mechanic could do the work in six hours, it was sometimes found that an apprentice could do a similar job in eight hours. If the good mechanic received $3.25 per day and the boy received $1.50 per day, the boy under the piece-work system received a much greater per cent increase in his wages than the mechanic. This discrimination was considered unfair to the older man, as the two hours' reduction in time necessary to perform a certain operation might require years of experience and practice.

Under the premium or bonus system each employee is always entitled to his regular day's wages, but the standard time adopted for any particular operation serves as a guide to the foreman on the workman's ability to do certain work, and in case the operation is performed in less than the standard time set he shares one-half in the money saved the company. In other

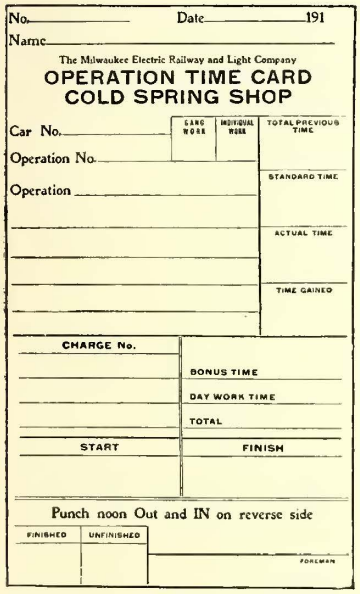
PULL-IN REPORT FOR MONTH ENDED JANUARY 31, 1914, MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY

Item	—Milwaukee City Cars— This Year	Last Year	Per Cent Increase or Decrease	—Interurban Motor Cars— This Year	Last Year	Per Cent Increase or Decrease
Hot bearing	2	3	33.33 D	6	10	40.00 D
Brake and truck trouble	20	64	68.75 D	5	7	28.57 D
Slack brakes	32	117	72.64 D	3	..	..
Air trouble	48	131	63.35 D	30	18	11.11 I
Heater trouble	23	28	17.85 D	16	11	45.45 I
Control trouble	25	101	75.24 D	3	3	00.00 ..
Wiring trouble	31	83	62.28 D	1	23	95.65 D
Motor trouble	69	274	74.81 D	30	18	66.66 I
Gear and pinion trouble	3	11	72.72 D	..	6	100.00 D
Broken glass	30	49	38.77 D	3	2	50.00 I
Door trouble	22	21	100.00 I	1	..	.. I
Collisions	32	29	10.34 I	..	1	100.00 D
Split switch and jumped track	14	23	39.13 D	..	..	00.00 ..
Miscellaneous	211	110	91.81 I	40	9	344.44 I
Total	562	1037	45.80 D	128	108	18.51 I
Chargeable to Transportation Department:						
Pulled in, found O.K.	39	32	21.87 I	2	2	00.00 ..
Broken glass	30	48	37.50 D	2	3	33.33 D
Due to trailer operation	21	..	.. I	..	..	00.00 ..
Collisions	32	29	10.34 I	..	..	00.00 ..
Miscellaneous	80	16	400.00 I	21	..	.. I
Total	202	125	61.60 I	25	5	400.00 I
Chargeable to Way and Structure Department:						
Split switch and jumped track	14	22	36.36 D	..	..	00.00 ..
Miscellaneous	..	1	100.00 D	..	..	00.00 ..
Total	14	23	39.13 D	..	..	00.00 ..
Grand total failures, other than equipment	216	148	45 94 I	25	5	400.00 I
Net equipment failures	346	889	61.07 D	103	103	00.00 ..
Failures per equipment operation	0.644	1.7603	69.99 D	2.06	2.06	00.00 ..
Failures per 1000 car miles	0.2872	0.7289	60.59 D	0.6933	0.6681	3.77 I

words, the time saved is multiplied by one-half his hourly wage and is added to his regular earnings. The system has been in operation for about two years.

Beginning the first of this year, the mechanical department broadened the scope of the planning department to include the planning of all shop work. This department now separates the work into definite operations, records the time and adds the bonus, where earned, to all operations on which a standard time has been fixed. It also determines the unit costs of all stock manufactured in the company's shops.

The establishment of the bonus system at first met with considerable opposition on the part of the employees. They believed that it was a means by which the company would profit, and there was a grave possibility that they might not receive the total daily wage they had been paid in the past. The first operation to be put on the premium basis was that of wiring a car. No doubt the formality with which this job was instituted had much to do with the slowness with which the premium system was accepted by other employees. A detailed contract was prepared and signed by the employee in charge of this first job, but this required more or less dickering before the exact terms could be decided. In order to eliminate this formality and at the same time simplify the work, an operating time card was adopted to serve the purpose of a long formal contract. The first operations under the new system were performed by loyal employees, but it was even then a little difficult to get them to accept the first job. The trouble appeared to be that the men could not estimate their ability, but they finally agreed to "take a chance" as there was apparently nothing to lose and everything to gain. Fortunately, the men who were selected "made good" and received a bonus for their work. This greatly influenced others to fall in line.


No. _____ Date _____ 191

Name _____

The Milwaukee Electric Railway and Light Company

OPERATION TIME CARD
COLD SPRING SHOP

Car No. _____ | LABOR HOUR | INDIVIDUAL HOUR | TOTAL PREVIOUS TIME

Operation No. _____

Operation _____ | STANDARD TIME

ACTUAL TIME

TIME GAINED

CHARGE No. | BONUS TIME | DAY WORK TIME | TOTAL

START | FINISH

Punch noon Out and IN on reverse side

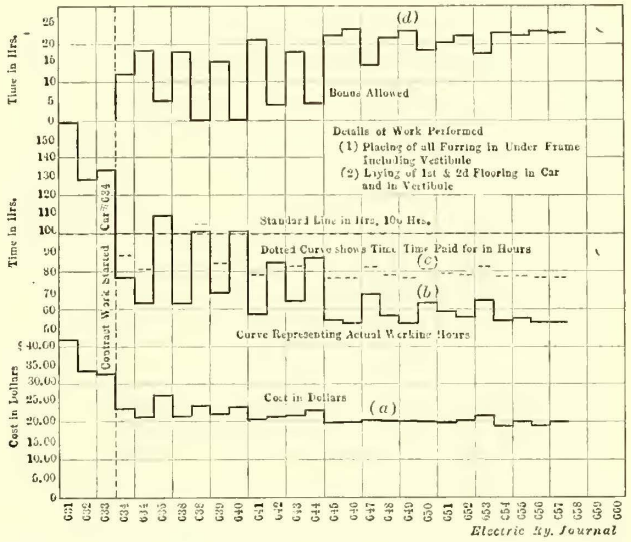
FINISHED | UNFINISHED | FOREMAN

Milwaukee Efficiency Engineering—Operation Time Card

The result of the first job was about as follows: The standard time for three men in a gang in wiring a car was fixed at 300 hours and the work was actually done in 210 hours. This meant that each man received a bonus of 23 per cent increase in his daily wage. Under the present arrangement employees' bonuses are limited to a 40 per cent increase over their regular daily wage. To date, a maximum of 115 men out of a total shop force of 360 men have worked in accordance with the premium system of pay.

Probably one of the most interesting tests of the premium system was made in connection with the construction of thirty car bodies. The time necessary to construct the floors and underframes of the first three cars was carefully observed and found to be 160 hours on the first car, 128 hours on the second car and 133 hours on the third. At the close of these observations it was decided to put this work on a premium basis, and accordingly a contract was let with the standard time fixed at 100 man-hours. This reduction in time was considered advisable, as careful observations indicated that all the men in the gang were not working up to their capacity, and, as a matter of fact, the fourth car was completed in seventy-six man-hours and the fifth car in sixty-two man-hours. The term man-hours indicates the total time worked by all the employees in the gang.

The curves shown in one of the illustrations are an example of what was accomplished by the adoption of the premium system in constructing the floors and underframes of thirty cars. Curve *A* represents the total cost of labor on floor and underframe construction for each car, curve *B* represents the actual working hours of each gang on this work, and the dotted lines



Milwaukee Efficiency Engineering — Diagram Showing Savings on Flooring Thirty Cars

shown on this curve indicate the total time paid employees. Curve *D* indicates the actual bonus time allowed on each car. Further reference to these curves shows that as the working time for the gang decreases the cost to the company also decreases and at the same time the bonus allowed to the men incretses.

TIME DISTRIBUTION

Each of the various departments in the Milwaukee Railway company's shops is equipped with employees' time-card cases and time clocks controlled through a master clock. Instead of the daily time cards assigned to each employee, as used under the ordinary system, the planning department prepares operation cards specifying a single unit of shop operation and the standard operating time allowed for the work. These slips are forwarded to the various department offices in the form of individual operating cards or gang cards, accompanied by the inter-department order and the manifests for the necessary material. These cards in turn are assigned by the foreman to the various employees, each card being inserted in its proper position in the time-card rack. Accordingly, when the men arrive in the morning and punch in at the time clock they receive notification as to just what work they have to do, either as individuals or in a gang.

In case the operation card assigned does not keep an employee engaged throughout his day, as many operation cards are assigned to him as are necessary to do this. At the completion of each operation, however, the employee punches the time clock which records the time of completion on the operation card, and at the same time he takes down his new card and punches it for the beginning time. Under this system it will be seen that the time is automatically distributed against each operation, it being necessary only for the clerks to compute the elapsed time.

On the contrary, if a specific operation provides work for an employee or a gang extending over several days, a sufficient number of operating cards to cover these periods are issued to the various members of the gang and each punches in and out in the morning, noon and in the evening in the usual way. In the case of individual work, the actual time put in is carried forward from day to day until a job is completed and the bonus earned computed. In the case of gang work, the regu-

The Milwaukee Electric Ry. & Lt. Co.

GANG TIME CARD

COLD SPRING SHOP

Operation _____ Car No. _____

Charge No. _____ Operation No. _____

No's of Men	Names of Men	Date											Actual Time	Bonus Time	

Standard Time _____

Actual _____ Totals per gang

Time gained _____

Electric Ry. Journal

Milwaukee Efficiency Engineering—Gang Time Card

lar time cards are turned in to the timekeeping department where the time is recorded and then forwarded to the planning department. As the cards indicating unfinished work are accumulated in the planning department, the time is entered on a gang time card until the final card is sent in showing that that particular job has been completed. At that time the bonus earned by each man is computed and amount of extra time allowed is forwarded to the timekeeping department. Each operating time card instructs the workmen that the punch in and out time is to be recorded on the back of the card, and the beginning and finishing time on the face of the card, in order that no confusion may arise in computing the elapsed time.

At the close of each day all time cards are forwarded to the main office where the time clerk enters the time on the pay-roll distribution, allowing the bonus time if it has been earned as indicated in the difference between the elapsed time and the standard time shown on the operation card. After the time has been recorded the distribution cards are forwarded to the planning department clerk, who attaches them to the shop order made out when the work was authorized.

The foregoing is the procedure in cases where the work has been standardized and placed on the premium basis. Prior to the standardization and adoption of the premium basis for a particular operation, each workman receives the standard unit operation time slip, punching it in and out at the time clock in the usual way. The unit operation time slip gives the number of hours spent by each man classified according to the operation. This card serves as a basis for standardizing the time of various unit operations. It gives a series of operation costs covering the same work on which an average may be computed to arrive at the standard time.

ESTABLISHMENT OF STANDARD TIME

In connection with stock manufacturing and other shop operations, the generally accepted method of determining proper time is followed by one or more of the planning department observers. These observers carefully check the work from start to finish and with a stop watch if necessary. While time observations are being made, the observers carefully study the movements of the workers with a view to determining whether they are working up to capacity or not. The results of both these observations enter into the establishment of a standard time. In the case of stock manufactured for shop use, preliminary data are available in the form of the costs shown by the purchasing department's records, as well as the records obtained for the past two years in the rolling stock department's determination of the various costs of production.

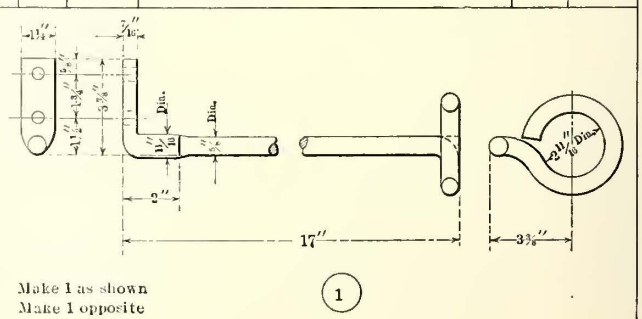
Planning department observers who collect the data from which the standard time for each operation is computed necessarily must be mechanics of considerable experience and better educated than the average shop worker. While they are making observations of a particular operation as the work proceeds on the regular day-rate basis, they not only check the actual time required and draw conclusions as to whether the men are working up to capacity, but suggest moves for reducing lost motion.

Prior to the time when actual observations were taken, considerable data had been collected on gang operations from the regular time cards. These gave an exact line on the work that was being done, and when several men's reports for an operation reached a point where the time was about constant, a single observation of this operation served as a check, which if it agreed with the recorded time fixed the standard time. Many operations, however, vary with each car. Consequently it will be impossible to put them on a premium basis, but the work of this character must be done by the regular wage men. Where similar operations are performed on the different types of cars, it is necessarily to be expected that the time will vary and, consequently, each type of car requires a standard time of its own.

It has been a rule since the establishment of the premium basis of paying shop employees that no standard time is fixed closer than the nearest one-half hour. It has also become a rule, or a policy of the company, that when the standard time is once fixed for any operation, it is not reduced. It is believed that the moral

Sand Hose Brace for-500 Type Car

Item No.	No. per Unit	No. per Working Man.	Description	Mat.	Lot No.
1	1	50	⅝″ Round Bar 35″ Long	W.I.	15061
		9 Pcs.	⅝″ " " 18′0″ Long		



Electric Ry. Journal

Milwaukee Efficiency Engineering—Typical Drawing Accompanying Operation Card

effect on the men would be bad if, after it was found that they were making a good bonus for a particular operation, the standard time was reduced so as to reduce their bonus. In all cases, however, the company will increase the operating time when it has positive assurance that, when the men are working up to their limit capacity, they cannot at the same time make a reasonable bonus for their efforts.

The method of obtaining standard drawings for the manufactured articles for which drawings have not already been made is about as follows: When an order is placed by any department with the storekeeper for a certain article, he in turn prepares an inter-department order which is passed on to the planning department. After being handled in the usual way the original order is sent direct to the department about to do the work and the duplicate is sent to the drafting room. At this time the chief draftsman is notified that a drawing is required if a blueprint number is not shown on the order. Each of these standard drawings contains all dimensions necessary to manufacture the article, together with a brief specification, as well as a complete bill of material. Some typical standard drawings are shown in the illustrations. A set of these standards or blueprints is retained in the planning department, and the general foreman's office also has a complete set to give out to the employees as they are needed.

To centralize further the work of the planning department as well as to increase shop efficiency, it is proposed to place the work of ordering material in connection with the premium system of paying employees in the hands of the planning department. All material requisitions which should accompany each standard-operating time card, either for individual or gang employees, are to be prepared by the planning department. The detailed bills of material necessary to make out these manifests or requisitions will be obtained from standard drawings on file in the repair shop drafting department. Hundreds of detailed bills of material have been made out for the use of the various department foremen, so that the centralizing of material orders in the planning department can readily be started. All copies of material manifests, in the same manner as the operating time cards, after they have been filled by the stores department, are to be forworded to the planning department, where they will be attached to the particular job order and filed.

UNIT COST SYSTEM

Along with the adoption of the premium system of paying employees, the rolling stock department has

Lot No..... S..... Date of Order.....

DESCRIPTION

No.

PAY ROLL CHARGE

Date	Amt.	Date	Amt.

Date comp.....
Tot. pay roll chg.....

Tot. cost est. as per P.D.....
Est. cost (shop).....

Lab.....Mat.....Tot.....
Actual cost.....

Lab.....Mat.....Tot.....

No. items mfd.....
Unit cost.....

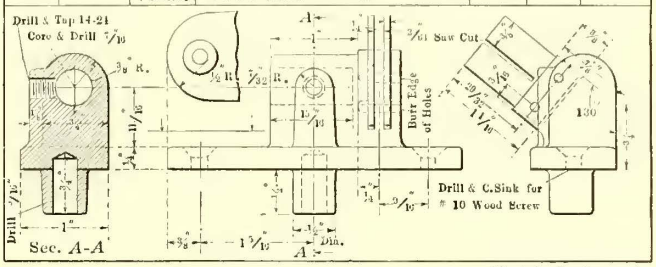
Milwaukee Efficiency Engineering—Card Record for Unit Cost System

established a unit cost system to obtain the correct unit costs of all manufactured material. This was done to determine whether it was more economical to manufacture specific items in stock than to purchase them in the open market. At the same time it eliminated the possibility of errors in charging material such as frequently occur when charges are made directly against a lot number. In other words, it was a check against the manufacturing efficiency of the shop and would determine whether it was possible to effect further economies.

Under the new system, all orders for stock manufactures are made out by the stores department, which assigns each a shop order number. After these orders are approved by the superintendent of rolling stock, the order is turned over to the planning department, where a card record is made of the shop order number, inter-

Single Switch Contact & Double Binding Post For K6 Controller

Item No.	No. per Unit	No. per Working Blank	Description	Mat.	Pat. No.	Lot No.
1	1	75	Castings	C.Brz	F4	6533
2	1	75	15 B & S (.057") x 3/4" Copper 1 1/8" Long	Hard Drawn Copper		
	7 Lin.Ft.		15 B & S x 3/4" Wide Hard Drawn Copper			
3	2	150	9 B & S (.114") Copper Pin 1/2" Long	Copper		
	7 Lin.Ft.		9 B & S (.114") " "			



Electric Ry Journal

Milwaukee Efficiency Engineering—Typical Drawing Accompanying Operation Card

department order number, the lot number charge, amount to be manufactured, description of item and the date of the order. Space is also left on this card record for entering the estimated cost of the item as furnished by the purchasing department and from past records, and for pay-roll charges against the order, so that when the card record is complete the estimated cost as compared with the actual cost is available. In case the work has been standardized the operating time cards are made out for each order.

At the same time a blueprint of the article is obtained from the drafting room, from which requisitions on the stores department for the different shop departments can be made from the bill of materials shown there. In case no print is available, an estimate of the material required is made, and a requisition is issued accordingly. If the shops find that the material estimate is not correct, additional requisitions are placed by them, or if the material is in excess the surplus is returned to the stores department.

ROUTING SHOP WORK

One of the duties of the planning department includes routing all shop orders through the various shop departments. All shop departments are numbered for convenience, and the number of the shop in which the work is started is the first shop noted on the order. Other shop numbers follow in proper sequence as the work progresses. This shop order is made in as many copies as there are shops interested, and each is accompanied with a requisition for the material required to do the work specified.

At the time the operating time cards and requsitions are made out, they are dated by the planning department, and copies of all orders, together with labor and material tickets, are sent to the production department or general foreman's office to be distributed. Where the operations have been standardized one labor ticket is made out for each unit operation, and if the work in any department is not completed by one man in a day a labor ticket for the following day will be made out by that department's clerk.

Material delivered from department to department according to the routing given on the shop order is accompanied by a delivery slip. Only one charge appears on any one delivery slip, and these slips are made out in triplicate and distributed. The original accompanies the material, the duplicate is sent to the planning department where it is attached to a copy of the shop order, and the triplicate is retained by the department issuing the delivery slip for its record.

As soon as work is completed in each department, copies of the shop orders are returned to the general foreman's office and held there until all the departments interested in a particular job have returned their shop orders marked completed, at which time this information is conveyed to the planning department. In the planning department the labor tickets are attached to the completed shop orders and the complete labor charge computed for the information of the purchasing and stores departments. If this labor and special material cost is approved, it is returned to the planning department, where a record of the estimated cost is taken off for future use.

To give an idea of what is being done in the way of defining unit operations as well as determining unit cost, the operating cost data for the electroplating and the oil and waste reclaiming departments are shown in the accompanying tables.

DIVISION OF COST OF ELECTROPLATING OPERATION

	Labor Cost	Misc. Sup.	Misc. Exp	Fixed Charge	Power	Tot. Exp.	O. H. per Hour Elec.	O. H. per Hour Help	Tot. Ch. Hr. Elec.	Tot. Ch. Hr. Helper	Tot. Hrs. Mon.	Tot. O. H. Chge. Month
November												
	$ 86.10	$14.15	$0.96	$9.50	....	$141.40	$0.071	$0.026	$0.421	$0.151	246	$17.92
	30.75										246	6.63
	$116.85											$24.55
December												
	$ 82.60	10.33	2.31	9.50	3.02	136.01	0.078	0.03	0.428	0.151	236	$18.36
	28.25										236	6.80
	$110.85											$25.16

In the accompanying tabulations, which are typical of the methods used in arriving at a unit cost, it will be noted that in the electroplating operation the basis of the unit cost is the charge per hour. Necessarily, this will vary with the quantity of work passing through the electroplating department. If it is assumed, however, that a sufficient amount of work is on hand at all times to keep the department working up to full capacity, the charge per hour as indicated on the detailed unit cost statement is about as fair a way to arrive at the cost of this work as can be found. The check on the operation of this department began in June, 1913, but only the last two months, namely, November and December, are shown as typical.

Similarly, in the oil and waste cleaning operation, unit cost data have been collected since June, 1913. For reclaimed oil the saving has been about 66 per cent, for reclaimed cotton waste about 40 per cent and for reclaimed woolen waste a little less than 70 per cent. In all of these calculations it is assumed that the oil and waste reclaimed has no value when it comes into the reclaiming department. Therefore, the item actual saving in money shown in the last column is the difference between the cost new of oil and waste and the actual cost of reclamation. The operation of the oil-reclaiming department regularly shows a net saving of approximately $125 per month. In order to be certain that all charges against this work are credited to the proper account, a special account number has been entered for time and material distribution.

RESULTS OF ADOPTING PREMIUM SYSTEM

Many direct and tangible economies have been effected since the adoption of the premium system by the Milwaukee Electric Railway which at the same time have been profitable both to the employees and the company. As indicated on the summary of contract work, the employees' wages have been increased from 18 to 24 per cent and the company has profited from between 14 to 16 per cent on the original cost of all operations now under the premium system. In addition, inaccuracies and direct loss of time resulting from the men distributing their own time have practically been eliminated. The operation time cards permit the foremen to devote their entire time to supervising work instead of directing their clerks or doing clerical work themselves. Each evening the foreman and clerk distribute the operation cards for the following day, assigning specific jobs to various employees. At the same time the accounting department is automatically supplied with complete labor data from which it compiles as many records and unit costs as are found economical.

DIVISION OF COST OF OIL AND WASTE CLEANING OPERATION

	Am't Recla. Gals.	Labor Cost	Misc. Supplies	Misc. Exp.	Fixed Chge.	Steam	Total Exp.	Unit Cost New	Unit Cost Recla.	Saving per Unit	Per Cent Saved	Actual Saving
Reclaimed Oil												
October	522.8	$14.55	$2.81	$0.07	$3.48	$0.45	$21.36	$0.12	$0.0404	$0.0796	66.3	$41.37
November	630	16.97	5.20	0.17	4.10	0.56	27.00	0.12	0.0428	0.0772	64.3	48.64
December	561	17.63	.....	.....	3.82	0.66	22.11	0.12	0.0394	0.0806	67.2	45.21
January	620	19.40	2.97	0.07	2.87	0.98	26.29	0.12	0.0424	0.0776	64.7	48.11
Reclaimed Cotton Waste												
October	1225	$27.11	$9.50	$0.07	$4.68	$2.45	$43.81	$0.07	$0.0358	$0.0342	48.6	$41.94
November	1003	25.01	9.75	0.07	3.81	2.00	40.64	0.07	0.0402	0.0298	42.5	29.89
December	1035	20.72	16.92	.....	4.49	2.07	44.20	0.07	0.0426	0.274	39.2	28.25
January	955	14.80	18.52	0.07	4.44	1.91	39.74	0.07	0.0416	0.0284	40.5	27.12
Reclaimed Woolen Waste												
October	660	$10.86	.....	$0.07	$2.93	$0.38	$14.24	$0.08	$0.0216	$0.0584	72.5	$38.56
November	730	11.92	.....	0.07	3.17	0.71	15.87	0.085	0.0217	0.0633	74.5	46.21
December	610	11.46	.....	.....	2.78	0.465	14.70	0.08	0.0241	0.0559	70.0	34.10
January	815	10.62	.....	0.07	3.78	0.74	15.21	0.08	0.0186	0.0614	76.7	50.04

The moral effect upon the men has been to increase their pride in the time required to accomplish a given operation, which results in benefit to themselves and to the company. Under the old system, when a workman completed one job and received another invariably there was an appreciable loss of time. This, too, has been eliminated, or at least minimized, by the new system, as the men upon completion of a particular job are immediately notified without hunting up the foreman what the next job will be. Moreover, all time elapsed must be accounted for on the cards, consequently workmen lose little time in punching in completed jobs and taking out the cards for the new one. Other tangible economies have been effected in the manner of making out the material requisitions, because workmen are held strictly to account for any extra material over and above the specified order.

STANDARD TIME FOR SPECIFIC OPERATIONS

Special interest should be attached to a number of specific operations upon which a standard time has been fixed. This standard time is indicated in man-hours, that is, the total number of hours required to do the work regardless of the number of men assigned to it. As a rule this work was done by a gang operation, it being found that three or four men could work to a better advantage than one. Details of several gang operations, some in connection with construction of new cars and some in connection with regular maintenance work, are as follows:

The work of stripping "300" and "400" type cars is called Operation No. 1 and includes removing (1) destination sign boxes; (2) boards under window pockets, clean-out window pockets and replace boards; (3) sash lifts and springs; (4) strap-hanger poles and brackets; (5) bells, bell cord and bell cord hangers; (6) stanchion posts; (7) entrance chain holders; (8) motorman's curtain; (9) grab-handles; (10) conductor's seats; (11) hand-brake handles; (12) Hunter sign index frames; (13) arm rests with clips; (14) "Please leave by front door" sign; (15) metal seat-back moldings and corner grab handles; (16) removing clips and catches on side destination sign boxes.

JANUARY, 1914, SUMMARY OF CONTRACT WORK IN CARPENTER SHOP

		Jan. 1-15	Jan. 16-31
(1)	Total number of contracts issued	95	105
(2)	Average number of contracts issued per working day	7.3	7.5
(3)	Total number of contracts completed	90	107
(4)	Average number of contracts completed per working day	6.9	7.65
(5)	Number men paid bonus	43	39
(6)	Total amount of bonus allowed	$199.08	$182.82
(7)	Average bonus allowed per man	$4.63	$4.68
(8)	Average day rate per hour of men working on contract	$0.2585	$0.255
(9)	Average hourly rate of men while working on contract	$0.3198	$0.3
(10)	Maximum amount of bonus earned by one man	$13.80	$9.
(11)	Minimum amount of bonus earned by one man	$0.47	$0.11
(12)	Number of contracts started during half month and completed in same period	56	70
(13)	Total standard time for all contracts completed during half month	4802	4992
(14)	Total actual time for all contracts completed during half month	3246	3903
(15)	Total number of hours gained for all contracts completed during half month	1560.5	1447.5
(16)	Total number of hours' bonus allowed for all contracts completed during half month	771.25	715.25
(17)	Number of hours actual time paid for jobs, for all contracts completed during half month being bonus time plus actual	4017.25	4618.25
(18)	Per cent salary increase	23.7	18.3
(19)	Per cent company profit	16	14.3
(20)	Per cent increase in speed of work output	32.5	29

The standard time for this operation is 12.50 hours, and the average time required for five cars to be completed on day work was 13.88 hours.

The work of finishing "300" and "400" type cars is called Operation No. 6 and includes installing (1) transom sash and transom-operating mechanism; (2) sash (one) in each vestibule where destination sign boxes have been removed; (3) sash lifts and springs; (4) strap-hanger poles and brackets; (5) bells, bell cord and bell-cord hangers; (6) stanchion posts; (7) remove plain brass door hinges, and replace with statuary bronze finished ones; (8) entrance chain holders; (9) motorman's curtains; (10) grab handles; (11) conductor's seats; (12) hand-brake handles; (13) Hunter sign index frames; (14) trip-sheet holders; (15) arm rests with slips; (16) "Please leave by front door" sign; (17) metal seat-back moldings and corner grab handles; (18) placing clips and catches on side destination sign boxes; (19) storm sash in vestibule; (20) all statuary bronze finished screws.

The standard time for the above operation is 38 hours, and the average time required for four cars to be completed on day work was 38.8 hours.

New construction of floor and underframe of "600" type cars included (A) all furring to be placed in underframe, including vestibule knees; (B) first and second floors in car and floors in vestibule. The standard time for this work is 100 hours.

New construction on car body frame of "600" type cars includes the erection of (A) bulkheads; (B) body posts and roof frame; (C) post caps; (D) window sills; (E) body letterboard. The standard time for the work is 280 hours.

The application of roof sheathing on "600" type cars includes (A) vestibule hoods; (B) roof sheathing on body and vestibules; (C) drip molding and car-line molding, including iron molding around vestibules. The standard time is 185 hours.

The erection of vestibule frame on "600" type cars includes (A) vestibule fronts, top frames and posts; (B) bulkhead sheet-iron panels; (C) sheet-iron dash panels, including one-half oval iron moldings; (D) vestibule post plates; (E) vestibule letterboards; (F) wood molding around entire car, including one-half oval iron molding, also one-half oval belt rail molding. The standard time is 185 hours.

The application of inside finish to "600" type cars includes (A) wire molding; (B) head lining; (C) advertising molding; (D) side sheathing; (E) destination sign boxes; (F) bulkhead and vestibule finish; (G) sheet iron in vestibule (inside); (H) longitudinal seat frames; (I) curtain holders; (J) air gage and signal light blocks; (K) floor matting and door treads. The standard time for this work is 200 hours.

TELEGRAPH VS. TELEPHONE IN TRAIN DISPATCHING

At the regular monthly meeting of the American Institute of Electrical Engineers held on March 13 M. H. Clapp presented a paper comparing the telegraph and the telephone as a means of communication in steam railroad operation. As the situation in that field was contrasted with electric train dispatching, a few of the comments of the author and those who took part in the discussion have value to electric railway operators.

The telegraph obtained its hold in steam railroad dispatching because it was the only means available in the early days of railroading. Had the telephone been available there is no doubt that it would have been adopted, just as it was later in interurban electric railway work. The extra expense involved in the telephone system is, therefore, considered justifiable. Mr. Clapp's summary of the situation, as far as the steam railroads are concerned, follows:

The advantages of the telegraph are: (1) flexibility in handling circuits; (2) simplicity of installation, operation and maintenance; (3) best adapted for long-distance service; (4) least affected by distance, in respect to transmission efficiency; (5) low cost of installation and maintenance; (6) the necessary standard of maintenance is not difficult to secure.

The advantages of the telephone are: (1) universality; (2) saving of time; (3) rapidity of transmission or dispatch of business; (4) psychological effects; (5) minimum delay in getting offices to answer calls; (6) lack of necessity of trained specialists to operate the service; (7) saving in total expenses of railroad operation; (8) minimum impairment of transmission efficiency in heavy weather.

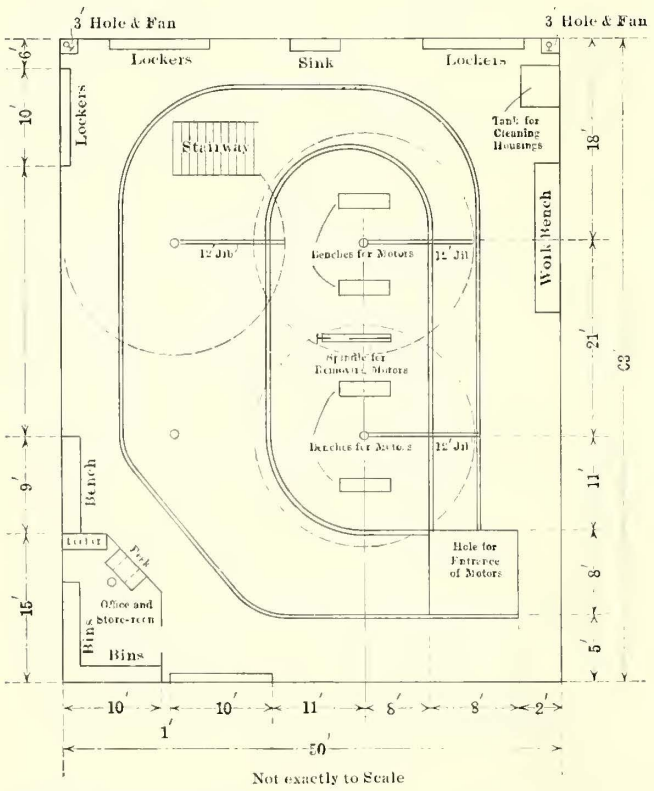
The provision of a means of selective signal for calling different telephone stations was a problem which required some time to solve satisfactorily. The selectors used have, in general, a step-by-step mechanism, and they are very efficient up to 125 stations. An incorrectly styled "booster" effect is utilized in dispatching sets by means of a switch which cuts out the receiver when the operator is talking and the transmitter when he is listening. In the dispatcher's office, special telephone sets are used which are wired like the sets at way stations, except that breastplate transmitters are provided to facilitate work on train sheets. Loud-speaking apparatus is being experimented with in the hope of doing away with this apparatus.

The Motor Repair Shop of the Third Avenue Railway, New York

The Installation Is in a Basement Directly Under the Truck Shop and Is Notable for the Very Extensive Use of Overhead Electric Hoists and Jib Cranes for Handling Motors and Other Parts—The Methods of Overhauling and Testing Are Also Described

BY R. H. PARSONS, ELECTRICAL FOREMAN

Owing to the need for overhauling a greater number of cars daily on account of the increased car mileage, the Third Avenue Railway, New York, found that it was necessary to enlarge its truck and motor repair quarters at its Sixty-fifth Street shops. This has been accomplished by removing the motor repair section from the truck department to a new room directly beneath the truck shop. This room, which is 63 ft. long and 50 ft. wide, with a head space of 13 ft., was formerly used for storage purposes. It is also adjacent to the room used for electric welding, which fact, while



Third Avenue Motor Shop—Plan, Showing Location of Equipment and Track Runs

not influencing the decision, was fortunate as the motor-overhauling foreman also has charge of the electric welders.

VENTILATION, LIGHTING AND SWITCHBOARD

Ventilation and light were the first points to be considered, and both have been satisfactorily provided for. Originally, this room had at one corner of the ceiling an aperture 8 ft. square for getting motors in and out. This hole now aids in ventilation. Additional ventilation is provided by the 6-ft. x 10-ft. opening of a stairway built near the diagonally opposite corner. One hole 3 ft. square was cut in each corner farthest from the large opening through the ceiling of the motor room into the truck shop. A fan, which is pointed in the direction of the 8-ft. square hole, is placed under each of these openings close to the ceiling so that the air is drawn down through the two 3-ft. openings and forced toward and out of the large opening. Thus the air is circulated overhead all the way across the motor room, carrying away the smoke and odors without subjecting the workmen to drafts. The temperature of this room is practically uniform the year round, varying from 60 deg. to 70 deg. Fahr. Of course, this mild temperature produces the best working conditions both in winter and summer.

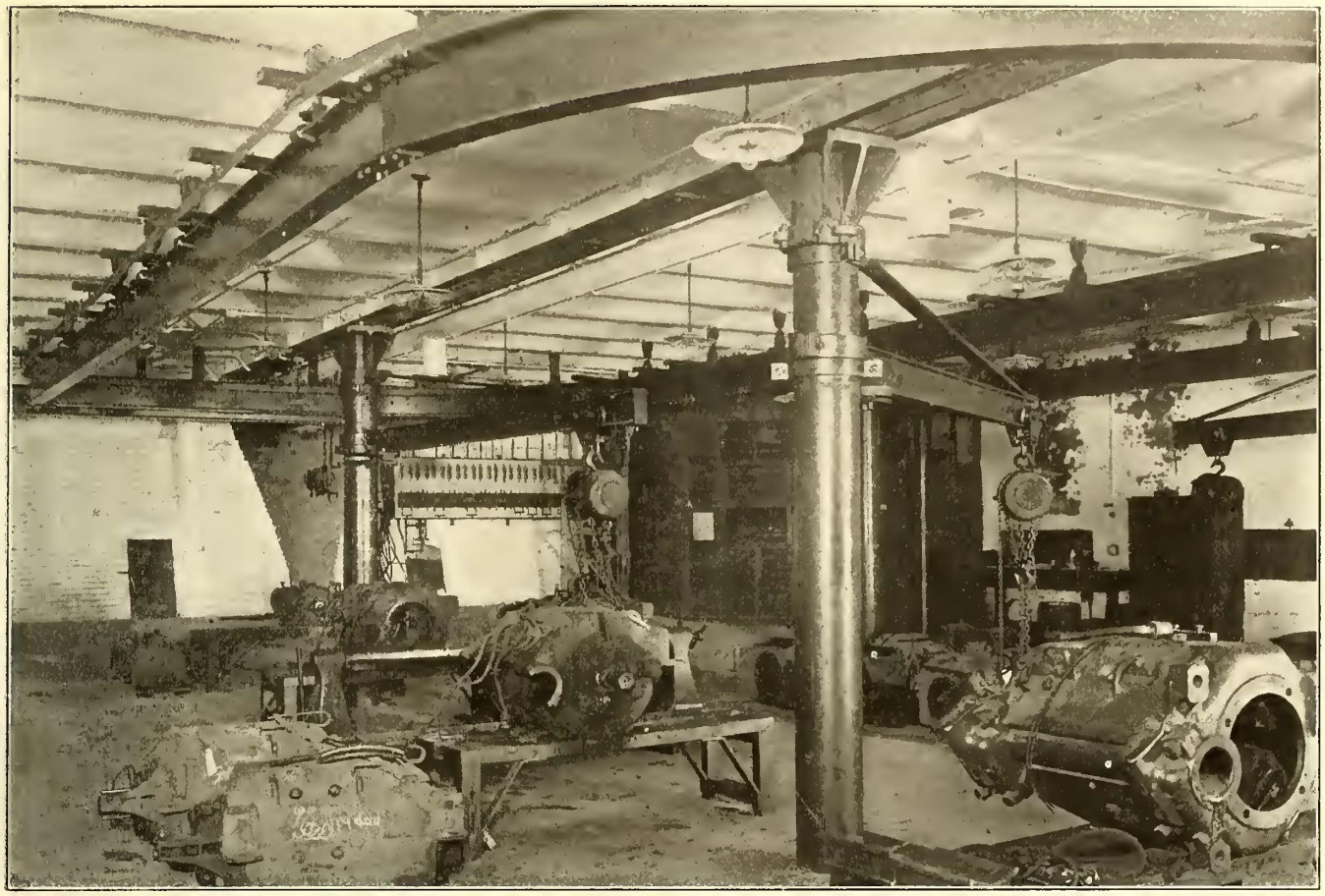
Light is provided by twenty-five five-lamp 600-volt circuits, arranged in three rows, each containing five five-lamp wireless clusters, and two rows, each containing five four-lamp wireless clusters, the two outside rows of clusters being four-lamp. The four-lamp clusters are in series with a two-way switch which is placed on the wall opposite the cluster, thereby completing the five-lamp circuit by lighting either a lamp placed on the side wall about 6 ft. above the floor or an extension lamp which is connected to a plug on the wall. This arrangement does away with drop lamps attached to clusters, while the simple turning of a button switch will light the lamp on the wall when the drop light is not needed. All lamps are of tungsten 40-watt rating.

A panelboard was installed with a switch for each row of clusters, for each fan, for the motor running test, for the light ground-testing circuit, for each of the telpher track trolley circuits and for the alternating current used for testing, thus centralizing all circuits used in this room. Each switch is double pole, fused on both sides and marked as to its connection.

TRANSPORT EQUIPMENT

The motors are removed from the trucks in the truck shop by a large traveling crane and are lowered through the 8-ft. opening into the motor room. The latter is equipped with two overhead tracks. Each track starts and ends at this opening, making a complete circuit of the room, one track inside the other, as shown in the accompanying halftones and floor plan. The track comprises a 12-in. I-beam suspended by clamps from the I-beams which carry the floor above. Each track has one Sprague electric hoist and one plain traveler with a 2-ton chain hoist by means of which the motors are lifted from the floor after they have been lowered by the crane and moved to any part of the room as desired.

This room has four 12-in. iron pillars which sustain the floor overhead, and three of these are used as supports for the jibs illustrated in an accompanying sketch. These jibs can be turned under the overhead tracks in a complete circle. Two jibs reach three tracks and one jib reaches two tracks, so that a motor can be lowered from almost any part of the track for pick-up by a jib. The motors are overhauled almost entirely with these jibs, each of which has a traveler and 2-ton Yale & Towne hoist. Although some of the old split-shell type



Third Avenue Motor Shop—View Showing Foreman's Office in Background, Ventilating Ducts, Jib Hoists and Overhead Track Which Serves the Entire Shop

Third Avenue Motor Shop—The Portion of the Shop Seen by the Foreman from His Office Window

motors are opened under the main telpher tracks, the latter are used primarily to get the motors in and out and to place them. The sketch of the jibs shows that they are fitted with solid wheels on the sides where the weight is taken and that the roller-bearing effect obtained, although simple in make-up, permits motors weighing 2600 lb. to be handled easily.

Third Avenue Motor Shop—Telpher Hoist, Ventilating Fan and Lockers.

GENERAL LAYOUT FEATURES

One advantage of having the electric welding room adjacent is that a low four-wheeled hand truck can be used to haul material to and from the same. Another is that a set of welding leads can be extended into the motor room so that all light welding jobs can be performed there under a shielded arc.

Originally, each side wall had four recesses 2 ft. high, 4 ft. long and 3 ft. deep, placed there for some reason unknown to the present generation but now found useful, nevertheless. By fitting each with a door, these niches were converted into excellent places for storing sledge hammers, wrenches, furnaces, paint, waste, oil, etc.

One corner of the room is partitioned off with ½-in. mesh for use as a storeroom and office. The office window is placed toward the middle of the shop and the foreman's desk in front of the window so that he has every man in sight. The storeroom has sixty bins, 12 in. x 12 in. x 12 in., and twenty bins about three times as large to keep all material for immediate use. Supplies are drawn from the main storeroom in quantities and are taken from this sub-storeroom as needed.

The foreman's desk has three drawers of card cabinet type on each side for the motor record cards, which are kept by the foreman himself. He has a card for every motor, each type arranged in one drawer and each in its proper numerical order. The card shows the motor number, type, date, armature numbers removed, whether it was brought in for mileage overhauling or for trouble and the repairs made. Every morning the foreman spends, say, thirty minutes to enter on the cards the work done the day before. The idea of having the foreman watch the cards is that, to him, each motor is an individual instead of being just a motor. If one comes in for trouble, he can quickly tell by looking at his cards when it was last in shop; if it shows a defect repeated, he will look deeper than ordinarily to overcome the trouble. Special test data on any particular motors are also recorded on these cards.

The mill room of the Sixty-fifth Street shop is equipped with a powerful vacuum system for removing shavings, etc. An extension was made from the ducts to the motor room so that when a motor is blown out a vacuum hood is placed over it to draw the dirt to the boiler several hundred feet away. The vacuum line is closed when not in use but it can be opened during periods of excessive smoke, or when bad-smelling waste is being removed from the bearings of a motor which has been running ten or twelve months.

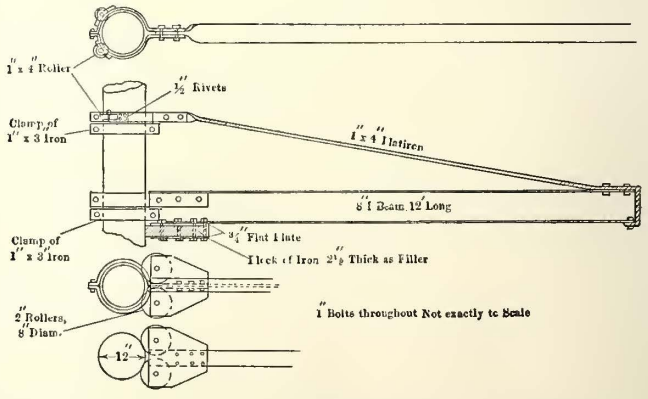
The box-frame motors, which are most numerous on our road, are overhauled on the four heavy benches shown in the general view. Each bench is 22 in. high, 26 in. wide and 72 in. long. The legs are 4 in. x 4 in., and the top planks 3 in. thick by 12 in. wide, all of oak. One spindle for removing the armatures of box-frame motors, placed midway between the two jibs, and one bench placed on each side of both jibs provide enough means for four gangs to overhaul box-frame motors.

The floor is cement. Instead of the lime generally used in similar places to take care of drip oil, white sand is sprinkled lightly all over. This sand keeps the floor white and clean at all times, regardless of the grease and dirt brought in on the motors.

COURSE OF MOTOR OVERHAULING

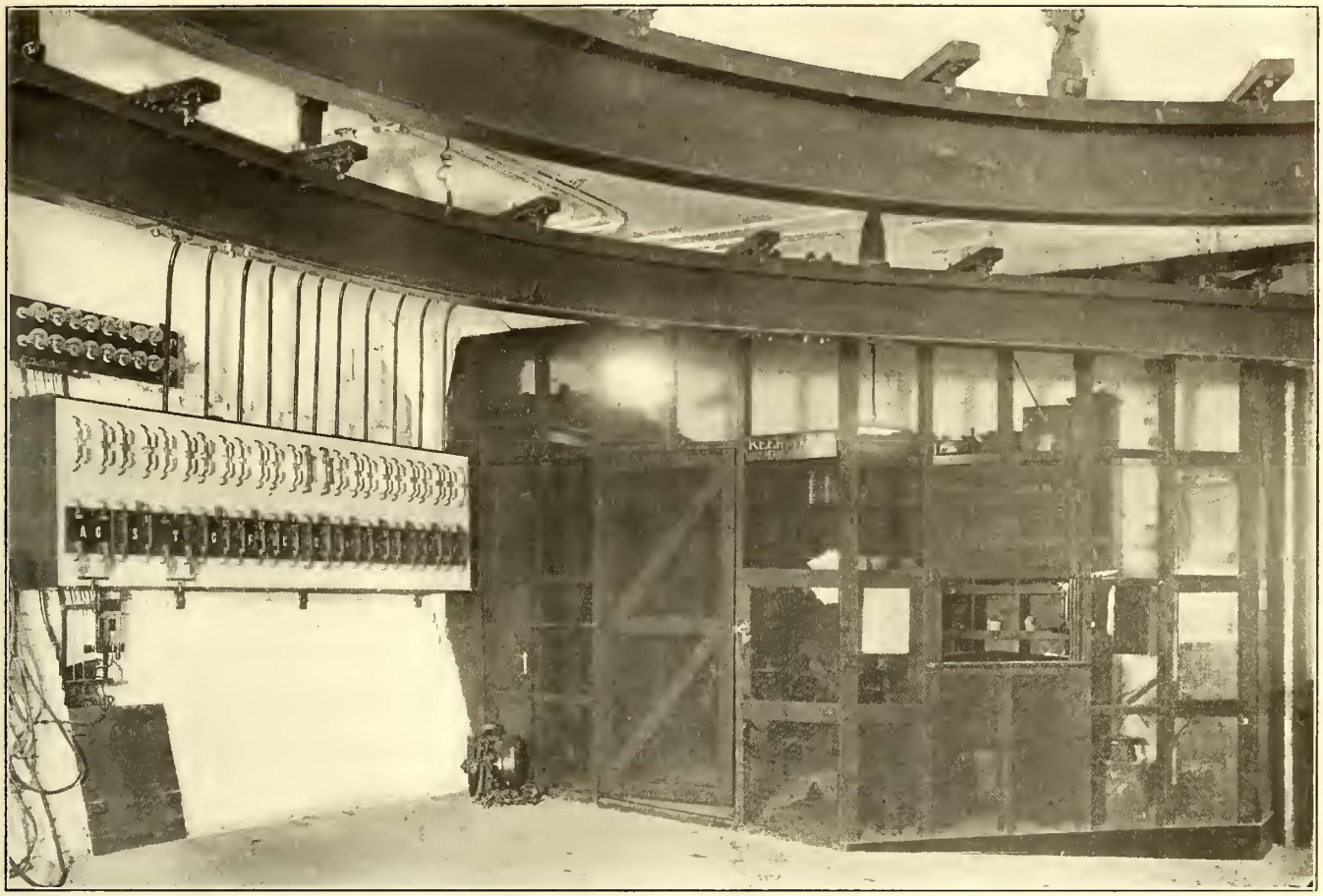
As the motors are brought in, the outside of the shell is scraped and cleaned before any other work is done. A pan is placed below the shell so that the dirt drops into the pan instead of on the floor.

It is this company's custom to do all the motor overhauling at the general repair shop and none at the carhouses. All cars with box-frame motors are brought to the shop for overhauling. Cars with old-style motors are cared for in the carhouses by keeping in reserve two or three extra motors of the type used on their division. Defective motors are thus replaced complete and forwarded to the shop for repairs. This practice eliminates all need for storing motor repair parts at the carhouses and insures a "shop" job in repairing motors

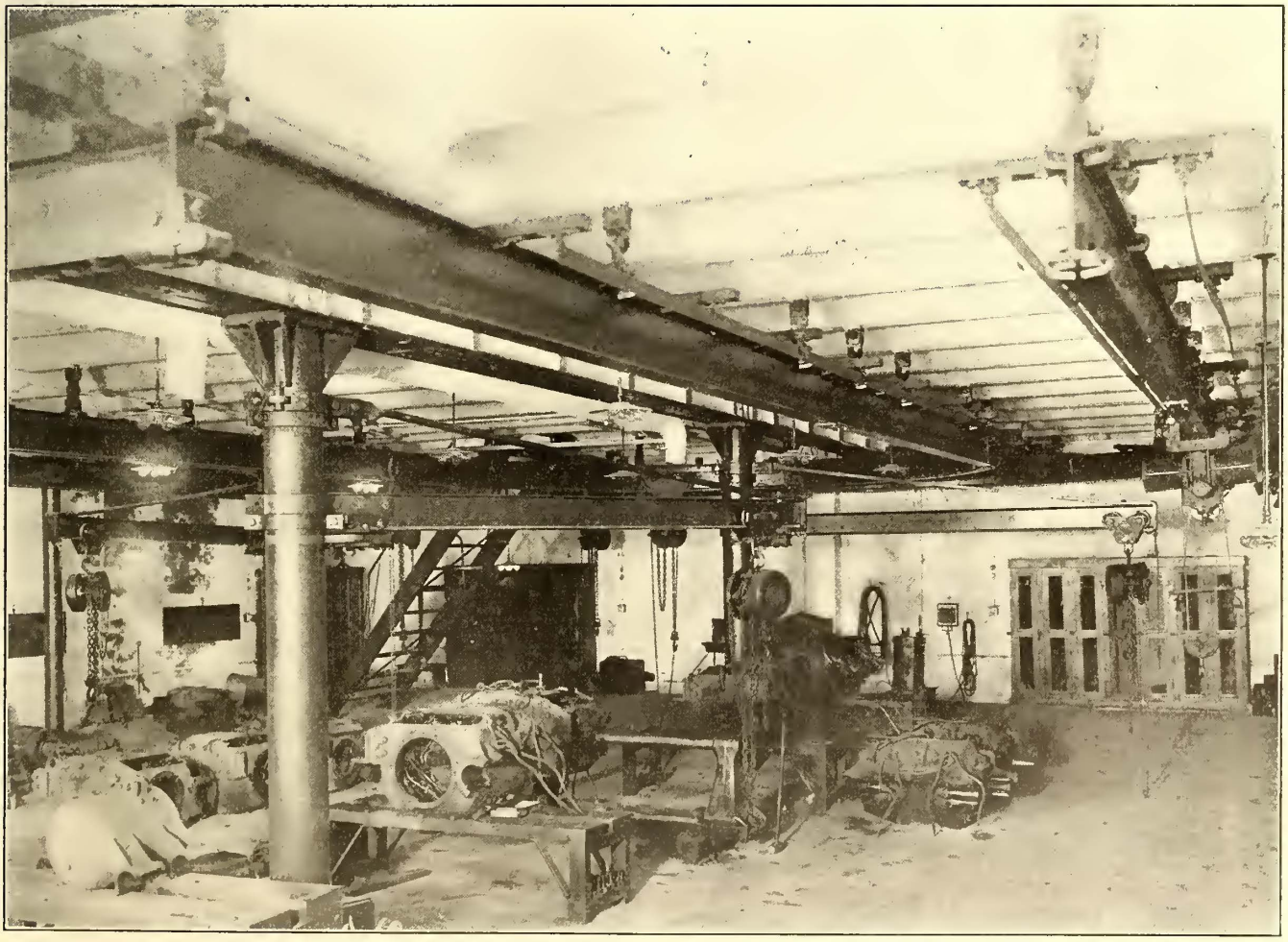


Third Avenue Motor Shop—Sketch of Jib Hoist Built to Turn in a Complete Circle

instead of the ordinary carhouse method. It is rare even for a carbon brush to be changed at the carhouses. Each motor on its arrival at the shop is inspected by the foreman. If the motor needs a general overhauling, it is entirely stripped, the shell is cleaned and painted inside, and the armatures, fields and brush holders are sent to the electrical repair shop for individual over-



Third Avenue Motor Shop—Detail Showing the Foreman's Office and the Operating Switchboard with Test Lamps Above



Third Avenue Motor Shop—View Taken Under the Opening from the Truck Shop

hauling. When a motor is completely overhauled the fields are tested with a compass for polarity. The other tests are mentioned in the next paragraph and under "Testing Equipments."

If all but the bearings of the motor are in good condition, the armature is removed and the fields are tested with the voltmeter and ammeter for short-circuits and loose connections and then with 1000 volts a.c. for grounds. Upon this the fields are cleaned and painted. The motor finally is reassembled with an overhauled armature and supplied with other bearings.

Each motor is handled by a man and a helper, who strip and reassemble the machine complete except that all brush holders are handled by a specialist. The brush-holder man also smooths the commutators with fine sandpaper, fits the brushes, examines the work of the men ahead of him, subjects the motors to the a.c. and light-running tests and gives them final touches with the paint.

Third Avenue Motor Shop—View of the Shop as Seen fro m Operating Switchboard, Showing Work Benches, Jibs, Armature Trucks, Etc.

TESTING EQUIPMENTS

The testing equipment of the motor room provides for an a.c. test, running test, volt-ammeter test and light ground test. A transformer with 330-volt primary supply from the substation and 1000-volt and 2000-volt secondaries is used for the final trial of all motors. We use 1000 volts ordinarily, but 2000 volts when the work is new and special.

The running test comprises a K-11 controller and a set of resistances which are made up of heater coils and car grids. These resistances are so connected that the first point reduces the voltage enough to run a 110-volt storage battery traction motor at a speed of 600 or 700 r.p.m. At the second point all the heater coils are cut out, whereby the resistance is reduced enough to run a 600-volt motor at about the same speed. The third, fourth and fifth points have correspondingly lower resistance so that a motor can be speeded up, but when the fifth point is reached enough resistance is left to hold the motor to a safe speed.

Two meters for the volt-ammeter test are placed compactly in a box for service in connection with the same controller and resistance which are used for the running test. Leads are attached from the controller to the box, and from the box to the fields of the motor under test. As the controller is moved to the first or second points, the current which is passing through the field is shown on the ammeter. A special table is used to show what the drop in voltage should be across the fields of each type of motor at different amperages. These figures were secured by testing a number of fields which were known to be good. With the combined aid of the meters and table, the operator can quickly detect a short or open circuit.

The light ground test is very simple. A pair of leads are connected with a set of heaters which have resistance enough to reduce the voltage to a point where the leads can be placed together and pulled apart with only a small arc. This test is used by the workman to check up his job and to locate trouble.

GENERAL

The shop has fifteen up-to-date lockers and a wash-basin with hot and cold water connection for the comfort and convenience of the men. The tracks, jibs and other equipment were installed by the motor-overhauling force with the aid of the blacksmith shop, which made up the parts of the jibs.

The Argentine government has approved the plans of the Buenos Aires Western Railway for electrifying the route between Plaza Once and Moreno.

Maintenance Costs and Records with Single-Phase Equipment

Operating Records and Costs of the Car Equipment Department on the New York, Westchester & Boston Railway Are Published Complete in Tabular Form, Showing That Remarkably Low Figures Have Been Attained During the Past Year

In the past there has been a widely expressed belief that a high cost of maintenance for single-phase equipment was inevitable. Much of this has been due to the fact that no accurate records have been available for publication, and for this reason the complete costs on the New York, Westchester & Boston Railway have been obtained. These are published herewith. The cars to which these records apply were described in detail in the ELECTRIC RAILWAY JOURNAL for March 30, 1912, page 492. They are built entirely of steel and have full-vestibuled patforms and center side doors. All are 70 ft. 4 in. long over platform end sills, 9 ft. 7¾ in. wide over side posts and 13 ft. 3½ in. high from rail to top of roof. The seating capacity is seventy-eight. The estimated weight of a car completely equipped for service is 120,000 lb. Both motors are on one truck, the other truck being an idler. The motor and trailer trucks are similar in design, but the trailer truck has smaller wheels and axles and a different arrangement of brake rigging from that on the motor truck, the former having a clasp brake with two shoes to each wheel. The motor truck on each car is equipped with two Westinghouse six-pole, single-phase, forced-draft motors, having an hourly rating of 175 hp. The continuous rating is 145 hp. These motors provide an

accuracy of the figures is undeniable, as they have been furnished direct from the auditor's books and their totals checked with the reports of the company to the Public Service Commission of New York State. The records are of especial interest, not only because they demonstrate positively that the cost of maintenance of straight single-phase equipment on multiple-unit cars is not necessarily high, but also because they present interesting records of performance, which may in many cases establish standards for the consideration of other roads.

TABLE I—MAINTENANCE COSTS ON NEW YORK, WESTCHESTER & BOSTON RAILWAY

Repairs—Labor and Material

	A. C. Eqpt.	Motors	Cont. Equipment	Car Body	Trucks, Wheels, Axles	Gears, Pinions	Pantos.	Air Brakes	Brake-shoes	Misc. Shop Exp. and Supervision	Total	Cents Cost per Car Mile
1—1913....	$234.29	$1557.06	$282.92	$116.05	$87.87	$40.94	$122.31	$168.71	$123.82	$659.37	$3393.34	3.04
2—1913....	209.21	169.49	319.84	162.66	117.87	85.82	110.05	111.53	46.50	675.74	2008.71	2.00
3—1913....	336.41	270.38	215.73	418.54	103.81	23.81	216.02	80.18	170.75	1312.16	3147.79	2.61
4—1913....	410.81	230.98	307.72	203.94	74.32	181.83	119.48	75.45	62.91	699.54	2366.98	2.02
5—1913....	45.62	102.95	47.55	57.70	75.03	6.00	159.03	101.36	221.51	835.65	1652.40	1.27
6—1913....	86.61	129.37	77.21	107.90	180.65	39.07	219.00	97.47	140.25	605.64	1683.17	1.30
7—1913....	159.44	94.22	106.46	115.39	277.91	6.00	157.39	66.31	228.12	421.54	1632.78	1.25
8—1913....	140.26	85.20	95.83	161.59	282.26	29.05	160.83	74.44	162.41	436.03	1627.90	1.28
9—1913....	126.03	105.27	71.85	276.48	193.29	.....	119.43	108.35	164.81	439.37	1604.88	1.31
10—1913....	94.02	136.65	101.77	139.08	165.57	13.25	95.37	82.33	152.14	366.72	1346.90	1.07
11—1913....	79.25	68.66	97.36	234.42	117.55	7.25	68.69	77.65	137.72	465.18	1353.73	1.12
12—1913....	150.04	105.03	191.40	213.55	112.27	28.99	169.65	60.91	177.78	300.00	1509.62	1.17
Average	$172.66	$254.61	$159.64	$183.95	$149.04	$38.50	$143.10	$92.05	$149.06	$601.40	$1944.01	1.62

Inspection—Labor and Material

	A. C. Eqpt.	Motors	Cont. Eqpt.	Car Body	Trucks, Wheels, Axles	Gears, Pinions	Pantos.	Air Brakes	Brake-shoes	Misc. Shop Exp. and Superv'n	Term. Insptrs.	Oilers	Total	Cents Cost per Car Mile
1—1913.....	$50.25	$52.98	$83.46	$40.50	$37.30	$16.15	$31.15	$29.75	$15.25	$150.00	$300.00	$58.73	$865.52	0.77
2—1913.....	48.50	47.25	75.75	35.55	37.50	15.00	30.50	32.60	22.00	135.50	241.50	49.30	770.95	0.76
3—1913.....	52.00	55.50	78.75	38.90	40.25	12.00	32.50	34.75	24.23	125.00	337.00	45.00	875.88	0.73
4—1913.....	60.82	83.29	40.56	33.62	73.12	11.75	55.23	37.35	60.52	138.99	357.00	65.00	1017.25	0, 86
5—1913.....	57.81	95.06	40.00	50.00	76.41	44.42	75.00	41.41	28.86	156.10	372.00	48.55	1085.62	0.83
6—1913.....	34.16	30.72	33.28	16.83	58.90	17.58	26.53	26.17	26.85	77.96	358.00	73.58	790, 56	0.61
7—1913.....	60.73	26.34	47.00	20.00	73.93	2.85	50.59	58.96	38.60	103.68	363.00	90.57	936.25	0.72
8—1913.....	75.41	19.35	42.38	23.05	83.94	29.05	39.00	64.13	32.56	120.70	376.65	61.49	967.71	0.76
9—1913.....	35.25	26.24	19.64	45.01	44.01	3.00	34.00	75.13	32.11	110.90	363.90	74.54	863.73	0.70
10—1913.....	30.30	61.51	41.52	42.01	86.12	12.28	29.00	30.37	25.11	113.68	372.00	96.96	940.86	0.74
11—1913.....	36.19	48.00	45.30	30.04	63.32	7.28	36.74	53.00	26.00	111.40	360.00	88.42	905.69	0.75
12—1913.....	53.17	52.97	83.46	40.53	37.29	16.08	31.00	29.98	23.92	151.75	366.00	57.25	943.40	0.73
Average.....	$49.55	$49.93	$52.59	$34.67	$59.34	$15.62	$40.10	$42.80	$29.67	$124.65	$347.25	$67.45	$913.62	0.74

NOTE.—Costs of car cleaning, lubricating materials and incandescent lamps not included in the above figures.

TABLE II—DELAY IN MINUTES CHARGEABLE TO DIFFERENT PARTS OF EQUIPMENT, NEW YORK, WESTCHESTER & BOSTON RAILWAY .

1913	Brakes	Minutes, Brakes	A. C. Equipment	Minutes, A. C. Equipment	Control Equipment	Minutes, Control Equipment	Panto-graphs	Minutes, Panto-graphs	Miscellan-eous	Minutes, Miscellan-eous	Total Delays	Total Minutes' Delay	Miles per Delay	Miles per Minute Delay	Cars Taken Out of Service	Total Miles
January.....	2	8	0	0	4	34	2	32	2	10	11	84	10,129	1,326	8	111,421
February.....	6	27	0	0	0	0	3	20	1	12	10	59	10,010	1,686	17	100,182
March.....	3	10	0	0	3	23	5	72	0	0	10	105	11,860	1,127	8	118,608
April.....	3	19	0	0	2	4	1	15	0	0	6	38	19,527	3,083	5	117,166
May.....	1	6	0	0	3	16	0	0	1	5	5	27	25,889	4,779	2	129,449
June.....	2	7	2	7	0	0	3	20	1	1	8	35	16,174	3,690	7	129,184
July.....	1	12	0	0	1	9	1	22	0	0	3	43	43,258	3,018	7	129,776
August.....	0	0	0	0	0	0	0	0	0	0	0	0	126,198	126,198	7	126,198
September.....	0	0	1	8	0	0	1	8	0	0	2	16	60,956	7,619	5	121,913
October.....	2	10	0	0	1	5	0	0	1	23	4	38	30,678	3,229	9	125,682
November.....	6	49	0	0	1	11	0	0	0	0	7	60	16,737	1,952	10	119,835
December.....	0	0	1	20	0	0	0	0	0	0	1	20	128,239	6,412	11	128,239
Totals.....	26	148	4	35	15	102	16	189	6	51	67	525	21,756	2,776	96	1,457,653
Average per month....	2.1	12.3	.3	.3	1.2	8.5	1.3	15.7	.5	4.2	5.6	43.7	41,638	13,343	8	121,471

Cars in service, 30.

acceleration for the car of 1 m.p.h.p.s. on level and straight track. The weight of the electrical equipment is 24,500 lb., including one transformer, two pantographs, one switch group, one blower outfit, two motors and the miscellaneous electrical control and lighting equipment.

MAINTENANCE COSTS

The total costs of maintenance are shown in Table I. These costs are divided into two parts, namely, repairs and inspection, this being the form of records required by the New York Public Service Commission. The figures include both labor and material but do not cover the cost involved in cleaning cars, the cost of material for lubricating purposes and the cost of lamps replaced in the cars owing to breakage or deterioration. The costs of car-cleaning and lubricating material are shown in Table VI, and the number of lamps replaced each month during the past year is shown on Table IV, the cost per lamp being 23 cents. In Table I the figures shown in the column headed "A.C. Equipment" cover all a.c. wiring, the blowers, the transformers and the switch groups, in fact, everything except the propulsion motors and the pantographs. The figures under the heading "Control Equipment" cover all d.c. apparatus, such as the batteries and the d.c. side of the switch-group and control, the a.c. side of the switch group being included with the figures for a.c. equipment.

The cost of the motor repairs shown during the month of January is high because the expense of rewinding four armatures during the previous summer was charged out during that month. These four armature failures were mentioned in the article on the maintenance of electrical equipment published in the ELECTRIC RAILWAY JOURNAL for Feb. 21. Three of the failures were due to overworking and overheating during hot weather, while the other was caused by a defective commutator bar which grounded on the armature shaft through faulty insulation.

The high cost shown under the heading "Miscellaneous Shop Expense" during the month of March was caused by the fact that the entire coal bill for heating the shops during the winter of 1912-13 was charged out in that month. The shop, it may be said, is in a residence district, and it is necessary to burn anthracite coal in the heating boilers, the price of this fuel being extremely high. Obviously both of these single items of high cost could have been distributed, one over the year before and the other over the entire winter, but this procedure would have necessitated making reports which were different from the figures as shown in the auditor's books. This, in many respects, has not been considered to be desirable.

The total cost of maintenance and inspection expressed in cents per car mile may be found by adding together the last two columns of each part of Table I, the average for the year being 2.36 cents. For the different months the total figures are as follows:

TOTAL COST OF MAINTENANCE AND INSPECTION BY MONTHS IN CENTS PER CAR MILE

January	3.81	July	1.97
February	2.76	August	2.08
March	3.34	September	2.01
April	2.88	October	1.81
May	2.10	November	1.87
June	1.91	December	1.96

DELAYS AND DEFECTS

In Table II, which shows delays in minutes chargeable to the different parts of the equipment, the column headed "Cars Taken Out of Service" means the cars taken off trains for any reason whatever. This does not mean, however, that the car broke down on the road but simply that some defect was discovered and the car was turned in at the inspection terminal at either end of the road and was replaced by another car. Not more than one car is ever held out of service at any one time for more than twenty-four hours, and this one car is held for painting, the cars going through the paint shop in regular rotation. The requirements of the present schedule are twenty-seven cars out of the total of thirty with which the road is equipped.

Table III, which shows the car-defect report for the year 1913, is made up from a monthly car-defect-report sheet that shows the same information by days instead of the totals for each month. These car-defect-report sheets, it may be said, are watched very closely by the superintendent of equipment, and he investigates any marked case of trouble in person, his attention being called to these cases whenever an exceptional number of defects of any one class is shown. As an example, in the month of October eleven doors were reported defective, and upon investigation the trouble was found to be insufficient lubrication by the inspectors. In consequence orders were issued to devote more time to oiling, and more elaborate instructions for the inspectors were posted in the inspection sheds.

TABLE III—CAR DEFECT REPORT FOR 1913, NEW YORK, WESTCHESTER & BOSTON RAILWAY

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Compressors	1	..	3	..	..	..	..	..	..	1	4	2	11
Governors	..	3	1	..	1	..	1	..	..	1	3	3	13
Control valves	4	5	3	..	..	..	8	1	4	..	1	..	26
Brakes leak-off	..	3	..	2	..	1	..	..	..	..	..	..	6
Stuck brakes	1	8	6	3	..	3	4	1	2	1	3	2	34
Electric brakes	4	4	..	3	3	5	8	..	2	..	2	1	32
Feed valves	..	..	1	3	2	2	1	..	..	1	3	6	19
Brake valves	5	9	2	2	..	3	2	..	1	..	1	..	25
Brakes release slow	1	7	1	..	..	2	2	1	3	3	7	1	28
Poor brakes	3	6	1	2	..	12	3	2	2	2	..	6	42
Emergency valves	..	1	..	..	..	..	1	1	1	..	..	..	4
Whistles	1	..	1	1	..	..	..	..	1	..	..	1	6
Air pipes	1	..	..	..	1	..	1	1	..	1	..	..	5
Angle cocks and hose	..	..	..	..	..	2	1	..	1	..	..	..	4
Line switches	..	..	1	..	1	1	1	1	..	..	..	..	5
A. C. wiring	..	1	..	1	..	2	2	..	2	..	..	..	8
Transformers	..	..	..	..	..	..	..	..	..	..	..	..	..
Control wiring	..	1	..	..	1	1	..	..	1	1	..	..	5
Current relay	..	2	6	..	1	1	1	..	4	..	3	3	21
Line relay	..	..	..	..	..	..	..	..	..	..	..	..	..
Overspeed relay	0	..	..	..	..	..	..	..	..	1	1	2	6
Jumpers and sockets	..	..	..	1	1	..	..	..	..	..	1	..	3
Switch groups	3	..	1	..	..	3	1	..	..	2	1	1	12
Switches	3	1	1	1	4	1	1	..	..	1	3	1	17
Lights	..	..	..	..	..	..	..	..	..	..	1	..	1
Battery lights	..	..	..	..	..	..	..	..	..	..	..	2	2
Motor leads	..	1	1	..	..	..	..	1	..	..	..	..	3
Pantographs	13	14	10	8	9	17	16	4	6	13	14	12	137
Batteries	..	..	1	..	2	3	1	..	2	6	1	4	20
Heaters	..	3	1	2	..	..	..	..	1	1	7	9	24
Motor generators	..	1	1	..	..	..	3	..	..	..	2	1	8
Reversers	2	..	1	..	2	2	1	..	..	2	..	..	10
Motors	..	2	1	3	1	1	..	..	..	1	..	2	11
Blowers	..	2	..	..	..	3	1	..	..	1	2	..	9
Flat wheels	9	14	4	4	4	3	..	..	6	1	6	4	55
Hot journals	..	3	1	2	..	..	3	1	3	5	3	4	25
Hot armature bearings	..	..	..	..	..	..	..	..	..	..	..	..	..
Gears	..	..	..	..	..	..	..	..	..	2	1	..	3
Doors	3	7	1	3	2	..	2	..	6	11	5	9	49
Glass	..	..	2	1	1	1	2	..	4	3	4	..	18
Car seats	..	2	..	2	3	2	1	..	12	3	2	1	28
Trucks	..	..	..	3	1	2	..	..	1	1	1	..	9
Leaky roofs	3	3	5	5	1	..	..	..	..	5	1	2	26
Car uncoupled	..	..	..	..	1	1	..	..	1	1	..	1	5
Shop	..	2	1	1	..	..	..	..	..	1	1	..	6
Motormen	2	1	1	..	..	..	..	2	1	..	..	1	8

These monthly car-defect-report sheets are filled in every day from a trainman's defect slip, which is made out and signed whenever trouble is discovered on any car. This defect slip is reproduced herewith. On the back is a space for remarks by terminal foremen as to the cause of the trouble. After the report is investigated and an explanation of the trouble is written on the back and signed by the terminal foreman, the slip is sent direct to the office of the superintendent of equipment for entry in the monthly car-defect-report sheet. In many cases no trouble is discovered upon inspection, the derangement as reported being only temporary in character or else imaginary on the part of the trainman. In such cases the inspector makes a thorough test under operating conditions and notes the fact on the back of a slip, reporting the car over his signature to be "O. K." Such reports of imaginary

defects are not held against trainmen's records. Instead, the men are encouraged to report everything, no matter how minor in character it may be. The reports for which no actual defect was found by the inspectors are not entered in the defect record for

NEW YORK, WESTCHESTER & BOSTON RAILWAY

This Copy to Inspection Shop Foreman

REPORT OF DEFECTS TO CAR NO.....

Date.....191 Line.....
.....A. M. .....P. M.
Length of detention.....mins. Train No.....
Place of trouble.....
Motorman.....No.....
Conductor.....No.....

CAR-BODY TROUBLES	CONTROL TROUBLES
Bad-order door	Circuit breaker
Broken glass	Circuit breaker reset
Ventilator	Switch group
Bell	Controller
Bell cord	Reverser
Light switches	Motor cut-out
Markers	Current limit relay
Heaters	Potential relay
Diaphragm	Resistance grids
Safety chains	Jumpers
Buffing device	Receptacles
Drawbar	Blower motor
Headlight	Motor generator
Car seats	Storage battery switches
Car floor dirty	Would not notch up
Lights	AIR BRAKE TROUBLES
Pantograph trolley	Brakes do not release quickly at times
MOTOR TROUBLES	Brakes release on lap
Motor bearings	Brakes do not stop train quickly enough
Motors hot	Motorman's valve stiff
Gears	Feed valve
TRUCK TROUBLES	Governor does not cut out
Motor truck	Compressor not working
Trailing truck	Electric brake
Flat wheel	Brake pipe
Hot box	Reservoir pipe hose
Broken brake rigging	Brake pipe hose
	Air whistle

DEAD CAR.....

REMARKS

Westchester Equipment—Defect Report Filled Out by Trainmen

obvious reasons, although slips covering the report are sent to the office of the superintendent of equipment in the regular manner.

MISCELLANEOUS COSTS AND REPLACEMENTS

In Table IV, showing replacement of small parts during the year, the heavy replacements of lamps of all kinds, especially during the first part of the year, were due to changing the standard, as a 23-watt lamp was

TABLE IV—REPLACEMENTS OF SMALL PARTS IN 1913, NEW YORK, WESTCHESTER & BOSTON RAILWAY

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Motor generator auto-starter	...	1	...	1	..	1	1	..	..	..	3	2	9
Controller fingers	...	...	5	...	..	1	..	..	..	..	2	1	9
Switch group contact tips	...	...	...	...	..	32	56	60	41	24	24	18	255
Reverser fingers	6	...	...	...	..	..	..	..	..	..	..	...	6
Resistance grids	6	...	...	...	..	..	..	..	..	..	..	...	6
Unit switches	2	1	...	...	..	..	..	..	..	..	..	...	3
Canopy switches	...	...	4	...	..	..	..	..	..	..	..	...	4
Canvas blower connections	...	...	5	6	6	1	..	2	..	..	2	...	22
Roller side bearings	1	2	3	...	1	1	5	1	1	1	1	2	19
Air-brake hose	...	...	...	1	12	20	..	..	..	..	..	...	33
Line-switch contacts	1	..	...	2	..	..	..	..	..	..	..	...	3
Motor-brush holders	...	2	...	...	2	..	..	..	..	..	..	4	8
Heater coils	...	...	1	...	..	..	..	..	..	4	2	1	8
Journal brasses	...	...	...	...	..	..	4	..	..	5	..	...	9
Pantograph insulators	2	1	..	...	..	..	..	..	5	1	..	...	9
Battery lamps	400	250	150	115	25	25	..	..	..	26	37	33	1061
Gage lamps	24	36	12	6	2	..	9	..	..	1	0	...	90
Car lamps	221	248	100	91	..	50	60	25	89	38	69	111	1102
Motor armature bearings	...	...	...	...	..	..	..	..	..	1	..	1	2
Motor axle bearings	...	...	...	...	..	..	..	..	..	..	..	...	....

adopted for use throughout the cars after extended experiments had been made with three other kinds of lamps. As mentioned before, the cost of lamp replacements is omitted from the general maintenance record as given in Table I, but if desired the total cost for lamps may be determined from Table IV and added to the total costs.

The replacements of switch-group contact tips, which are shown to begin in June, are accounted for by the fact that, according to the standard time basis which has been established for renewing them, all cars are due to have this work done at the present time. The work will, of course, continue until all contacts are overhauled.

Table No. V gives the number of replacements and the mileage of brakeshoes, pantograph shoes and main motor brushes. The cost of labor and material for brakeshoes is given in Table I. The weight of a new brakeshoe is approximately 40 lb., while the weight of the scrap averages 14 lb. This gives a net ratio of use-

TABLE V—REPLACEMENTS AND MILEAGE OF BRAKE AND PANTOGRAPH SHOES AND MAIN MOTOR BRUSHES, NEW YORK, WESTCHESTER & BOSTON RAILWAY

	—BRAKE SHOES—		PANTOGRAPH SHOES		—MOTOR BRUSHES—	
	Number Used	Miles per Shoe	Number Used	Miles per Shoe	Number Used	Miles per Brush
January	219	5,988	130	840	285	18,384
February	123	9,627	94	1049	774	6,096
March	116	12,205	112	1046	738	7,624
April	124	11,160	104	1109	980	5,651
May	156	9,957	96	1320	400	15,214
June	90	12,224	93	1357	200	30,308
July	124	12,558	89	1425	100	60,864
August	95	15,552	66	1866	100	59,088
September	86	17,011	50	2379	350	16,308
October	150	10,054	46	2667	475	12,384
November	85	16,917	66	1775	350	16,068
December	129	11,644	75	1669	500	12,017
Average	124	12,075	85	1542	437	21,667

ful metal to the total weight of metal purchased amounting to 65 per cent. The pantograph shoes are worth about 20 cents each, including the cost of labor and material employed in their manufacture at the company's shop. The cost of pantographs given in Table I covers, in addition to the cost of the shoes, the cost of work on pantograph frames, insulators, pressure cylinders and springs. The figures given for motor brushes, as shown in Table V, apply only to brushes for the main propulsion motors. These cost about 8 cents each for material only, there being six poles and twenty-four brushes to each motor.

Table No. VI includes miscellaneous costs and records, as shown. The cost of lubrication given in this table covers the cost of material only. The labor is shown under the heading "Oilers" in Table I. Car cleaning is expressed on a basis of cost per car per month, two general cleanings being given to each car during that

TABLE VI—MISCELLANEOUS COSTS AND RECORDS, NEW YORK, WESTCHESTER & BOSTON RAILWAY

1913	Lubrication Material per 1000 Car Miles	Total Shop Payrolls	Car Cleaning, Cost per Car per Month	Kw-hr. per Car Mile	Watt-hr. per Ton Mile	Number of Shopmen	Pantographs Broken
January	$0.21	$2338.89	$6.48	5.60	93.3	26	4
February	0.20	2229.47	4.91	6.00	100.0	29	8
March	0.26	2687.07	5.42	5.30	88.3	29	9
April	0.25	2216.68	5.02	4.76	79.3	21	8
May	0.21	2267.47	5.02	4.55	75.9	21	6
June	0.26	2003.59	6.17	4.61	76.8	22	10
July	0.18	2139.41	6.69	4.65	77.5	22	8
August	0.16	2112.55	6.74	4.58	76.3	22	7
September	0.16	1985.08	6.63	4.48	74.5	21	4
October	0.22	2035.26	6.65	4.54	75.6	20	3
November	0.17	1849.96	6.74	4.91	81.6	20	4
December	0.23	2076.91	6.94	5.34	89.0	20	6
Average	$0.21	$2161.86	$6.11	4.94	82.3	23	6

period of time. This work includes interior washing and disinfecting. In addition all cars are dry-swept and dusted every day, the windows being dry-cleaned with whiting. Windows are washed only after rainstorms.

The figures for kilowatt-hours per car mile and watt-hours per ton mile are obtained from measurements at the car by means of the wattmeters permanently mounted thereon. The figures include the power used

for lighting, heating and for auxiliaries as well as for the main propulsion motors.

MILEAGE BETWEEN INSPECTIONS AND OVERHAULING

The cars are inspected on a mileage basis, the minimum being 1200 miles and the maximum 1800 miles. These limits are adhered to very closely. All cars, it should be said, are tested thoroughly after every inspection, and at these times all parts needing attention are repaired and all necessary replacements are made, so that the cars are maintained in perfect condition at all times. The overhauling periods are therefore established only for heavy apparatus which does not readily get out of order but which must be gone over at intervals to avoid failures and progressive deterioration.

An overhauling period of one year has been established for the main propulsion motors. At these overhaulings the commutators are turned and slotted, the armatures and fields are inspected and tested and the bearings and brush holders are readjusted. One-year intervals have also been established as overhauling periods for trucks, switch groups, pantographs, reversers, line switches, and air-compressor governors. The air compressor is overhauled at one-and-one-half-year intervals, the brake valve at six-month intervals and the control valve and feed valve of the brake system at three-month intervals. Painting and varnishing are done once each year. This short period is due, as explained in a previous article, to the rust which falls upon the car roof and slides from the steel overhead wire and thus tends to cause streaks upon the car after each rainstorm.

ELECTROLYSIS TESTS IN SPRINGFIELD

In the Electric Railway Journal for Jan. 31, 1914, an abstract was published of a set of suggestions by the United States Bureau of Standards for electrolysis mitigation in Springfield, Ohio. Since that time the proposed installation of insulated negative feeders has been made together with additions that were considered necessary to make a complete arrangement. Recently a series of tests was made upon the new system, and the report upon this has been issued in Springfield by the committee of investigation, which included representatives of the National Bureau of Standards, the city of Springfield and the telephone, telegraph and gas companies in the city.

The system actually installed included insulated return feeders for the Ohio Electric Railway as well as for the Springfield Railway Company, the former company now having installed negative copper amounting to 33 per cent of its positive copper, and the latter company 35 per cent. The conditions were very favorable to a system of insulated negative feeders owing to the fact that the substations of the two companies were at opposite sides of the city so that by interconnecting the tracks it has been possible to interchange current on the negative sides to a very considerable degree, thus aiding in securing low potential differences.

The negative feeders were designed to reduce the potential gradient in all parts of the track system to a mean value not exceeding 0.5 volt per 1000 ft. under net average schedule traffic. This corresponds to approximately 0.8 volt per 1000 ft. averaged during the hour of peak load. The test data show that this condition has been substantially realized.

The report states that the present conditions existing in Springfield correspond to those prevailing in cities in Great Britain and Germany where experience has shown that there is substantial freedom from injury by electrolysis. The regulations in effect in Great Britain as stated by the report limit the maximum over-all voltage drop in any city to 7 volts, the maximum being defined as a mean value between the highest momentary peak and the average for the hour of maximum load. In Springfield the tests showed that the highest value obtained exceeded the British limit by only 2 volts, and in the majority of cases the over-all voltage readings were considerably lower. The limiting value prescribed in Germany prevents the over-all voltage within city limits from exceeding 2.5 volts during average schedule traffic. In Springfield only 19 per cent of the readings were above this.

With regard to potential gradient measurements the largest average value in Springfield for any one hour was 0.98 volt per 1000 ft. This, however, was due to defects of track which could be repaired. The average of all the values obtained throughout the city was 0.23 volt per 1000 ft. The German regulations prescribe for suburban lines a gradient limit of 0.3 volt per 1000 ft. of track during average scheduled traffic. In Springfield the average of all peak load gradients is found to be 0.35 volt for the hour and 0.64 volt for the highest ten-minute period.

The over-all voltage prescribed by law in Lorain, Findlay, Galion, Fremont and Canton, Ohio, is limited to 7 volts between any two points on the non-insulated portion of the track return during the ten minutes showing the highest value, and the potential gradient for the corresponding period is limited to 1 volt per 1000 ft. The values of over-all voltages and potential gradients existing in Springfield are considerably below these limits, except in isolated cases where there is bad rail bonding.

From the results obtained the authors of the report state that they are convinced that the insulated return-feeder system combined with proper maintenance of track bonding is the best means of dealing with the electrolysis problem in all cases where it is not practicable to insulate the tracks from the ground.

The report makes strenuous objection to the use of pipe drainage under any circumstances for the city of Springfield, but instead recommends that the insulated return-feeder system should be supplemented by a certain proportion of insulating joints in the water pipes and gas pipes. With regard to lead cable sheaths of the telephone and telegraph companies, however, it says that it would not be commercially practicable to extend the insulated return-feeder system so that they could be safeguarded against electrolytic action. It is therefore cheaper to apply a limited amount of drainage protection to the cables, which, being continuous conductors, can be protected in this way. The problem of draining cables differs in many respects from that of draining pipes, particularly in that cables are continuous conductors and the difficulties arising from high resistance joints are not encountered. Great care, however, should be exercised not to overdrain the cables, as such overdrainage may involve danger of electrolytic action in neighboring structures.

The report presents definite recommendations which are briefly as follows:

(1) The insulated return feeders now installed should be made permanent, subject to necessary extensions.

(2) No insulated negative feeders are necessary on the interurban lines in the city at the present time, on account of the light loads.

(3) All electric railway tracks within the city limits should be so constructed and maintained that no rail joint will exceed the resistance of 8 ft. of rail.

(4) All tracks within city limits should be inspected once each year.

(5) No metallic connections between water or gas pipes and the railway return circuit should be permitted.

The Best Trolley Wire

The Writer Shows Why Current-Carrying Conditions, Limits of Wear, Salvage Values and Other Factors Should Be Considered in Selecting a Standard Trolley Wire

BY G. H. M'KELWAY, ENGINEER OF DISTRIBUTION BROOKLYN RAPID TRANSIT SYSTEM

A short time ago my office was invaded by an enthusiastic and persistent salesman of a large wire company who, immediately after his entrance, announced that he had come in to sell me 10 miles of trolley wire. The fact that the company with which I am connected was not then buying any of its trolley wire from his company did not shake his confidence in the least, but seemed rather to increase his ardor, as he stated that he loved a good fair fight.

He knew that wire similar to that now furnished by his company had been tried out by us several years before and that there had been no repeat order for it. Assuming, therefore, that I had already learned of the high quality of the wire made by his company from the previous experience, he did not enlarge at length upon its advantages over other makes of wire in so far as its strength, toughness or conductivity was concerned, but he tried to convince me of the desirability of using it principally because of its lower first cost as compared with other wire of the same size and similar qualities. This, perhaps, was due to my statement that I did not doubt that the wire in question was a very good one, but that I had never been able to see that it was as economical in the long run, all things being considered, as the one that we were using.

At last, becoming convinced that general statements as to the economy of the wire were futile and that I must be "shown" by means of figures that could be applied to specific cases, he left, but in a week or two he was back with a typewritten statement which gave the results that might be expected on the lines of my company.

The figures were conservative and in all but one point seemed to agree closely with what might be expected from the conditions under which we operate. Even the figures to which exception was taken could easily have been duplicated on many systems, but here it was our experience that it was safer and more economical to use others. The different conditions required by our service did not seem to be so important as greatly to change the salesman's figures, and he was greatly surprised and disappointed to find that the results, in dollars and cents, were entirely altered, and that instead of his wire showing a saving of approximately $175 per mile over what we were using, the revised figures indicated that we would lose about $15 for the same unit of length.

As a seemingly slight and relatively unimportant change in but one of several conditions had entirely altered the results of the calculations and caused an apparently better wire to fall below our standard in desirability, it might be well for the engineers of other lines to look more carefully into this matter to see if they are using the kind of wire best suited to their purposes when both service and price, the latter including maintenance, scrap value and first cost, are considered.

NEED FOR MATHEMATICAL STUDIES

It is impossible to know what wire will be the most efficient in any special case without making some kind of a calculation, yet how seldom is any calculation made! The usual way is to buy the wire that has been used with success before by the same road or about which the engineer has heard such reports from other roads as would make him believe that it will be the best for his road. Even if the first cost of the two different makes varies considerably, an attempt is seldom made to go into the matter carefully to see which would be the more economical in the long run. Almost invariably the choice is made either because one wire is cheaper than the other in first cost or because the life of one is expected to be longer than that of the other.

No attempt is made to balance the additional cost of one wire against the shorter life of the other and also to take into account the freedom from breaks or other causes of trouble and delay, as well as the salvage value of the wire when it has become so badly worn as to necessitate removal. Yet, as has been shown in the example given above, there may be a difference of $100 or $200 per mile of line and even much more. Carelessness in choosing the right kind of wire may often make very decided differences in the maintenance cost per mile per annum.

EFFECT OF CURRENT-CARRYING CONDITIONS

The trolley wires ordinarily used are of copper, steel, copper and steel or of a bronze composition, and it is between these that a choice must be made. While copper is the most used and can be shown to be the best for many lines, yet it is very likely that it is employed in more cases than it should be, as the only point where it can show any advantage over the other wires is that it has greater conductivity than any of them and less first cost than some of them. This high conductivity is important where there are no feeders and where all of the current has to be carried by the trolley wire, but it is not nearly so important where heavy feeders are in multiple and all but a small proportion of the current is carried by them, because then the voltage drop and wattage loss in the trolley wire are very small.

Therefore, hard-drawn copper will usually be the best material on light lines where there is little likelihood that more than three or four cars will take current at the same time, so that the average current will be too small for feeders, although fluctuating between wide limits. On the other hand, copper will seldom be found to be equal to some of the other wires of greater strength, although of less conductivity on heavy lines where the average current consists of perhaps 1000 amp or even more and where it is necessary to run feeder in multiple with the trolley wire. The same reasoning, to even a greater extent, will apply to lightly loaded but very long lines where much feeder has to be run to keep up the voltage and the current density in both the trolley wire and feeders is low. Between these limits there is much debatable ground where each case must be worked out separately and where the conditions may vary enough, owing to the fluctuation in the price of copper, to make it desirable to install at some times one kind of wire and at other times another kind.

COSTS AND SCRAP VALUES OF DIFFERENT KINDS OF WIRES

In order to show how the cost of the wire may differ at different times and also as a help to anyone who may

care to work out the costs of trolley wires of different materials for his road, Tables I, II and III are given, showing respectively the price of copper, bronze, copper-clad steel and plain steel wire, of sizes from No. 0 to No. 0000, and at varying prices per pound. While copper and bronze weigh the same per foot, yet there is a difference between the weights of copper, steel and copper-clad steel. For that reason different tables are given of the costs per mile at varying prices per pound of the wire.

TABLE I—PRICE PER MILE OF COPPER AND BRONZE WIRE

Cts. per lb.	No. 0	No. 00	No. 000	No. 0000
13	$219.31	$276.51	$348.66	$439.66
13½	227.74	287.14	362.07	456.57
14	236.18	297.78	375.48	473.48
14½	244.61	308.41	388.89	490.39
15	253.05	319.05	402.30	507.30
15½	261.48	329.68	415.71	524.21
16	269.92	340.32	429.12	541.12
16½	278.35	350.95	442.53	558.03
17	286.79	361.59	455.94	591.85
17½	295.22	372.22	469.35	591.85
18	343.66	382.86	482.76	608.76
18½	312.09	393.49	496.17	625.67
19	320.53	404.13	509.58	642.58
19½	328.97	414.76	522.99	659.49
20	337.40	425.40	536.40	676.40
20½	345.84	436.03	549.81	693.31
21	354.27	446.67	563.22	710.22
21½	362.71	457.30	576.63	727.13
22	371.14	467.94	590.04	744.04
22½	379.58	478.57	603.45	616.86
23	388.01	489.84	616.86	777.86
23½	396.45	499.84	630.27	794.77
24	404.88	510.48	643.68	811.68
24½	413.32	521.11	657.09	828.59
25	421.75	531.75	670.50	845.50
Weight per mile, lb.	1607	2127	2682	3382

TABLE II—PRICE PER MILE OF COPPER-CLAD WIRE

Cts. per lb.	No. 0	No. 00	No. 000	No. 0000
13	$204.49	$257.40	$323.96	$408.46
13½	212.35	367.30	336.42	424.17
14	220.22	277.20	348.88	439.88
14½	228.08	287.10	361.34	455.59
15	235.95	297.00	373.80	471.30
15½	243.81	306.90	386.26	487.01
16	251.68	316.80	398.72	502.72
16½	259.54	326.70	411.18	518.43
17	267.41	336.60	423.64	534.14
17½	275.27	346.50	436.10	549.85
18	283.14	356.40	448.56	565.56
18½	291.00	366.30	461.02	581.27
19	298.87	376.20	473.48	596.98
19½	306.73	386.10	485.94	612.69
20	314.60	396.00	498.40	628.40
20½	322.46	405.90	510.86	644.11
21	330.33	415.80	523.32	659.82
21½	338.19	425.70	535.78	675.53
22	346.06	435.60	548.24	691.24
Weight per mile, lb.	1573	1980	2492	3142

TABLE III—PRICE PER MILE OF STEEL TROLLEY WIRE

Cts. per lb.	No. 0	No. 00	No. 000	No. 0000
4	$59.12	$74.80	$93.92	$118.24
4¼	62.81	79.47	99.79	125.63
4½	66.51	84.15	105.66	133.02
4¾	70.20	88.82	111.53	140.41
5	73.90	93.50	117.40	147.80
5¼	77.59	98.17	123.27	155.19
5½	81.29	102.85	129.14	162.58
5¾	84.98	107.52	135.01	169.97
6	88.68	112.20	140.88	177.36
6¼	92.37	116.87	146.75	184.75
6½	96.07	121.55	152.62	192.14
6¾	99.76	126.22	158.49	199.53
7	103.46	130.90	164.36	206.92
7¼	107.15	135.57	170.23	214.31
7½	110.85	140.25	176.10	221.70
7¾	114.54	144.92	181.97	229.09
8	118.24	149.60	187.84	236.48
8¼	121.93	154.27	193.71	243.87
8½	125.63	158.95	199.58	251.26
8¾	129.32	163.62	205.45	258.65
9	133.02	168.30	211.32	266.04
Weight per mile, lb.	1478	1870	2348	2956

First, let us consider the purchase price of the wire. Some figures obtained by the writer a few months ago will show the relative values of the different types at that time. They were as follows:

Copper	16¼ cents per lb.
Bronze	17¾ to 20 cents per lb.
Copper-clad	15⅞ cents per lb.
Steel	6¾ cents per lb.

At the same time the scrap values of the metals were quoted as:

Copper	13¼ cents per lb.
Bronze	13¼ cents per lb.
Copper-clad	3½ cents per lb.
Steel	1/3 cents per lb.

From a comparison of these two statements of cost it will be seen that while copper is one of the highest priced of the metals, yet its scrap value is so high that the amount of its value lost in service—that is, the difference between the first cost and the scrap value—is the least of all, while the copper-clad wire is greatly handicapped in its race with the other materials on account of its low salvage value.

RELATIVE LIFE OF DIFFERENT KINDS OF WIRE

So far as the relative life of the different wires is concerned, there will be found to be great difference of opinion. Each grade mentioned in the list is made by at least two firms, and although the composition of the metal or metals entering into the wire is the same for all of the firms making that type, the methods of manufacture are often different in some particulars, and even different reels of the same grade of wire made by the same company often vary considerably among themselves. Add to this the different conditions under which the wire is used—light or heavy service, up or down grade, on curves or straight line, over good or bad track—and it will not seem at all strange that all engineers do not agree in their ideas as to the life that can be expected from each kind. However, as some definite life must be assigned to each kind if they are to be compared with each other, it might be said that the engineers with whom I have talked appear to agree, on the average, that, with the exception of copper, the lives of the materials are about equal and the life of hard-drawn copper is approximately one-half of that of any of the others under similar conditions of service. The wire designated by the letter "A" has not been manufactured long enough to show what it will do in the matter of standing up under service, but, judging from the results of tests upon it, it would seem to have a life about midway between the bronze and copper wire, or one and one-half times the latter.

CURRENT-CARRYING CAPACITIES

In order to appreciate the difference that will be made by the different amounts of current that will be wasted in the wire, the resistances of the various kinds must be given as the loss varies directly as the resistance. Compared to Mathiessen's standard the conductivity of the wires is about as follows:

Hard-drawn copper	95
"A"	85
Bronze	45
Copper-clad	40
Steel	10

Before comparing directly the cost per annum of the different wires, one other point is to be considered, namely, the average amount of current carried by the trolley wire. To use the average current is not quite correct, as what should be known is the average current that will occasion the same amount of loss in the line per year as the square root of the mean squares of the current taken at short intervals. Where the load fluctuates little the average current will be very close to the correct amount, but where the line shuts down entirely during several hours of the night or where the rush-hour peaks are high the square root of the mean squares should be taken. It will be found that on most lines the engineer, unless he has had considerable experience in such work, will over-estimate the current in the wire, as he will think principally of the load during the heavier hours of the heaviest seasons of the year and will be surprised to find how much nights, Sundays and light seasons will reduce the current in the wire from the amount which he supposed was a fair average for it. Very often he will think that because during rush hours in the winter, perhaps, the current amounts to 200 amp on the trolley

wire, one-half of that, or 100 amp, would be a good average. Looking further, he will find that 100 amp is the average load carried during the day only, and that shutting down at night and light loads on Sundays and holidays will make 50 amp a better average for the winter, while the saving due to the cutting out of the heaters and the use of light, open cars will still further reduce the current during the rest of the year so that it will not average for the entire year more than 35 amp.

In attempting to valuate the current lost in the trolley wire, much difference of opinion will be found as to the charge per kilowatt-hour that should be made. This difference of opinion is only natural, as with some companies the cost of energy will be much higher than with others. Energy bought from a steam generating station will cost more than energy obtained from a water-power plant, especially if the latter is lightly loaded. In that case the additional energy will cost almost nothing, as no fuel, labor or capital would be required.

COSTS OF DIFFERENT KINDS OF WIRE IN PLACE

In addition to the cost of the wire itself, there must be added to make up the cost of the material in place the cost of installation, but this will not differ materially for the different types of wire. The copper will not be so stiff as any of the other materials and therefore will be a little more easily handled, but the difference in ease of handling will not be great enough to make any appreciable difference in the cost of installation. The latter will probably average $60 a mile, the amount of special work on the line making a great difference in the cost.

Therefore, taking No. 00 wire, which is standard with a great many companies, especially for city work, the first cost of the various kinds in place would be as follows:

	Copper	"A"	Bronze at 17¾ Cents	Bronze at 20 Cents	C-C	Steel
Cost of wire	$340.32	$425.40	$377.54	$425.40	$316.80	$250.90
Installation	60.00	60.00	60.00	60.00	60.00	60.00
	$400.32	$485.40	$437.54	$485.40	$376.80	$310.90

If the investigation should stop here, it can easily be seen that the steel wire would be thought to be the most desirable and the copper-clad next, but let us see what the net cost of the wire will be when the value of the salvage after the wire has been taken down is deducted from the first cost. Suppose that one-quarter of the wire has been worn away so that the weight of the scrap is only three-quarters of that of the new wire. Even that much salvage will seem to be a great deal to many engineers, and there is no doubt that much wire is left up in the air until its weight is far less. However, for important lines where the delay caused by a broken trolley wire is a serious matter, to say nothing of the chances of accident claims due to persons being struck by or frightened at the fallen wire, it will not be safe to have the average wear more than that given above, although at certain points the trolley wire may be much below the average in section. The net cost of the wire would then be:

	Copper	"A"	Bronze at 17¾ Cents	Bronze at 20 Cents	C-C	Steel
First cost	$400.32	$485.40	$437.54	$485.40	$376.80	$310.90
Salvage	211.20	211.20	211.20	211.20	51.83	4.67
	$189.12	$274.20	$226.34	$274.20	$324.97	$306.23

EFFECT OF DEDUCTIONS FOR SALVAGE AND LENGTH OF USEFUL LIFE

A comparison of the figures obtained by subtracting the salvage value of the wire from the first cost will correct many mistaken ideas concerning the cheapness of some kinds of wire. Copper, previously one of the expensive materials, now shows up as the cheapest instead of steel or copper-clad, the two latter now being at the foot of the list instead of the head. If the wire is permitted to stay up in the air until 50 per cent of it is worn away, the salvage will be only two-thirds of the amount given in the previous table and the results will be:

Copper	$259.52	"A"	$344.60
Bronze at 17¾ cents	292.74	Bronze at 20 cents	344.60
C-C	342.25	Steel	307.79

While copper is still the lowest when net prices are considered, the copper-clad steel and the plain steel have much bettered their positions.

But even the two tables do not show all that should be taken into account, because of the difference in the length of life of the wires under the same service. To get the proper relation the fixed cost per year of interest and depreciation should be estimated for each of the wires. Then, supposing the life to be ten years for the best wearing and five years for copper, with the trolley wire worn down to 75 per cent of its section, the results for each year would be:

	Copper	"A"	Bronze at 17¾ Cents	Bronze at 20 Cents	C-C	Steel
Depreciation	$37.82	$36.56	$22.23	$27.42	$32.50	$30.62
Interest, 5 per cent	9.46	13.71	11.11	13.71	16.25	15.31
	$47.28	$50.27	$33.34	$41.13	$48.75	$45.93

An examination of these figures will show another series of upsets. Copper is no longer the lowest-priced material, but the bronze wire has taken that place, while those wires composed either wholly or partly of steel have again risen to being the highest in price. If the wire is kept in service until one-half of it is worn away, the yearly cost will be:

Copper	$64.88	"A"	$63.18
Bronze at 17¾ cents	43.91	Bronze at 20 cents	51.69
C-C	51.33	Steel	46.17

These figures show copper to be highest in price and the bronze to be lowest, but with steel not far away.

EFFECT OF ENERGY LOSSES IN THE LINE

There is still one other variable to be taken into account, namely, the value of the energy lost in the line. This will be the hardest of any of the values to determine because of the difficulty in estimating the average current in the wire, its value in cents per kilowatt-hour, and whether all that appears to be wasted in the line really is wasted or merely takes the place of current which, with a higher voltage on the wire, would be wasted in the car resistances because the motormen would then run for a longer part of the time with resistance in series with the motors.

In spite of this trouble of ascertaining the amount of energy lost, an inspection of the following table will show that, even if the cost per kilowatt-hour is only a fraction of a cent, a high line loss will throw out the results calculated so far and without taking account of this point. The average current density in the trolley wire can best be taken as one-half of that measured at the point where it first feeds into the line, as from that point it will decrease to zero at the other end of the section.

LOSS OF POWER PER MILE PER YEAR IN KILOWATT HOURS

	Copper	"A"	Bronze at 17¾ Cents	Bronze at 20 Cents	C-C	Steel
100 amp.	9,480	11,250	20,000	20,000	22,500	90,000
50 amp.	2,370	2,812	5,000	5,000	5,620	22,500
20 amp.	379	450	800	800	900	3,600
10 amp.	95	112	200	200	225	900

The average current in this table is that at the feeding-in point so that the calculations are made

with one-half of that amount distributed over the wire.

While these figures make the showing of the low-conductivity wires very bad in comparison with that of copper, yet it must be remembered that the amount of current in the wire will be much less, if there is feeder in multiple with it, when the trolley wire is of low conductivity than when its resistance is less, because in the former case a greater proportion will be carried by the feeder. While this will reduce the loss in the trolley wire and also to some extent that in the whole distribution system over what might be expected, yet there will be an increased loss in the feeder in consequence of the greater proportional load which it carries.

CONCLUSION

The life of wire upon which these estimates were based—five years for copper and ten years for most of the other materials—would probably go with a current density of from 20 amp to 50 amp in the trolley wire, so that those figures would be the most likely to be taken by anyone looking into the case for an ordinary example. Therefore, the steel wires would be very expensive for such service if they were made of the same size as those of the other materials. This trouble, however, might be avoided by enlarging the section of the wire, which would not only decrease its resistance but would increase its life. This will give anyone of a mathematical turn of mind a further chance to investigate the matter as regards his own line. However, it was the intention of the writer merely to point out the conditions which might modify the choice of the wire and to let each engineer figure out what one would be the best for him to use.

On many systems it will be found that while one wire will prove the cheapest for the greater number of the lines, it will not be so for all of them. Several wires might be found, all with one or more sizes, each of which would prove to be the best for some particular line. Owing to the amount of stock that would have to be carried both in the storerooms and by the emergency crews it will not be found advisable to have more than two or three sizes and kinds of wire as a greater variety will cause confusion and expense.

Therefore, it is best to choose that wire which appears to be the most economical for the system as a whole and to make that wire the standard. There will then be no need for the crews, when making repairs, to run in one size or type of wire in a line which was first run with another wire. At the same time the engineer should look well into the subject before choosing his standard because great economies are to be gained by the choice of the proper one.

At the recent annual meeting of the Lancaster & Yorkshire Railway, England, the chairman said the estimate of capital expenditure for the ensuing year was $3,335,025, including $608,750 for a new power station about to be erected at Clifton Junction. It is proposed to electrify the existing lines from Manchester, through Crumpsall, to Bury, and there is little doubt, judging from experience in the Liverpool district, that the additional traffic will well justify the expenditure. Referring to the electric power and light account, the chairman said that the small cost of generating electricity showed the wisdom of the company in generating its own power. Included in the statistical report are figures showing that generation and distribution costs amounted to $174,195, and that $48,700 was provided for renewals. The high-tension energy generated and supplied is classified thus: traction, 28,719,591 kw-hr.; power, 1,576,484 kw-hr., and lighting, 1,753,679 kw-hr.

REMODELING SIXTEEN YEAR-OLD CARS AND OTHER MAINTENANCE FEATURES OF THE CLEVELAND, PAINESVILLE & EASTERN RAILROAD

Along with the radical changes in the power generating and transmission system of the Cleveland, Painesville & Eastern Railroad, as described in the ELECTRIC RAILWAY JOURNAL of July 19, 1913, has come a corresponding improvement in the condition of the rolling stock and many original features have been introduced into the shop practice. The largest single job has been the making over of the old interurban cars, which have been giving excellent service for sixteen years or more. These cars are of substantial construction, weighing about 25 tons equipped, and as reconstructed they operate like new ones.

The first step in the reconstruction was to strip the cars of all trim, ceiling and sash. The old-fashioned beading was planed off everywhere, leaving smooth, chamfered surfaces in its place, and all trim was entirely refinished. The most conspicuous change was in the vestibule. One of the accompanying halftones

Cleveland, Painesville & Eastern Railroad—Contrast of New and Old Vestibule

indicates the difference in style of the yearly and present periods of car construction. The older type of vestibule appears to be a separate feature added to the body, being narrower and lower; the newer form, with Pullman roof, is an integral part of the car. Not only is the appearance thus improved but the windage resistance at high speed is reduced.

Another illustration shows a Brill-27 truck re-equipped with inside-hung brakes. More than one-half of the truck equipments have been thus remodeled and the rest will be completed shortly. The change has been made to secure more even wear of brakeshoes, better braking effect and quicker release. Greater life of brakeshoes is also obtained by this arrangement. In changing the construction, the outside rigging was removed and four bent-steel plates were bolted in the side frames and transoms as shown. The brake hangers are carried under these plates from bearings attached to them by four bolts each. The brake levers slide in slots cut in the plates. Short angles are bolted to the plates to form guides for the bolsters. The motor suspension bars hang in stirrups formed of U-shaped pieces of steel bolted to the inside edges of the plates. The large nut shown at the rear of the plate in the foreground in the illustration is on the bolt by which

the motor-suspension stirrup is secured to the plate. The fixed points for the levers are furnished by brackets bolted to the plates but not shown in the illustrations. The floating ends of the levers are joined by cross-bars, at the centers of which the tension rods are connected. The release springs are attached to the ends of these bars by means of brackets. In the illustration an express car is seen in the background equipped with a truck with the older outside-hung brake rigging. The third engraving gives an excellent idea of the appearance of the complete remodeled car.

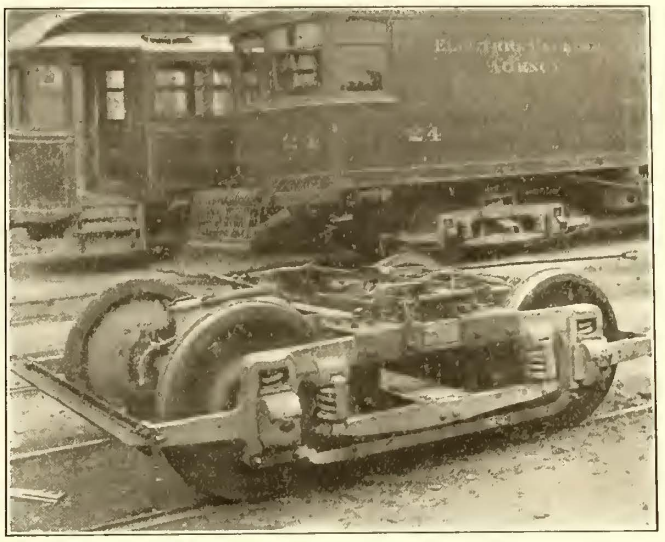
SHOP PRACTICES

One of the shop features is a babbitting machine, original with J. G. Swain, the former superintendent. It consists of a steel mold with a movable steel core, operated by means of a 10-in. air-brake cylinder and plunger. Admission of air draws the core downward and out of the babbitt, leaving a smooth wearing surface. The oil-fired melting pot and machine are compactly mounted on a steel frame so that little space is needed. The machine is provided with an assortment of cores of standard diameters. All commutators are slotted, motor shafts are restored by the use of journal sleeves, which are made from rough tubing $\frac{3}{8}$ in. thick. When turned down they are 3/16 in. thick and are allowed to wear to 3/32 in. before replacing. The cars are equipped with GE motors which have strap field windings on brass spools. It has been found difficult to keep the winding permanently tight in the spools and as a result the insulation has chafed very much. A successful expedient devised to overcome this trouble consists in sawing the spools in two in the middle in the plane of the coils. The coils can then be wound and thoroughly insulated and the two parts of the spool shoved into them and clamped tightly in place. Since this plan has been in operation field-coil troubles have practically disappeared. The split spools are used on all motors of this type and a good stock of coils and spools is kept for emergency use.

Cleveland, Painesville & Eastern Railroad—Remodeled Standard Interurban Car

A simple but effective seat-sparing device is a brass foot rail on the exposed edges of the front-seat cushions. These cushions make natural and tempting foot rests for passengers who are riding on the facing seats. As most passengers object to riding backward the front seats are filled last so that the cushions are almost always available as foot rests. A brass tube, mounted on simple brackets at the ends and middle, protects the corner of the cushion and supplies the supposed need for a foot rest.

The important work hereinbefore described was begun by Mr. Swain and his associate, Mr. Wood, before their change to the Northern Ohio Traction Company, and it is being continued by the present master mechanic, Ed. Hengst.



Cleveland, Painesville & Eastern Railroad—Remodeled Truck

RESULTS OF SYSTEMATIC PROVISION FOR PROMOTION ON THE PENNSYLVANIA RAILROAD

Records just compiled of careers of the 170 ranking officers of the Pennsylvania Railroad System give striking evidence of the policy the company pursues in training men, and of the opportunities open to men in the service. Of the 170 officers, 163, among whom should be mentioned the president of the company, started at the bottom. This census of Pennsylvania officers now in active service shows that J. B. Hutchinson, assistant to the vice-president in charge of real estate, purchases and insurance, Pennsylvania Railroad; A. L. Langdon, traffic manager of the Long Island Railroad; E. T. Postlethwaite, assistant to the president of the Pennsylvania Railroad, and E. A. Dawson, manager of the Star Union Line, have worked for the railroad more than fifty years. Each of the five vice-presidents of the Pennsylvania Lines West of Pittsburgh, who have just been elected, has been in the service of the railroad more than forty years. Every one of them began at the bottom of the railroad ladder. J. J. Turner, first vice-president, began work for the Pennsylvania as a ticket sorter; E. B. Taylor, second vice-president, started as a clerk; D. T. McCabe, third vice-president, as clerk; G. L. Peck, fourth vice-president, and A. M. Schoyer, resident vice-president at Chicago, began with the company as messengers.

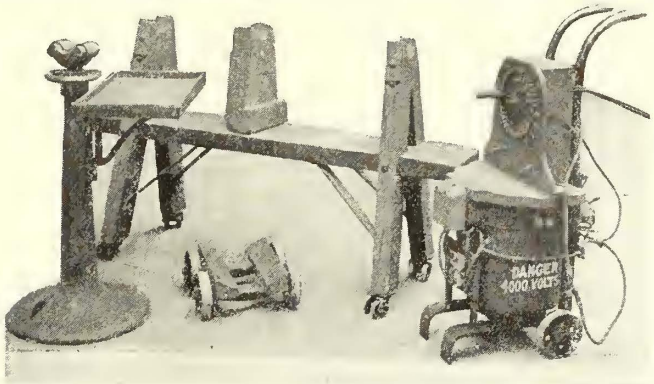
Twenty-two of the company's officers have been in the company's service between forty and fifty years; fifty-seven between thirty and forty years, and fifty-nine between twenty and thirty years. Thirty of these 170 officers are between sixty and seventy years old, sixty-one between fifty and sixty years, sixty-two between forty and fifty, and seventeen between thirty and forty years of age.

The above record is of special interest in view of the criticism to which railway managements have recently been subjected.

Shop Practices at Milwaukee

In the Various Repair Departments of The Milwaukee Electric Railway & Light Company a Number of Quick Methods of Doing Work Have Been Introduced with Marked Success in Reducing Costs

The following series of descriptions of shop kinks and jigs in the shops of The Milwaukee Electric Railway & Light Company are published on account of their general interest as well as for the fact that they may



Milwaukee Shop Kinks—Armature Repair and Test Outfit

offer suggestions for economies in other electric railway shops.

PRESS FOR REMOVING BEARINGS

Solid bearings are not removed from the end housings of motor frames on the truck repair-room floor but are brought into the armature room by way of the electric freight elevators. Here they are removed from the housing by an air press especially designed for this purpose. This consists of a 10-in. x 12-in. brass cylinder suspended on a 66-lb. T-rail, which in turn is held in position on a bar-iron frame. The brake cylinder is held rigidly in the vertical position by a section of T-rail bolted to the bar-iron frame and to the cylinder. The supporting frame is attached to two I-beams which form the side frames of a four-wheel truck. The brake cylinder air piping is supplied with a section of hose so that it may be coupled into the shop compressed-air system where 90-lb. pressure is available. Air is either admitted or released to the brake cylinder by way of a valve conveniently located in the air-pipe connection.

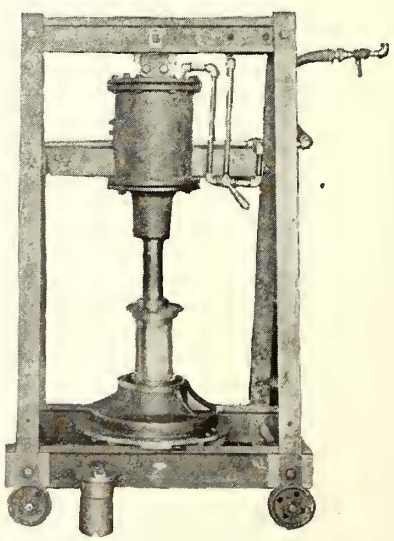
The method followed in removing an armature bearing from the housing is as follows: The housing is mounted on two sections of rail set across the I-beam frame beneath the brake-cylinder plunger. The plunger is fitted with a ram, which is held firmly in position by dovetailed connection. This ram is set on the bearing, and as air is admitted to the cylinder the bearing is pressed from the housing. To replace the bearing in the housing, the ram is removed, and a flat plate similarly held in position on the plunger head by a dovetailed connection replaces it. The rails are removed from beneath the bearing housing, which has been reversed in position and allowed to rest on the I-beam truck frame. After the bearing has been accurately set in position on the housing, the plunger is lowered by the admission of air into the cylinder until it comes in contact with the bearing. Then full air pressure is applied to force the bearing into the housing. A view of this air press for removing solid bearings from the housings is shown in one of the illustrations.

ARMATURE DOLLIES AND HORSES

To facilitate the handling of armatures about the armature repair room, as well as from the repair shop floor to the armature room gallery, wooden armature horses and dollies have been provided. As shown in the accompanying cut, both the dolly and the portable armature horse are substantially built of wood, the dolly being provided with four ordinary truck wheels and a wooden saddle and the horse being provided with a double 3-in. caster under each leg. Each portable horse is provided with extra wooden bearing blocks so that armatures smaller than those from standard railway motors may be set in them and transported about the shop. The shelf between the two legs of this portable horse is provided as a place for the workmen to lay tools. In the winding process the usual cast-iron bracket with a double-roller bearing is employed. Each standard is fitted with a pivoted bracket supporting a wooden tray and the armature shaft bearings may be adjusted vertically by a hand wheel and screw attachment.

POTENTIAL TEST SET

The armature testing outfit embraces short-circuit test sets for armatures and field coils, and an armature potential tester. The latter equipment is somewhat different from that found in other street railway shops and embodies a number of features which make it worthy of special attention. Essentially, it consists of an auto-transformer made from an ordinary pole transformer mounted on a simple truck. This transformer is arranged by way of tap connections and paralleling switches so that the voltage may be stepped up from 125 to 4000 volts in 125-volt steps. This potential test equipment is connected with the 125-volt or 250-volt, sixty-cycle shop-lighting and power circuits, and the actual testing is done by two 30-ft. flexible cord connections to two wooden handles at the ends of which the cords terminate in bare copper points. As a rule each complete armature is put under a 1250-volt a.c. potential test lasting one minute. To indicate to the operator that the test set is operating satisfactorily, a small pilot light set is mounted on the front of the transformer and a small circuit-breaker is installed on the back. This test set, the armature dolly and portable horse, as well as the standard used in winding armatures, are shown in one of the illustrations on this page.



Milwaukee Shop Kinks—Air Press for Removing Solid Bearings

FIELD-COIL DIPPING TANK

All the armature coils used in repair work are wound by girls in a special inclosed section of the armature repair department. In connection with field work a home-made field-coil dipping tank has been devised to in-

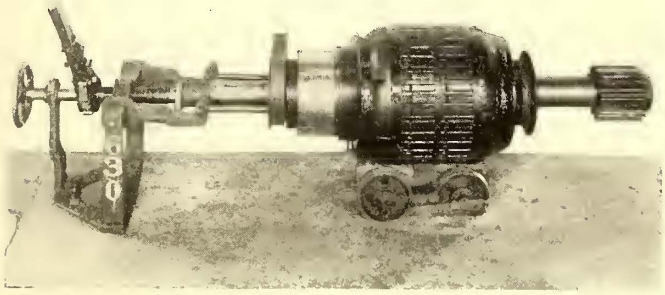
crease the output and at the same time prolong the life of the insulating compound. This dipping tank is made of galvanized iron 3 ft. in diameter and 3 ft. deep. The lid of the tank is attached to an air hoist which raises and lowers the dipping rack into the fluid. This wooden rack is supported on four strap-iron hangers, and is of sufficient size and strength to permit dipping twelve GE-70 field coils at one time. In charging the dipping tank, the slatted platform of the rack is raised even with the top of the dipping tank and the coils set in position. Air is then released from the air hoist, which lowers the rack to the bottom of the tank and at the same time sets the tank lid in position. All coils are left in the insulating compound about one hour, during which time the lid is securely clamped in position with thumb-screw locks. After the coils have been dipped the rack is raised above the liquid but not high enough to raise the lid, and in this position the coils are allowed to drain for three hours before being placed in the baking oven. In conjunction with this field-coil dipping tank, an ordinary block and fall has been conveniently attached to the roof beams so that the very large coils may be raised from a truck and swung onto the coil dipping rack.

ARMATURE STRIPPING ROOM

To remove the dust and dirt which always accompanies the process of stripping old armature cores of defective coils, the armature repair department has found it more economical as well as more satisfactory to do this work in a room devoted solely to this purpose. When armatures come into the repair shop they are lifted to the portable horses, run into this stripping room where all defective coils are removed, after which the armatures are wheeled into the repair department where all repairs necessary are completed.

RATCHET COLLAR PULLER

With certain classes of defective armatures it is necessary to remove the collar which adjoins the commutator segments. Under ordinary conditions this is a difficult task, but the armature department of the Milwaukee company has facilitated this work by building a home-made ratchet collar puller. This consists of a half-moon shaped forging which is slipped over the inside of the collar. Two ¾-in. bolts are passed through this forging, and the heads of these bolts are dropped into two slots provided on the puller frame. When the yoke is in position the slack is taken up with a hand wheel set between the head of the puller and

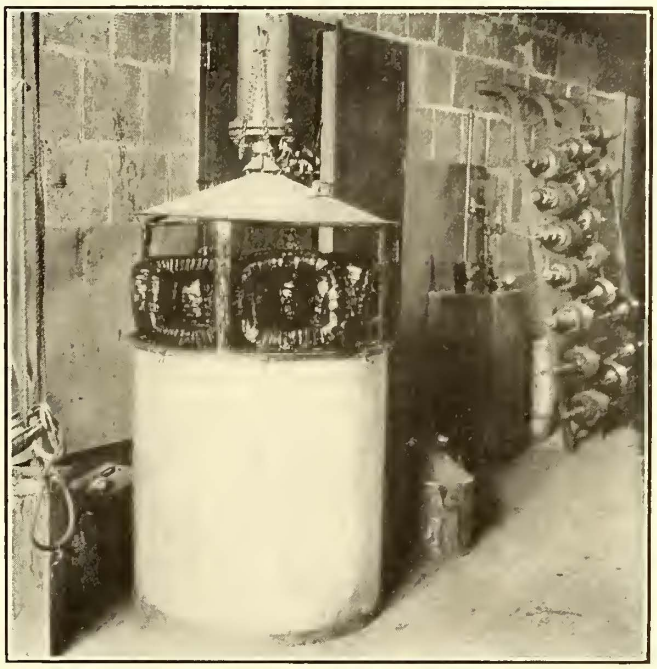


Milwaukee Shop Kinks—Ratchet Collar Puller

the end of the armature shaft. The removing pressure is brought to bear on the armature shaft by advancing the screw with an ordinary hand ratchet and lever. This device is shown in one of the illustrations.

NOVEL PINION PULLER

By the use of the ratchet and lever principle in connection with the collar puller in the electrical department, a novel pinion puller has been provided for removing pinions from the armature shaft. This consists essentially of a steel-lipped casting which fits over the pinion, the lips engaging with the pinion teeth. The slack is taken up between the armature shaft and the plunger of the pinion puller by a quick take-up hand wheel, after which the ratchet and lever are brought into play. When considerable pressure has been



Milwaukee Shop Kinks—Field-Coil Dipping Tank

brought to bear on the end of the armature shaft, a hammer blow struck on a striking block at the exposed end of the pinion puller loosens the pinion. A view of this pinion puller is shown in one of the illustrations on the following page.

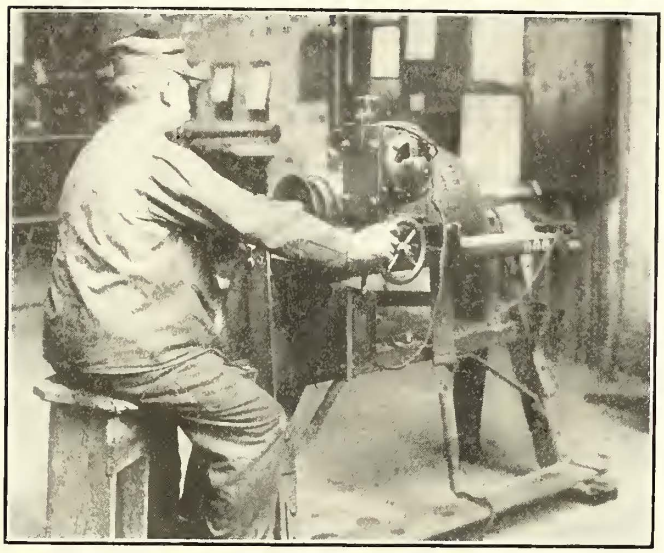
SIMPLE COMMUTATOR SLOTTER

Like a great many other street railway companies in this country, the Milwaukee railway's armature repair department has designed and built a commutator slotter which has given very satisfactory service. The principal part of this slotting machine consists of a ¼-hp motor which operates at 1800 r.p.m. and is fitted with an extended armature shaft. The slotting saw is applied to the end of the shaft and is held firmly in position by a nut. The motor, in turn, is mounted on a bed which is reciprocated by a hand wheel and a twin pinion mechanism engaging in a rack attached to the underside of the bed. This complete slotting tool is mounted on one of the portable armature horses and may be shifted to any point in the shop. Energy is supplied to the motor by way of a long flexible cord and plug which may be connected into the shop power circuits.

TROLLEY-WHEEL GRINDING ATTACHMENT

All trolley wheels used on the cars of the Milwaukee Railway are manufactured of a very hard and tough bell metal in the company's own brass foundry. Until recently the work of smoothing the trolley wheel groove has been done with an ordinary round file which limited the work of one man to about fifty wheels per day. This added greatly to the manufacturing cost of the trolley wheels, and consequently it was desired to increase the output and at the same time reduce this cost of manufacture. This was accomplished by providing a countershaft attachment to the tool rest of one of the small engine lathes. A carbonite wheel, having the same con-

tour as the trolley wheel groove, is keyed to an extension on one side. The grinding tool is forced into the groove by way of a hand lever and ratchet which already formed a part of the tool rest. This device has increased the output approximately 200 wheels per day. The extreme hardness of the trolley wheel metal, however, makes it necessary to renew the 10-in. grinding wheel after finishing each 1000 trolley wheels. A view of this lathe attachment for grinding trolley wheels is shown in one of the illustrations.



Milwaukee Shop Kinks—Commutator Slotting Machine

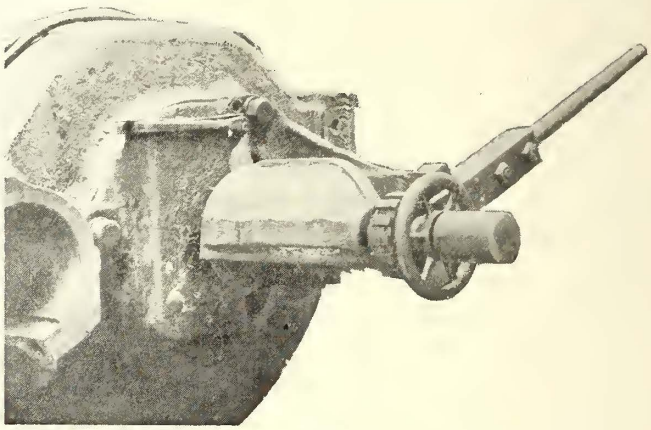
SPECIAL AXLE STRAIGHTENER

Wheel routine in the Milwaukee Railway repair shop is as follows: As wheels are brought in from the truck repair department, they are run through the special axle-straightening machine, where the axles are inspected and straightened if necessary, after which they are passed on to the wheel lathe for truing the wheel treads and flanges. In case of new wheels, after they have been pressed on the axle in the wheel press, they too pass through the axle straightener to verify the axle before going into service.

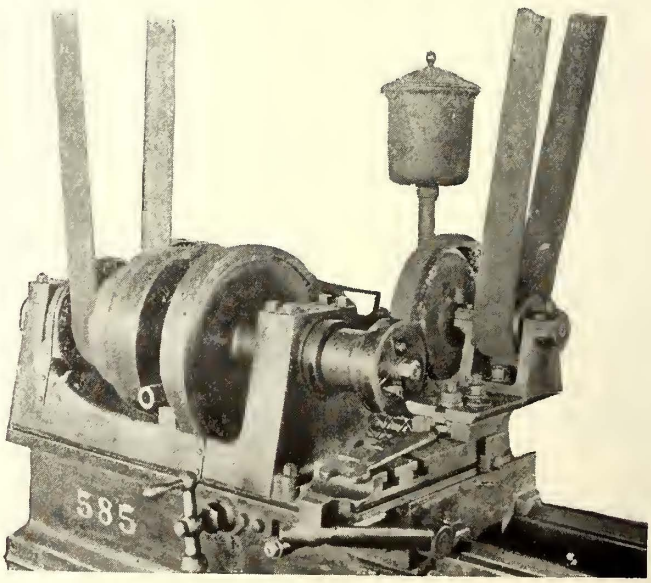
The axle straightener is a special tool built by a local manufacturer. It consists of two pairs of I-beams, one acting as a support for the axle-straightener plunger and the other as the bearing for the wedges and inclined planes which support the axle during the straightening process. The axle-straightener plunger is mounted on a trolley swung from the lower flanges of the I-beams and is connected through a universal-jointed pipe to the oil pump mounted on the top of the upper supporting beams. Swung between these upper I-beams and near each end is a hand-wheel, with screw and chain attachment arranged for raising and lowering the car wheels to the revolving centers of the machine. These centers are arranged with sufficient swing to take the largest sized wheel and are provided with a special spring support so that they will adapt themselves to any deflection during the straightening process. After the car wheels have been centered and the bent portion located by starting the rotating motor installed beside the machine, the axle is supported by a system of wedges. Then the position of the straightening plunger is shifted so that, when the necessary pressure is applied, it will spring the axle true. This machine has a pressure capacity of 30 tons, consequently most axles may be straightened cold. A view of this special axle-straightening machine is shown in one of the illustrations.

OVERHAULING MOTORS

To obtain a largely increased motor efficiency from old GE-70 motors and at the same time reduce the cost of maintaining them, all motors of this particular type are being overhauled. The process necessary to accomplish this includes, first, truing on a planer the frame seal between the halves of the motor housing and then boring out the ends for the motor casing to receive new cast-steel armature-bearing housings. A change also was made in the manner of holding the bearings in place in the housings. Heretofore this was done by two dowel pins at the bearing ends, but much trouble was experienced in pressing the bearings into the housings and at the same time keeping these pins in line with the holes. In the overhauled motors these bearings were secured in place by rolled-steel keys. The GE-70 axle bearings were also standardized with the GE-80 bearings by boring out the motor-axle bearing housing to the proper diameter to receive a GE-80 bearing. All worn bolt holes also have been retapped to the next larger size. The work of overhauling the GE-74 motors is now practically complete, and it has been found that at a reasonable cost for overhauling, the efficiency of the motors has been increased considerably.



Milwaukee Shop Kinks—Ratchet Pinion Puller



Milwaukee Shop Kinks—Trolley Wheel Grinding Attachment

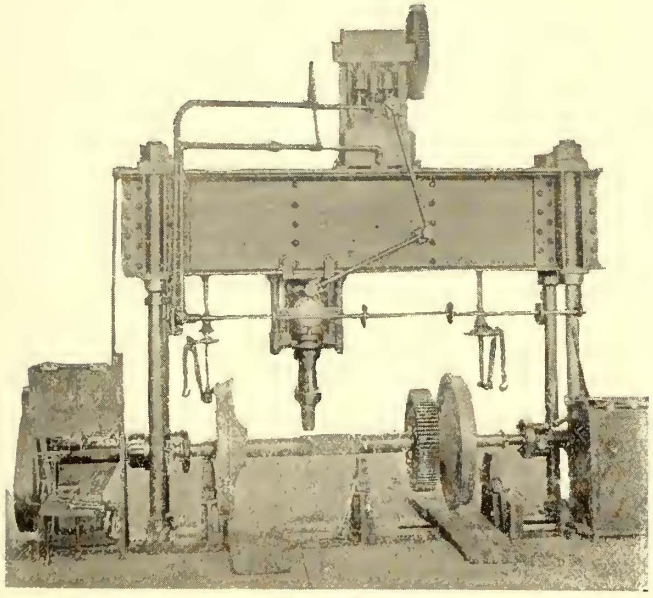
OVERHAULING AIR COMPRESSORS

At each 45,000-mile general overhauling the air compressors and air equipment are removed from the car

and the machine is completely dismantled. All oil is removed, the valves reground, the armatures thoroughly tested in the armature repair department, and, in fact, all parts thoroughly cleaned before reassembling and testing. Each compressor is tested for fifteen minutes at 100-lb. pressure before it is returned to service. The heads of the triple valves are rigged up in connection with an engineer's valve so that the emergency valves may be tested for leaks. This testing equipment is connected with an ordinary pressure gage to indicate leaks. A rack is also provided in this air-testing equipment for testing motorman's valves under 100-lb. pressure after the valve seats have been carefully ground and made ready for service.

MOTOR-TESTING MACHINE

A motor-testing machine equipment has recently been added to the truck repair department of The Milwaukee Electric Railway & Light Company. The principle of this machine consists simply of the old device of bucking two motors, one operating as a generator and the other as a motor. The armature shafts are connected through a flexible coupling after the motors have been lined up and clamped into position on the testing bed. The motor leads are connected by flexible cords and plugs to a switchboard, which is so arranged that either test unit may be run as a motor or a generator by throwing a switch. The generator is loaded through a bank of resistance coils installed in the coil-baking oven on the gallery overhead. The heat from these coils is used in heating the baking oven, steam heat being used as an auxiliary at times. The load on the generator is controlled at will by a system of double-throw single-pole switches. At the same time all parts of each motor are thoroughly inspected to insure good condition before it is placed in service. All motors, both new and old, are put through this load test before they are installed on the trucks. The test operation is carried on by a storeroom attendant, whose quarters are convenient to the testing equipment. This man

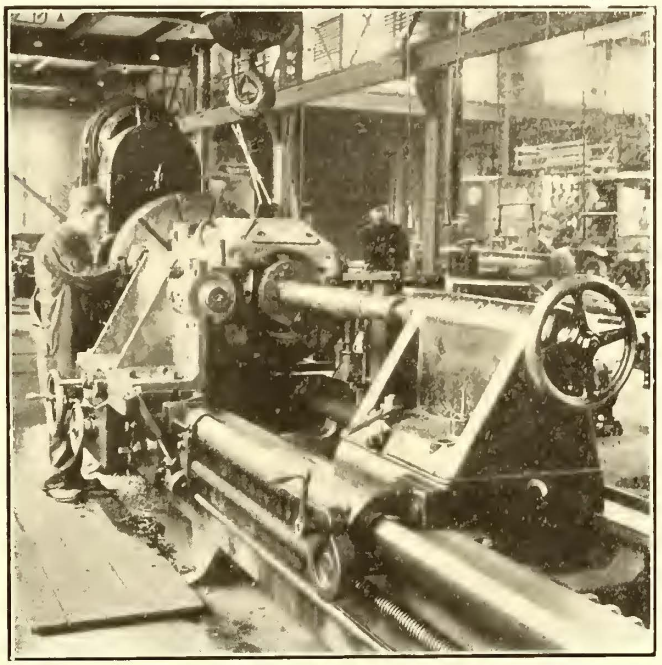


Milwaukee Shop Kinks—Special Axle Straightener

has been carefully instructed as to the manner of testing and inspecting, and he fills out the form report for each motor inspected.

BOLSTER STANDARDIZATION

As a part of the general overhauling of cars on the 45,000-mile inspection, all bolsters are being standardized as to the height of the center and side bearings, as well as the gage of the car body. Standardizing gages for this purpose have been made of ¼-in. steel plates and designed to check the gage and the relative heights of the center and side bearings. These standardizing gages are made in two forms, one for the truck bolster and another for the body bolster. During the



Milwaukee Shop Kinks—Jigs Used in Boring Motor Housings

overhauling process all bolsters are being equipped with special pocket and castings. These castings serve as chafing plates and foundations for the side bearings and also contain the spring pockets for the end bolster springs.

REHABILITATING 6-IN. AXLES

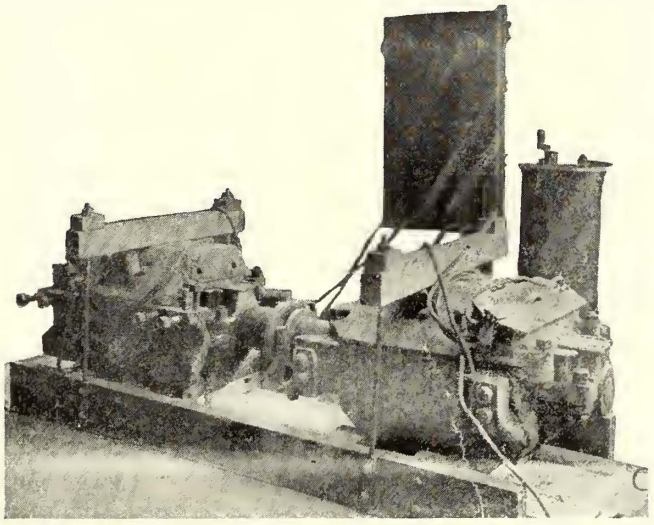
At the close of the 45,000-mile inspection period, when all cars receive a general overhauling, the 6-in. axles have been found to have worn considerably at the motor-axle bearings. In order to rehabilitate these axles for further service when the wear is shown to be in excess of 1/16 in. under size, they are turned down to 5⅞-in. diameter at the point where the motor axle bearing is applied. The bearing mandrels are changed and the axle bearings reduced in diameter to fit the new axle—all of which results in a first-class job, and at the same time no apparent weakening has developed in the axles so repaired.

DRUM SANDER OF LARGE SIZE

It has been found to be very economical when old cars are overhauled and new cars are constructed to install a 49-in. triple-drum sander. In this machine each drum gives a different gradation of sanding and is equipped with individual motor drive so that all three or any one of the sander drums may be operated at one time. This machine is used for sanding sashes and doors and, in fact, any large panel work which will pass over the 49-in. drums. It has been found especially adapted for sanding all sashes and doors, and these are put through the machine with the glass in place. Either before or after these old sashes are put through the machine, a little hand work is necessary in the panels and around the moldings. This, however, is only a small part of the hand work which would be required without the machine. The parts are then ready for finishing.

BURNING-OFF TORCH

In the paint shop it was found that considerable time was being consumed in the process of burning off paint on cars undergoing general repainting. This work was being done with an ordinary hand blow-torch, which before a car could be completed had to be replenished with gasoline several times, thus delaying the work. To eliminate this waste of time, the equipment engineering department has designed and provided a simple torch which gives a constant flame. Essentially, this torch consists of an ordinary wrought-iron pipe mixer made up in the shop, with two hose connections, one to the illuminating gas-pipe lines and the other to the compressed-air piping system, and of sufficient length to burn off an entire car. Valves at the mixer on the air line and the gas line permit the mixture to be regulated to obtain the hottest possible flame. The time of burning off cars has recently been reduced considerably and the saving is attributed to the adoption of this torch.



Milwaukee Shop Kinks—The Motor Test Set

ELECTROPLATING

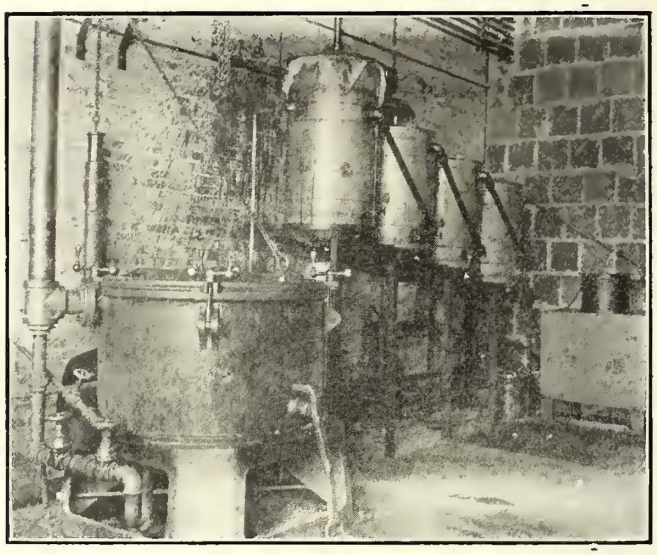
Recently the Milwaukee Railway company has found it practical as well as economical to add an electroplating and dipping department to its repair shop. An unused portion of the balcony over the machine shop has been partitioned off for this purpose, and two men, namely, a plater and a helper, have been able to handle all work of this character without difficulty. The present equipment is sufficient to electroplate all the hardware from two city cars in a nine-hour day. All brass trimmings and fittings are removed from cars brought in for the general overhauling at 45,000-mile intervals. The material receives a railway statuary-bronze finish. After this work has been done, it is anticipated that parts not subject to wear will never have to be removed from the car again, and all worn parts may be lacquered in place.

Essentially, the process necessary to produce this finish is as follows: First, all fittings are submerged for about one and one-half hours in a potash solution to remove old lacquer and grease. From this tank the fittings are given to a polisher who carefully wire-scratches and brushes them until they are thoroughly clean. Following this operation, they are immersed in a copper electroplating tank for fifteen minutes. In order to give all fittings uniform finish, as the quality of brass on different types of cars varies widely in color, they are copper-struck. The final stage of the electroplating process includes scouring with a hand brush and pumice stone to give the desired shade for the statuary-bronze finish. The parts are then dipped into a lacquer tank and hung up to drip.

It is sometimes necessary to do other kinds of plating called for by inter-department orders, some of which originate in the power and lighting department of this company. The equipment necessary to do this work includes tanks and dripping racks; the most expensive part, however, is a small motor-generator set, which delivers 150 amp at 5 volts or 6 voltts, as is required in the electroplating process.

OIL AND WASTE RECLAIMING

All waste collected in the truck repair department as well as the outlying car stations is deposited in special retainers, and from time to time is delivered to the oil and waste reclaiming department which is inclosed in a separate room on the truck repair department floor. Each carhouse, as well as the truck repair department,



Milwaukee Shop Kinks—Oil and Waste Reclaiming Outfit

is credited with the gross weight of waste received, after which it is carefully sorted and bad or badly caked waste is scrapped. That remaining is put into a cylindrical oil and waste saving machine, where the oil is abstracted. This oil in turn is run through four settling tanks and a special filter. The first and third tanks have steam coils to accelerate the settling process. After the oil has passed through the fourth tank it is again placed in a retainer and used only for saturating waste used in packing journal boxes.

When the waste is removed from the machine it is held and sorted further, and finally placed on a screen over steam-heated coils, where it is dried thoroughly. All cotton and wool waste is kept in separate retainers for delivery to the oil and waste reclaiming department. The cotton waste is used for wiping, and it is reclaimed by washing it in a sal-soda solution, after which it is found to be better and cleaner than when purchased new.

The *Daily Consular and Trade Reports* contains a notice that proposals are requested by the Direccion General de Obras Publicas, Ministerio de Fomento, Madrid, Spain, for the concession and construction of an electric tramway in Madrid. The American consul at Madrid states that the estimated cost of this tramway is $22,935, and its rolling stock must include at least two electric cars. Work must be commenced within one month from the date of award and finished within three months from the same date. Proposals should be submitted through a resident agent before April 22.

Supplementary Report on Swiss Electrification

This Is an Abstract of the Report Which Resulted in the First Appropriation for Electrifying the St. Gothard Line—The Selection of the System of Propulsion Is Held in Abeyance

Following the report of the Swiss Electrification Commission, of which an abstract with map was published in the ELECTRIC RAILWAY JOURNAL for March 7, 1914, a supplementary report was made under date of Aug. 23, 1913, to the Administrative Council of the Federal State Railways by Chairman Dinkelmann as representative of the railways department. It is pointed out in the introduction that, technically speaking, electrification can no longer be considered a risk and that the lack of coal deposits in Switzerland and the abundance of hydraulic power make electrification peculiarly attractive. While the amount of capital required to electrify the Federal Railways could not be raised at one time, it was well to plan now for the acquirement of the water-powers so that the necessary energy would be available under favorable conditions when wanted for railroading.

The report then explains why the Erstfeld-Bellinzona section of the St. Gothard line is a favorable one for the first electrification on account of its heavy traffic and profile conditions. Further, the choice of this section will not require an extraordinary outlay of capital while its length is ample for trial purposes. The installation, however, will be based on the eventual electrification of the entire line, or that from Chiasso to Lucerne. The energy requirements quoted by the Electrification Commission were none too high, as the increase in traffic due to electrification would probably be greater than estimated. Again, the Electrification Commission had laid more stress on the reduction in operating cost than on the technical advantages of electrification, but these advantages would be sufficient to justify the change even if it did not produce a direct saving in cost per ton mile. In general, it was apparent that if the traffic on the Federal State Railways continued to increase it would prove profitable to electrify a large number of sections. Water-power concessions of ample capacity for electrification had already been acquired as part of the franchise properties of the original St. Gothard Railway.

CHOICE OF ERSTFELD-BELLINZONA SECTION

Table I shows the extent and physical conditions on the Erstfeld-Bellinzona line. Local traffic on this line

TABLE I.—PHYSICAL CONDITIONS OF LINES TO BE ELECTRIFIED FIRST

Sections	Length of Sect. in km.	Length of Tunnels in Percentage of Length of Section.	Per Cent of Maximum Grade on Given Lengths.
Erstfeld-Goeschenen	28.88	25.0	2.6 on 10.41 km 2.5 on 7.85 km
Goeschenen-Airolo	15.74	95.0	0.6
Airolo-Biasca	45.58	18.0	2.7 on 3.25 km 2.6 on 11.36 km 2.5 on 7.94 km
Biasca-Bellinzona	19.10	1.4	0.8
Erstfeld-Bellinzona	109.30	28.0	2.5 to 2.7 on 40.81 km
Bellinzona-Chiasso	55.28	10.0	2.6 to 3.89 km 2.5 on 3.90 km
Lucerne-Erstfeld	60.52	15.0	1.0
Other parts of Fifth District, including Pino (frontier)-Luino	64.68	7.7	1.0
Fifth District complete, including Pino-Luino	289.78	16.6	2.5 to 2.7 on 48.60 km

is so small that the management does not recommend motor-car service until such time, at least, as the electrification can be extended to Lucerne. Only locomotives can be considered, and most of these should be adapted for hauling any kind of train. As a rule, express trains should have one locomotive and freight trains two, one acting as pusher. These machines must be capable of exerting at least the present permissible maximum drawbar pull of 10,000 kg, but, if desired by the connecting foreign railways, the locomotives of a through express train should be capable of exerting a drawbar pull of 12,500 kg. In this event ten-car trains would be possible in place of eight. As for freight trains, it is necessary to retain the present standard of permissible tractive effort. However, as one locomotive would not always suffice to handle up a grade the load which it could draw on the level, a locomotive must be used at each end of some trains.

Regeneration possibilities had been carefully studied, but were not considered important. Any reduction which they might effect on station loads depended too much on the timetable and might be affected by unforeseen conditions. Again, an economy in water use at the Ritom power station would be of little practical value, and even then only for three or four months during the year. A possible water saving there of 10 per cent would hardly balance the higher cost of the locomotives. In no sense does the advisability of electric traction on the St. Gothard line depend upon regeneration as a factor.

ESTIMATES OF TRAFFIC

The daily fluctuations in traffic throughout the year on the section under consideration are very great. Thus in 1911 the minimum was 1,680,000 ton km and the maximum 2,282,000 ton km. The power plants, of course, must be capable of handling these variations.

Table II compares the present steam and possible electric speeds on the St. Gothard line. It should be

TABLE II.—SPEED COMPARISON, ELECTRICITY AND STEAM IN KILOMETERS PER HOUR.

	Express		Local		Freight	
	Elec.	Steam.	Elec.	Steam.	Elec.	Steam.
On up grades of						
0 per cent.	85	85	70	55	40	35
0.5 per cent.	80	80	70	55	40	35
1.0 per cent.	75	68	70	55	40	35
1.5 per cent.	68	55	61	50	38	28
2.0 per cent.	58	46	51	40	33	23
2.6 per cent.	50	40	42.5	31	27.5	19
On down grades of						
0 per cent.	85	85	70	60	40	35
0.5 per cent.	85	85	70	60	40	35
1.0 per cent.	80	80	70	60	40	35
1.5 per cent.	70	70	70	60	38	35
2.0 per cent.	65	65	65	53	33	30
2.6 per cent.	60	60	60	45	27.5	27.5

understood that the speeds on down grades are limited by safety regulations and so would not be appreciably increased by electrification.

It is calculated that if electric traction had been used in 1911 the maximum requirements would have been 210 per cent of the average requirements. This ratio was used as a basis for estimating future needs. The traffic of 1918 is estimated as 35 per cent greater than that of 1911. Based upon the average daily output for 1911 at the drivers of 4850 hp this would mean in 1918, 4850×1.35, or 6550 hp. By proper arrangement of the timetable the additional trains can be scheduled so as to improve the load factor, and it is believed that the power station capacity in 1918 would not have to be more than 19,000 hp. The ratio between the maximum and average loads would then be $19{,}000 \div 6550$, or 2.86. In the ten years following, namely, up to 1928, an addi-

tional increase of 35 per cent in traffic is assumed. The probable average output at the drivers would then be 6550 × 1.35, or 8250 hp, and the maximum load would be 21,000 hp. The ratio between the maximum and average would then be 21,000 ÷ 8250, or 2.55, compared with 2.86 in 1918 and 3.1 in 1911. The power requirements for the rest of the lines in the Fifth District is estimated at 13 per cent less than for the Erstfeld-Bellinzona line. Hence in 1928 an average of 5050 hp and a maximum of 16,000 hp would be required. As the peaks are not simultaneous, it is thought that a power station capacity of 32,000 hp will be required in the first case and of 35,000 hp in the second case.

It is assumed that by 1928 the entire St. Gothard line will be electrified. If the traffic is 70 per cent greater than in 1911, the average output of the turbines would have to be 26,000 hp and the maximum about 60,000 hp.

The power station sites are on opposite watersheds of the St. Gothard line, namely, a station at Amsteg on the north and one at Ritom on the south. Fortunately the high-water conditions for the two stations occur at different seasons. These stations would suffice for a long time for the Fifth District without building a third station, which would make a grand total of 70,000 hp during twenty-four hours, or enough for many of the eastern, central and northern lines of Switzerland.

CHOICE OF SYSTEM

The Electrification Commission had recommended single-phase operation at 10,000 volts to 15,000 volts, fifteen cycles, not because this system was the best for any one condition but because it was the most flexible for Swiss railroad electrification as a whole. In commenting on this decision, Mr. Dinkelmann's report takes up the three systems as follows:

The d.c. system is the oldest and best tried, but it is universally agreed that high tensions are needed for supplying energy to heavy trains from an overhead wire. The necessary current could be obtained with a 1000-volt third-rail, but the management considered such a proposition speculative and so did not take it into serious consideration. On the other hand, a 3000-volt d.c. overhead line would have to be very heavy to handle the loads on the St. Gothard line; nor would it be possible to use a high d.c. voltage without sacrificing some of the good weight and speed-regulating qualities of the d.c. motor. Further, with a high-tension d.c. line it would be very difficult or practically impossible to use direct-connected accumulators.

The adoption of the single-phase system as recommended by the Electrification Commission has been assumed in making up the costs hereinafter given. This was done because it is now clear that single-phase motors of the desired capacity can be built and that the single-phase locomotive has all the speed flexibility of the steam locomotive.

The three-phase system has, in point of age, an advantage over single-phase. It is characterized by the simplicity of its traction motors, but this advantage is inseparable from the very narrow speed limitations. The three-phase locomotive may be superior for certain conditions, but where a great variety of profiles obtain the running speeds would often be too high or too low for economy. Thus the Simplon locomotives, 1906 model, are limited to the approximate speeds of 35 km and 70 km an hour, while the 1907 model has four speeds, namely, 26, 35, 52 and 70 km an hour. No intermediate speeds with full tractive effort are possible. Not even a light Simplon train exceeds 70 km an hour, and if one standard speed was raised all the others would increase also. The continuous use in three-phase equipment of a maximum speed which is actually required for short periods only would in one case mean an increase of one-third in the amount of the energy requirements.

The rigid limitations of three-phase equipment appear in another way. Thus the 1906 type of the Simplon locomotives can be coupled to those of the 1907 type only for the common speeds of 35 km and 70 km an hour. The Giovi locomotives, which operate at 45 km and 22.5 km an hour, could not be worked economically with the Simplon machines. In general, the three-phase system does not give the desired flexibility in speed. Further, lost time could be made up only on down grades by sacrificing regeneration, the very quality for which three-phase is most highly praised.

If single-phase is adopted for the Erstfeld-Bellinzona line, it would be possible with little extra cost to use a potential of 15,000 volts in some sections and one of 7500 volts in tunnels. However, the experiences with 15,000-volt suspension in the Loetschberg tunnel will serve to settle the need for two voltages.

Despite the foregoing remarks, the management does not definitely recommend the immediate adoption of single-phase as this matter can be settled after the hydroelectric development is fairly well advanced.

STATIONS AND TRANSMISSION

The Amsteg and Ritom stations would be fitted with 7500-volt to 8000-volt, 8000-hp single-phase generators, driven by Pelton wheels and connected to the line either direct or through step-up transformers. The transmission potential would be 60,000 volts. The first feeding-in points would be at the two power stations and at the Biasca substation. Up to say 1918, a 7500-volt trolley would be used, and then it could be raised to 15,000 volts with the establishment of substations at Goeschenen, Lavorgo and Bellinzona. The transmission system would be in duplicate and each line would be proportioned to carry the quantities of energy demanded by all railways in the Fifth District. All substations would be tied in with each other and to the transmission system to minimize interruptions.

SUBSTATIONS AND CATENARY LINE

The Amsteg and Piotta substations will be located close to the Amsteg and Ritom plants. The Amsteg substation would contain an initial equipment of three 3500-kva transformers. Biasca and Piotta would have four such transformers. Goeschenen and Lavorgo would be equipped like Amsteg, while the installation at Bellinzona would depend upon developments. The contact line would be of catenary type with transverse bridges on open sections. In the tunnels the overhead structure would be carried from supports fixed in the arched roof. Suitable precautions would be taken to localize mechanical failures. The rails would be bonded for the return current.

LOCOMOTIVES

Generally speaking, the use of larger capacity electric locomotives will make it possible for two such locomotives to do the work of three steam locomotives. One class of electric locomotives would be designed for a drawbar pull of 12,500 kg and a maximum speed of 90 km an hour. This type would be used primarily for through passenger service, but it would also be available for other operation. A second class of locomotives would be designed for lighter miscellaneous service. The design of locomotives for freight service exclusively is in abeyance. Electric operation of the Bellinzona-Airolo section would demand twenty-six to thirty locomotives, and of the Erstfeld-Bellinzona section thirty-six to forty-two, or even more, according to the increase in the number of trains following electrification.

Among the special costs would be that of ten car-heating outfits for use on through trains, besides 290,000

francs for placing all weak-current circuits underground and augmenting the telephone service and for the modification or construction of car maintenance plants. The reinforcement of certain bridges is not considered in the costs pending knowledge as to the weights of the future locomotives and trains, etc.

COSTS

In presenting the cost estimates the management points out that many of the items are necessarily tied in with the electrification of the Fifth District as a whole rather than with the particular sections to be electrified first. This is especially true of the water-power developments. The costs, also, cannot be compared directly with those of the Electrification Commission as they do not cover exactly the same items. The new figures are higher, because the commission calculated that only three plants would be required for the Fifth District, whereas the new calculations call for two for the Erstfeld-Bellinzona line alone. The new contact line costs are somewhat higher; the transmission cables have been extended and devices have been added to insure protection against all possibility of accident. Further, it is believed advisable to give up the commission plan of running more but lighter (320-ton) trains, as the increased business will demand trains of present (420 to 500 metric tons) or heavier weight at higher speeds. The request for an appropriation covers all items except locomotives. A special appropriation will be requested when the locomotive designs are settled. The replaced steam locomotives will be transferred to other lines.

TABLE III.—SUMMARIZED COSTS OF ELECTRIFICATION.

	Chargeable to Construction.		Chargeable to Operation.		Total
	Francs.	Francs.	Francs.	Francs.	Francs.
I. A. Cost of organization and administration		1,000,000			1,000,000
B. Interest on capital during construction		2,100,000			2,100,000
C. Condemnation costs		430,000			430,000
D. 1. Roadway	10,000		10,000		
2. Track	170,000				
3. Shops and buildings	1,580,000		290,000		
4. Telegraphs, signals, etc.	1,700,000				
5. a. Contact lines	4,770,000				
b. Substations	1,540,000				
c. Transmission lines	5,500,000				
d. Hydroelectric station	16,700,000				
Total of I. D		31,970,000		300,000	32,270,000
II. Cars, including heating equipment		400,000			400,000
III. Miscellaneous furnishings		650,000			650,000
Contingencies		1,000,000		650,000	1,650,000
Total		37,550,000		950,000	38,500,000
Expenses up to end of 1912 (not included in the request for an appropriation):		Francs.		Francs.	Francs.
General costs account of construction		93,399.43			93,399.43
Engineering		85,822.80			85,822.80
Water rights		577,909.80		596,000	1,173,909.80
Total		757,132.03		596,000	1,353,132.03
Amortization for discarded equipment					290,000,00

TECHNICAL RESULTS EXPECTED FROM ELECTRIFICATION

One result of electrification would be faster trains. Thus express train No. 58, which now requires 132 minutes from Erstfeld to Bellinzona, would make the trip in 114 minutes, a saving of eighteen minutes, or 13 per cent. Again the headway would be improved by the reduction in time required by trains to pass through the St. Gothard tunnel. Passenger trains which now traverse the tunnel in seventeen minutes would do so in fourteen minutes, and freight trains would cut down their time from thirty to twenty-three minutes.

In 1911 the steam locomotives of the Erstfeld-Bellinzona section ran 3,712,000 km. Electric locomotives of 10,000 kg to 12,500 kg drawbar pull to perform the same work in ton-kilometers would have to run only 2,950,000 km, a saving of 21.2 per cent in mileage. Assuming a 35 per cent increase in travel by 1918, steam locomotives would have to run nearly 5,000,000 km, compared with 3,950,000 km by electric locomotives. In 1911 the actual cost per steam locomotive km on the Erstfeld-Bellinzona line was 1.27 francs. This figure included interest, maintenance and depreciation of locomotives, depreciation on track, coal, stores and labor. On the assumption that steam should be used during 1918 and that there was no increase in the cost of coal, steam traction during that year would cost 5,000,000 × 1.27 francs, or 6,350,000 francs. But the estimated cost for electric power per locomotive kilometer, exclusive of energy but inclusive of all of the charges mentioned above, is 0.73 franc, so that, on a basis of 3,950,000 electric locomotive km, the cost for electric operation for these charges would be 2,883,500 francs.

The annual cost of producing energy and supplying it to the locomotives is made up of the following items:

	Francs.
Interest on 37,000,000 francs	1,480,000
Amortization of capital and payments to depreciation fund	554,300
Water rights and various charges	331,400
Labor and material	281,700
Maintenance and repairs	457,000
Total	3,104,400

The cost of train heating is placed at about 100,000 francs. The annual expenses for electric traction would therefore be 6,087,900 francs, apportioned as shown in the figures given below.

	Francs.
Electric traction exclusive of energy	2,883,500
Energy	3,104,400
Heating	100,000
Total	6,087,900

This is an approximate saving of 260,000 francs a year in comparison with steam. The superiority to steam will increase with the growth of traffic and with extensions of those lines much of whose basic expenses are comprised in the present electrification. Furthermore, the cost of locomotive fuel is likely to increase while the rising wage rate will affect steam operation more than electric operation.

REQUEST FOR APPROPRIATION

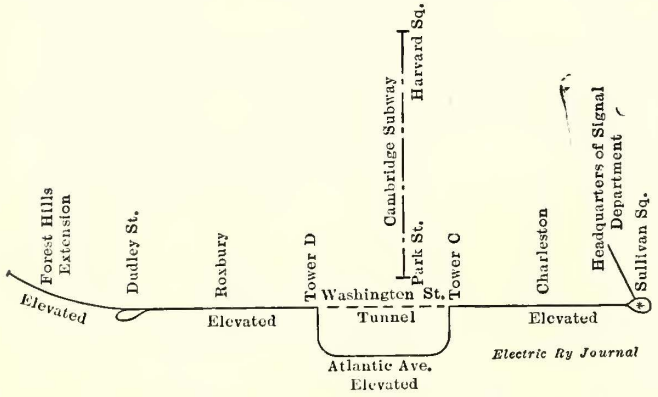
In view of the foregoing an appropriation of 38,500,000 francs plus 290,000 francs for the amortization of the scrapped steam equipment was requested for the electrification of the Erstfeld-Bellinzona line. This proposition was approved by the board of directors on Oct. 31, 1913.

For the Usui-Tage mountain railway in Japan, which was formerly operated by steam, twelve direct-current gear-and-pinion locomotives have now been provided. The power plant contains three 1000-kw turbo-generators producing three-phase energy at 6600 volts and fifty cycles. The third-rail system is used.

Signal Maintenance on the Boston Elevated

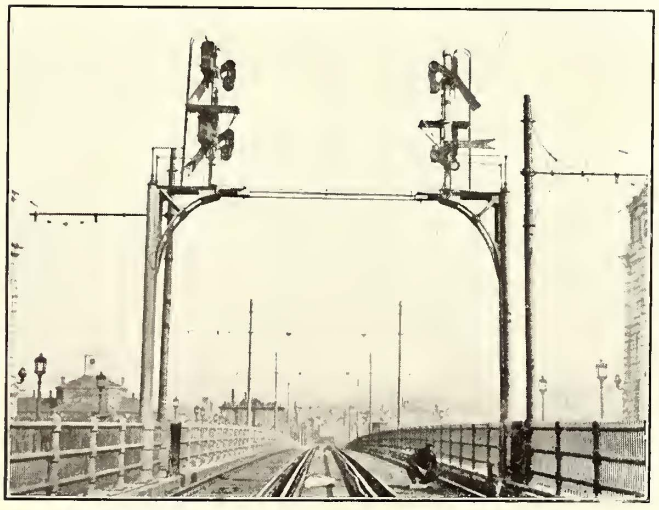
Details of Methods Used in Inspecting and Repairing Signal Apparatus on 27 Miles of Subway and Elevated Track Are Given—In January, 1914, There Were but Eight Trouble Reports for More than 2,000,000 Operations

The rapid transit lines of the Boston Elevated Railway comprise about 27 miles of main-line track, and include the elevated lines completed in 1901, the Washington Street tunnel, the Forest Hills elevated extension and the Cambridge subway. All train movements on these lines have been controlled by block and interlocking signals from the beginning of service, and at present



Boston Elevated Signal Maintenance—Diagram of Rapid Transit Lines

about 250 signals are in use, all being of the Union Switch & Signal Company's manufacture and of the electro-pneumatic type. The signals in the Cambridge subway are operated by alternating current, forty-five blocks being in service, while those in the Washington Street tunnel and on the elevated lines are of the direct-current type. In the former case, the double-rail return is used, and energy is supplied to the local transformers of the system from 550-volt mains, the feed to the track circuits being 10 volts maximum. The mains supplying

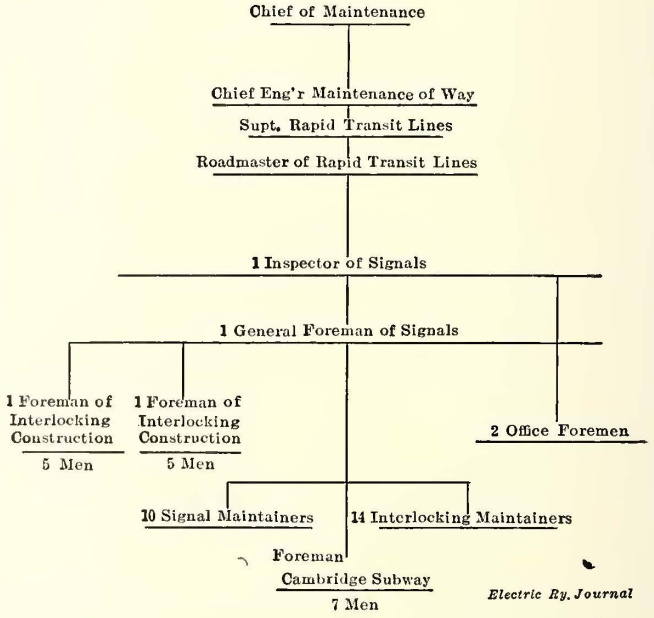


Boston Elevated Signal Maintenance—Signal Bridge, Cambridge Subway Line

the direct-current signals are operated at 110 volts with a single rail return, the pressure drop across the track relays ranging from 15 volts to 20 volts. The Cambridge subway and the other rapid transit lines do not interchange equipment, but all are operated under the direction of a superintendent of rapid transit lines.

ORGANIZATION OF SIGNAL MAINTENANCE WORK

The maintenance of signals and interlocking and all new construction in connection with either is handled by the company's department of maintenance and way, headed by a chief engineer responsible to the chief of maintenance. Reporting to the former through the superintendent of rapid transit lines is a roadmaster of rapid transit lines, and to the last-named official the head of the signal department reports, with the title of inspector of signals. As shown in the accompanying diagram, the inspector of signals is assisted in executive duties by a general foreman of signals, under whom are a foreman of interlocking construction, a foreman of electrical construction, ten signal maintainers, fourteen interlocking maintainers and a Cambridge subway foreman, under whom are seven men, four being assigned to interlocking and three to signals. Under the foreman of interlocking construction are five constructors and helpers, and under the foreman of electrical construc-



Boston Elevated Signal Maintenance—Organization Chart

tion are also five constructors and helpers. There are two classes of interlocking maintainers, the first class being responsible for both electrical and mechanical interlocking apparatus, and working from 5.30 a. m. to 3 p. m., the second class having no responsibilities in relation to electric interlocking maintenance, but otherwise having the duties of the first class, their working hours being from 3 p. m. to 12.30 a. m. Train service on the rapid transit lines extends roughly from 5:30 a. m. to 12.30 a. m. daily. There are also two office foremen who report to the general foreman or the inspector of signals, and who have general charge of all signals and interlocking forces in the absence of both.

A schematic diagram of the rapid transit lines is shown herewith. The track layout requires the use of eleven interlocking towers, which are in general operated in three daily tricks, as follows: First trick, 12 midnight to 9 a. m.; second trick, 9 a. m. to 6 p. m.; third trick, 3 p. m. to 12 midnight. An overlap is thus provided to care for the afternoon rush-hour conditions. Monthly

shifts in tricks are made in regular rotation by signal maintainers. Men on the first trick work in connection with night construction and repair crews and are required to understand both electrical and mechanical apparatus. Towermen are directly responsible to the train dispatcher, whose headquarters are at Sullivan Square, the general office of the superintendent of rapid transit lines. The signal blocks on the system vary from a maximum of 2020 ft. to a minimum of about 600 ft., with an average length of 1100 ft. The signal department normally employs about forty men aside from the foreman and inspector.

DUTIES OF SIGNAL MAINTAINERS

The work of signal maintainers on the elevated structure is similar to that in the subway and tunnel lines, with the exception that in the latter installations all signal indications are rendered by lamps, both lamps and semaphores being required on the elevated lines. Compressed air controlled by electrically operated valves and supplied at a pressure of 90 lb. per square inch is used in the operation of semaphore arms and switches throughout the system. Single maintainers on the elevated lines and in the Washington Street tunnel work in three daily shifts, viz., 12 midnight to 9 a. m., 9 a. m. to 6 p. m. and 3 p. m. to 12 midnight. Those in the Cambridge subway work from 12 midnight to 9 a. m., from 6 a. m. to 3 p. m., and from 3 p. m. to midnight. The following outline of the distribution of maintenance work on signal equipment in the Cambridge subway illustrates the character of the duties required:

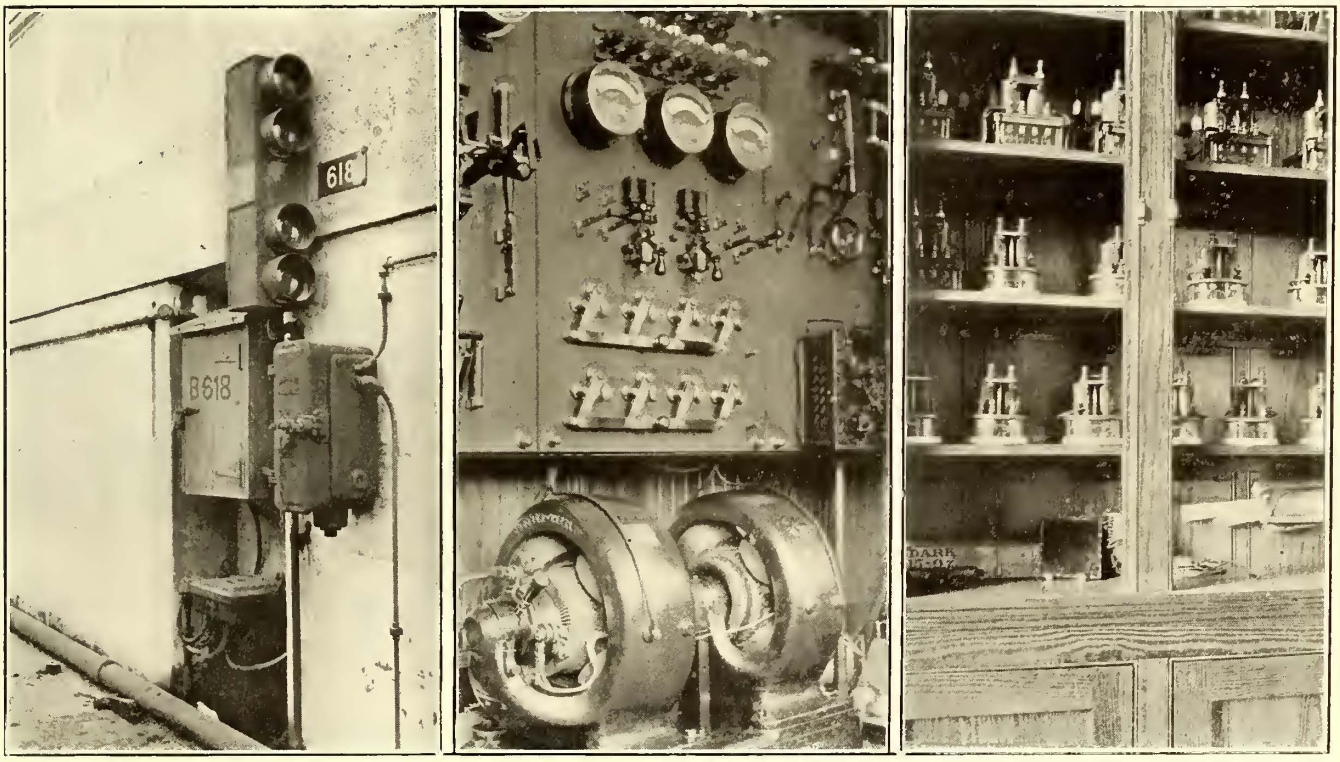
First trick, midnight-9 a. m.—Inspect all lamps in subway inverts, Eliot Square shop and yard, with necessary replacements. Look after cleaning of all electric lighting switchboards (sixty-three in number). See that automatic throw-over switches supplying emergency subway lighting current are working properly. Inspect pumps at five pump chambers between Harvard Square and Kendall Square, inclusive. Test cross-over track switches at Kendall and Quincy Squares. Answer emergency calls for light or signal trouble.

Second trick, 6 a. m. to 3 p. m.—Inspect and keep oiled all signal apparatus between Harvard Square and Park Street, covering twenty-four straight electric signals, three electro-pneumatics on bridge and twenty-seven automatic stops. Inspect pumps in chambers daily and answer emergency calls.

Third trick, 3 p. m. to midnight.—Inspect daily and keep cleaned and oiled all pumping apparatus. Inspect and clean ejectors at Harvard, Central and Kendall Square. Answer light and signal emergency calls. All maintainers keep tower P, at Harvard Square, informed as to whereabouts.

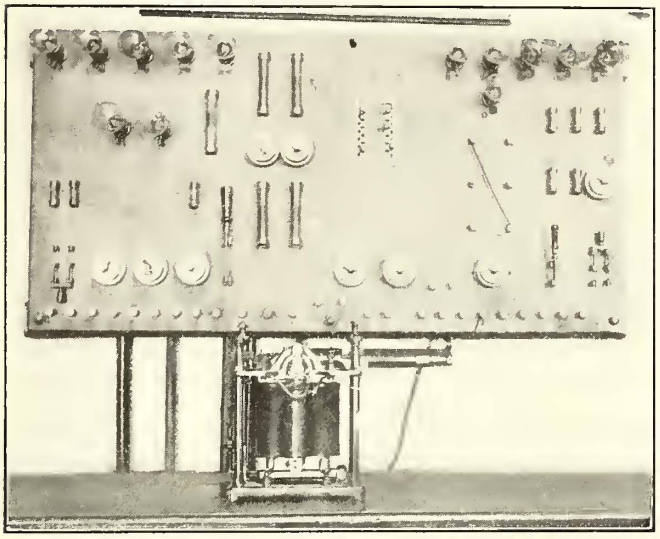
DETAILS OF MAINTENANCE WORK

The maintenance work includes the inspection and oiling of ten pumps, including switchboards and automatic starters controlled by floats, replacement of work-out foot valves, repairing burned-out or defective connections, rheostats, lamps, fuses, etc. There are about 4000 incandescent lamps in the Cambridge subway and its stations. In general, signal maintainers are expected to note any defects in track or roadbed when on duty, and on the elevated lines the mechanical adjustment of semaphore mechanism receives a good deal of attention. Light parts are renewed by maintainers. In renewing resistance tubes, improving contacts, etc., the signal circuit within the case is easily killed by pulling an inclosed fuse. In general, relay adjustments are made at the office of the inspector of signals by an office foreman, who specializes in this delicate work. In the Cambridge subway a maintainer often receives from fifteen to twenty calls daily to replace burned-out lamps, fuses or other light repairs. The inspection of motor-generator sets in towers which furnish current at 110 volts to the signal mains is handled by signal maintainers, storage batteries being kept in condition by interlocking maintainers. Maintainers are promoted from



Boston Elevated Signal Maintenance—Block Signal with Relay Box, Transformers, etc.—Motor-Generator Set for Signal Service—Repeaters and Relays in Signal Tower

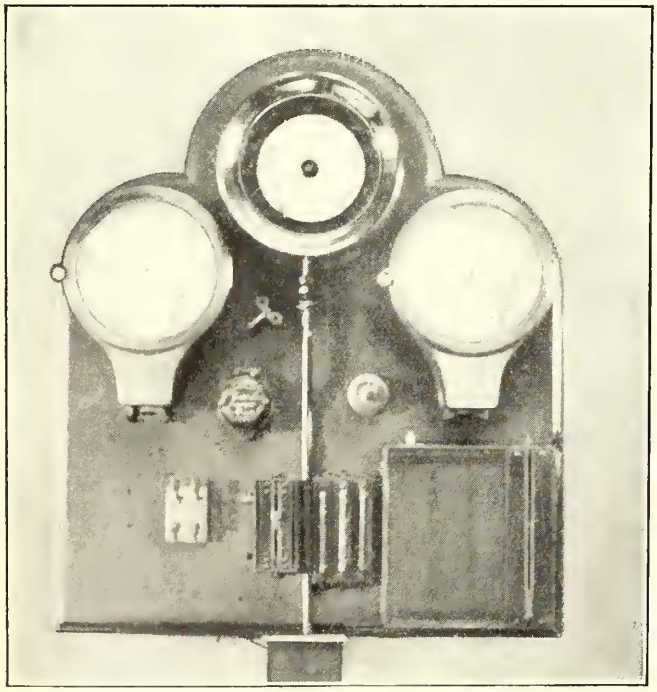
construction crews, the senior construction man being utilized as a spare maintainer. He thus has experience in the work prior to becoming full-fledged maintainer. Before attaining this rank the candidate is required to pass an oral and written examination given by the inspector of signals, the written portion dealing



Boston Elevated Signal Maintenance—Signal Test for Maintenance Work, Signal Inspector's Office

mainly with the making and interpretation of signal or interlocking wiring diagrams.

On maintenance work each man is allotted a regular section of the line, although on occasion the force is concentrated at points requiring special attention. Exclusive of the Cambridge subway, the rapid transit



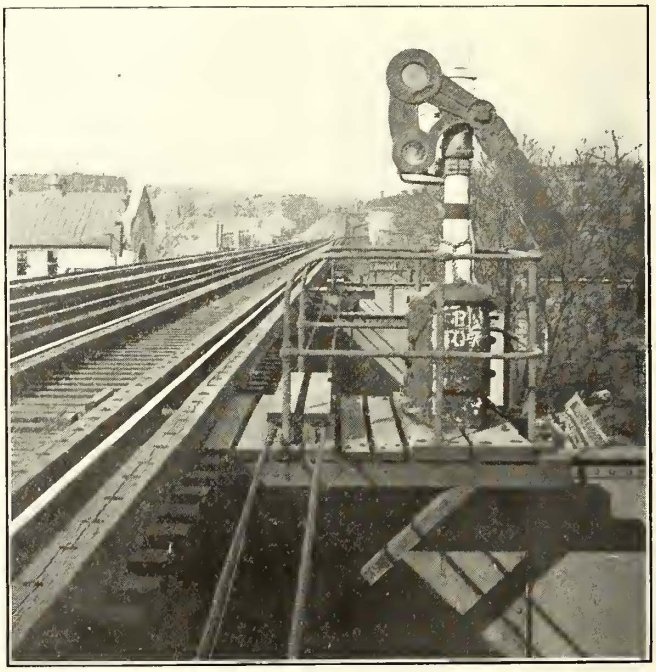
Boston Elevated Signal Maintenance—Recording Air Gage and Voltmeter, Office of Signal Inspector

lines are divided into two approximately equal geographical sections, three maintainers making their headquarters for trouble calls at Tower C and three at Tower D. Signal maintenance in the Washington Street tunnel is divided between two men, each of whom cares for some additional outside signal work on the elevated structure. Shifts of maintainers overlap in the afternoon rush hours.

RECORDS AND REPORTS

Each signal department employee is provided with a 4-in. by 8-in. pocket-book of blueprints containing the standard symbols of the Railway Signal Association, lists of standard terminal strips, wiring diagrams of all signal, track and supply circuits of typical arrangement on the system, wiring of detector and interlocking machines, surface car signals and track switches, track layouts at important junctions, car clearance diagrams, speed tables, heater wiring, telephone circuits and platform clearances, with an explanation of pneumatic valve operation and other data bearing directly upon the work of the department. Reports of signal troubles are transmitted to the train dispatcher by telephone or telegraph and are at once turned over to the signal maintainers and then to the signal inspector's office.

Each maintainer upon completing a repair job or upon adjusting any operating trouble reports to the



Boston Elevated Signal Maintenance—Typical Automatic Block Signal

office on a 4-in. by 6-in. slip recording the nature of the trouble, the time required to attend to it, etc., retaining a yellow carbon copy for reference. From the reports of maintainers a 3-in. by 5-in. day card is made up, giving the signal number and the cause of trouble reported, and from the day cards a monthly report to the roadmaster is compiled, showing in summary form the date of occurrence of each trouble, the kind of trouble experienced and an analysis of the month's operations. The monthly report for January, 1914, shows thirty-two trouble calls in 2,086,597 total operations of automatic and interlocking signals and switches, there being 50,577 operations per block or automatic signal troubles and 65,206 operations per total number of trouble calls. In this record a loss of power is considered as a trouble report, even though the signal system may not in any way be responsible. Twelve reported trouble calls were found to be without foundation, and in the month there were but eight trouble reports for apparatus in more than 2,000,000 operations.

The repair shop work of the department is handled

at the George Street yard, where facilities for bench and machine tool work are available in association with other work performed by the department of maintenance of way. Surface line signals are maintained by the department of wires and conduits. Adjoining the office of the inspector of signals is a schoolroom for car-service employees, a feature of whose equipment is a model track circuit operated by a miniature elevated car. In the main office of the signal department extra relays are kept ready for immediate use and a repair and test bench is installed with a 2-ft. x 4-ft. slate switchboard at which all forms of electrical energy used by the department are available, including direct and alternating current at various pressures, typical track circuit connections, etc. A small lathe, belt-driven by a fan motor, is available for coil winding and the office is equipped with recording instruments showing on twenty-four-hour charts the variations in third-rail voltage, air pressure and signal main potential. The department stockroom is combined with that of the maintenance of way department at the George Street yard.

CHICAGO MEETING OF SIGNAL COMMITTEE

The joint committee on block signals of the Engineering and Transportation & Traffic associations met at Chicago on March 17. The representatives of the committees in attendance were J. M. Waldron, New York; Gaylord Thompson, Trenton, N. J.; C. H. Morrison, New Haven, Conn.; John Leisenring, Peoria, Ill.; H. A. Nicholl, Anderson, Ind.; J. W. Brown, Newark, N. J.; L. H. Palmer, New York; F. W. Coen, Sandusky, Ohio; Chester P. Wilson, Indianapolis, and W. C. Smith, Boston, representing the railway members of the committees. The representatives of the manufacturers present were S. M. Day, General Railway Signal Company; H. W. Griffin, Union Switch & Signal Company; Carl P. Nachod, Nachod Signal Company, Ind., and Charles N. Wood, of Boston. L. E. Gould, of the ELECTRIC RAILWAY JOURNAL, acted as secretary of the meeting.

Chairman Waldron called upon J. W. Brown for a report from the joint sub-committee on rules and definitions. Mr. Brown said that his committee had spent the previous day in a thorough discussion of necessary revisions and additions for the existing block-signal rules in order to make them include methods of operation with trolley-contact signals. Definitions for such terms as "neutral indications" were then discussed generally by the whole committee, after which the chair instructed each attendant at the meeting to co-operate with Mr. Brown in determining the best definition for this and for such other terms as "registering signal," "permissive block," "absolute block," etc. It was the belief of the sub-committee that a foundation or skeleton for a complete set of block-signal rules should first be prepared and that the future work of the sub-committee should then be directed toward filling in and making each rule or definition satisfactory to the entire field.

It was decided that the existing steam railroad rules and definitions should be followed wherever possible. The committee also instructed its sub-committee to work with the Railway Signal Association in obtaining uniform definitions for semaphore, clear indication, caution indication, switch indicator, etc., and a new rule defining the location of signals with respect to the established direction of traffic was tentatively prepared. C. L. Henry, president Indianapolis & Cincinnati Traction Company, was quoted as offering to supply copies of his signal rules which were used for the operation of trains under the Simmen signal system.

The possibility of a more general use of light signals for day and night indications was then discussed by several members of the committee. Mr. Morrison pointed out several features, as shown by tests made at New Haven, in which existing types of light signals using 15-watt lamps gave indications that were entirely distinct at 1500 ft. These signals had 8-in. lenses. He mentioned a new type of light signal with a 10-in. lens which in daytime could be read at 3500 ft., and summarized the New Haven tests by saying that the developments of light signaling were interesting and encouraging.

H. A. Nicholl spoke regarding the twenty-nine blocks of light signals which protected 50 miles of track on the lines of the Union Traction Company of Indiana. These signals had 8-in. lenses and 40-watt lamps and could be read at 3500 ft. The indications were clear and satisfactory both day and night. There had been but one false clear indication by the signals during a period lasting for more than a year, and he was not even sure that this should be charged against the signals. No phantom indication had been given by reflection from headlights, and recent sleet storms had not affected the continuity of signal operation. He thought that so far as operation and cost of installation were concerned the light signal was the equal of the semaphore.

John Leisenring pointed out that the Illinois Traction System was largely equipped with semaphore signals, but also had some light signals. He thought that the light signal could be read for a greater number of hours out of the average day than could the semaphore.

Chester P. Wilson then briefly described the block-signal installation on one line of the Interstate Public Service Company in Indiana. The system included semaphores at sidings and light signals for intermediates. The intermediates shortened the block to about 60 per cent of the distance between sidings. There had been no trouble at all with the light signals except for the burning out of a few lamps owing to excessive voltage, and this was the result of the use of a voltmeter that was in bad order.

Mr. Leisenring spoke of the value of semaphores in showing the public that traffic was being protected, and he pointed out that the back lights on semaphores at night helped the crews get long trains in the clear. Mr. Griffin spoke about the legibility of light signals, saying that with 8-in. lenses a layman could easily read them at 2000 ft. and a motorman at 2500 ft. His company had installed some light signals with 5-in. lenses for speeds as high as 45 m.p.h. Mr. Day recommended 8-in. lenses and spoke also of the remarkable freedom of light signals from lightning troubles, as shown by results in Indiana. Gaylord Thompson said that his road, between Trenton and Princeton, N. J., was protected with Nachod signals having 5-in. lenses, and that these were entirely satisfactory for slow-speed service.

Just before the close of the session the committee agreed tentatively to recommend as good practice the use of 8⅜-in. lenses for high speed and 5⅜-in. lenses for medium speed.

The committee then adjourned subject to call of the chairman for another meeting which will be held in May or June.

Construction of electric tramways in Parana, Argentina, has been commenced and it is expected that the work will be finished about the middle of 1916. As soon as the electrification of the Santa Fe tramways is completed, it is probable that electric tramways will be laid in Esperanza, the oldest colony in the Province of Santa Fe, and to-day one of the principal cities of the country.

Convention of the American Railway Engineering Association

Reports of Committees Formed the Basis of Profitable Discussion on Roadway, Ties, Rails, Ballast, Track Structures and Other Features of Railway Work Affecting Electric as Well as Steam Railway Operators and Constructors—Abstracts of Important Reports Are Given in This Issue

The fifteenth annual convention of the American Railway Engineering Association was held in Chicago March 17 to 21. The National Railway Appliance Association gave a comprehensive exhibit in the Coliseum and the First Regiment Armory. Abstracts of the papers and reports of special interest to electric railway men follow.

TRACK

The report of the committee on track contains an interesting study of speeds on curves and the relation between speeds of trains and the lead curves and switch angles of turnouts. As a part of this study the committee presented tables and diagrams showing the results of its study of speeds of trains on curves. The committee also drew the following conclusions on the relation of speed and unbalanced elevation for curvature:

The comfort of a passenger on a train which passes over a curve or through a turnout at high speed is not dependent on the height of the center of gravity of the engine which draws his train, or of the car in which he is riding, nor is it dependent on the point where the resultant of forces intersects the plane of the track. But it is much affected by the condition of the track in the matter of surface and line, and the disturbed equilibrium of the passenger is due to centrifugal force uncompensated by the cant of the track.

The relation of speed to the condition of the track cannot be reduced to formulas, tabulated or shown on a diagram, but the relation of equilibrium to speed can very readily be shown. There are nearly as many opinions as there are individuals as to what constitutes a comfortable speed on curves. By tabulating speeds which will produce a certain fixed degree of disturbance of equilibrium one can at least furnish a basis for comparison between speed and comfortable riding.

Another point of interest in this report is the result of an experiment in extending the duties of the section foreman to include simple work commonly handled by men of the bridge and building, water service, telegraph and signal departments. He is at all times on one section of limited mileage and can attend to any such work with the minimum delay and expense, as compared with sending a man from one of the other departments from the division headquarters. This plan has been tried to a limited extent with the consolidation of the track and carpentry, telegraph and water-service work, principally, however, on the smaller lines. The combination of track and signal departments has been most thoroughly tried and has made the most progress.

In view of the limited extent to which this plan has been followed, no definite conclusion can be drawn at this time, and the entire subject is still in the experimental stage. At the same time, this method would appear to offer possibilities for economy in maintenance and deserves careful consideration by railway officers not only in combining the maintenance of the track and signals, but more particularly the combination with light carpentry and similar work. An incidental advantage, which should not be lost sight of, is the possibility of attracting a better class of men for the signal, bridge and other departments because of the increased salary paid for the enlarged duties.

BALLAST

The committee presented standard ballast sections from the principal railroads of Canada, the United States and Mexico. In all nearly eighty cross-section drawings were given. By superimposing the sections of the different roads, for both single track and double track, the committee was able to produce composite drawings of ballast sections. On the basis of these it recommended certain standard sections. Certain fairly definite conclusions had been reached by studying one point at a time as follows: In class A, stone ballast section, the top ballast should consist of broken stone, and where economical, there should be a sub-ballast of fine material, such as cinders, gravel or granulated slag. The depth of the ballast should be 24 in. and on curves the depth of 24 in. should be continued under the low rail. Where top and sub-ballast is used, the thickness of the top or coarser ballast should be 12 in. and the thickness of the sub-ballast or finer material, 12 in. The slope of the ballast on the side should be two to one and the upper corners should be rounded off to a 4-ft. radius. The top of the ballast should slope with a grade of ½ in. to 1 ft. from a point in the center of the track at the top of the tie to the intersection with a 4-ft. radius above mentioned, to avoid interference with track circuits. The top of the sub-grade should not be level but should be raised to provide drainage.

The committee recommended further that foul ballast should be cleaned with ballast forks or screens, that the space between tracks should be cleaned to a depth of 6 in. or more below the bottoms of the tie, that the berm should be cleaned to the bottom of the ballast, preferably not less than 12 in., that cross ditches should not be under rail joints, and that a statement should be made indicating that in the report of the committee on ballast for 1914 tests are reported which indicate that stone ballasts can be cleaned by use of screens for approximately one-half the cost of cleaning with forks.

In an appendix a report on cleaning stone ballast by means of screens, by W. I. Trench, division engineer of the B. & O. Railroad, is given. In another is a set of drawings of a collapsible screen for use in cleaning ballast.

TIES

The report covered a study of the effect of the design of the tie plates and spikes on the durability of ties; a continuation of the study of stresses to which cross-ties are subjected and a determination of the sizes required; a study of economy of labor and material effected through the use of treated ties as compared with untreated, and the compiling of further information as to the use of metal, composite and concrete ties.

On the basis of data furnished by railroads on the matter of plates and spikes the following important conclusions were drawn: Plates with deep ribs or claws cut the ties so as to admit moisture and decay. The

deep ribs or claws are not necessary to hold the plates in position and are undesirable. Flat plates used with cut spikes become loose and the looseness results in mechanical wear of the tie. They are satisfactory, however, when used with screw spikes. Plates with cross ribs not over 3/16 in. deep or other independent fastenings that will hold them to the tie do not seriously damage the latter and at the same time do not become loose and cause mechanical wear when used with ordinary cut spikes. The width of the tie plate is an element to determine the mechanical wear of the tie. When plates less than 7 in. wide are used with soft-wood ties, they cut into the wood sufficiently in some cases to determine the life of the tie. The plate should be of sufficient thickness to avoid cupping on either side of the rail. This thickness depends on the projection beyond the rail, the amount of traffic, the kind of tie and the rate of deterioration from rust, etc. Screw spikes prolong the life of the tie over that obtained with cut spikes. Where treated ties are used all boring should preferably be done previous to treatment. Ordinary driven, cut spikes, by breaking down the structure of the wood for an inch or so around the spikes, facilitate decay at that point where greatest strength of the tie is required. In the case of treated ties, this introduction of decay below the treatment may defeat the purpose of treatment. The breaking down of the structure of the wood with the use of cut spikes is, to a considerable extent, avoided where the spike is driven in a bored hole. Spikes so driven have at least the same holding power as spikes driven without boring. Where spike holes are to be bored and cut spikes used the diamond-pointed cut spike is preferable because of the greater ease with which it follows the hole. Appended to the report were a number of tables and photographs showing the comparative holding powers of different forms of spikes and illustrating the effect of the design of track spikes and tie plates on the durability of ties.

On the subject of treating ties the statement was made that the ever-increasing demand for tie timber and the ever-decreasing supply have created the necessity for treating timber not suitable for ties in its natural state. The economy in labor resulting from the use of treated as compared with untreated ties depends largely on the cost and frequency of tie renewals and therefore on the comparative life of the tie. Economy of both labor and material in cost per tie per annum was therefore presented in the report. Reports showed that the service life of ties depends on many conditions, many of them variable ones. Further, American railways have used treated ties such a short time that available data on the length of life as compared with that of untreated ties are not at all reliable.

The report gave numerous tables of data with comments thereon. The general principle is laid down that the increased cost of the treated tie is justified when the annual cost of its maintenance in track does not exceed the annual charge of the untreated tie. The increased life of the treated tie naturally decreases the number of annual renewals, resulting in decreased labor charge and disturbance of track and ballast. This item of decreased track disturbance has a value estimated by some as high as one-fourth the total cost of surfacing. The determination of this factor is so much involved, however, that it may be properly accounted as an undetermined credit to the use of the treated tie. The increased initial cost of the treated tie over the untreated one raises the question of interest charges on the additional expenditure for the period of its life in track; the ultimate economy of the treated tie used must cover this interest feature. The attempts to assign monetary values have resulted in questionable accuracy, but the results from a comparative standpoint have a workable value.

Tabulated results of ninety answers from railroads representing 230,000 miles as to the comparative cost and life of treated and untreated cross ties indicate that the average life of untreated ties is 7.78 years and the average cost $0.761; the average life of treated ties is 13.85 years and the average cost $1.031. The average cost of removing an old tie and installing a new one is about $0.23. There is an undetermined factor of cost incidental to tie changing due to the disturbance of the ballast and consequently of the surface of the track. Whatever this cost may prove to be, it is an inverse ratio to the life of the tie, and therefore least in the tie of longest life. There is need for further investigation of this subject.

The committee's investigations up to the present as to the comparative costs of labor and material involved in the use of treated and untreated ties favor the tie treated with preservatives of such quantity and quality as to preserve the wood fiber against decay to the limit of mechanical wear. In favor of the use of treated ties are the following points: the rapid and alarming disappearance of the available supply of timber suitable for use as untreated ties; the possibility of using available supplies of cheaper and so-called inferior timbers when chemically treated; the decrease in cost over a term of years of total tie renewals, owing to reduced cost of necessary renewals, and of reduced cost of labor of surfacing, tamping and replacing ties, fastenings and ballast resulting therefrom. There is a growing realization of the desirability of adzing and boring ties before treating and of obtaining more perfect drainage by boring spike holes clear through the ties. The committee believes that it is feasible with the formulas and facts presented in the report for any intending user of cross-ties to calculate the comparative cost of treated and untreated ties in any particular case.

In regard to the use of metal, composite and concrete ties, the committee compiled information from a large number of railroads and arranged this alphabetically under the names of the roads. The compilation showed very active experimenting with the use of metal and concrete ties. The committee evidently does not consider the data sufficient for the drawing of any general conclusions. As the report states the committee is building up a history of cross-ties that will be good for future reference and is reporting only on those ties that have been put in the tracks and used by some steam or electric railroad.

WOOD PRESERVATION

The report of the committee on wood preservation contains some interesting conclusions on the use of refined coal tar in creosote oil and on the question of methods of accurately determining the absorption of creosote oil. In an appendix the committee presented a paper by Dr. Hermann von Schrenk and Alfred L. Kammerer on the use of refined coal tar in the creosoting industry. They state that since 1908 approximately 24,500,000 ties have been treated with a combination of 80 per cent creosote oil and 20 per cent refined coal tar. Practically all paving blocks since 1907 have been treated with such a combination. The total amount of creosote oil used in the United States in 1912 was 83,666,490 gal. During 1912 it is estimated that 12,500,000 gal. of coal-tar-creosote combination were used for the treatment of ties and about 14,000,000 gal. for paving blocks, or a total of 26,150,000 for both, or about 31 per cent of all the oil used. Adding to this similar oil used at plants from which no figures are available, a conservative estimate indicates that about

40 per cent of all the creosote oil used in 1912 was a coal-tar-creosote combination.

Coal tar is one of the by-products obtained from the destructive distillation of coal, either at retort gas works or at by-product coke-oven plants. Gas-house tar usually has a high percentage of free carbon, coke-oven tar a low percentage of free carbon, and both tars when redistilled yield creosote oil.

Coal tar was added to creosote oil in large quantities in the early days of creosoting and is still added to creosote oil in England to give a black color to creosoted wood. The addition of a small amount of coal tar to creosote oil reduces the amount of evaporation which takes place. The combination remains in wood longer than the same creosote oil without the coal tar addition.

Experience of many years has shown that the high-boiling constituents of creosote oil are the most effective in preserving wood. Coal tar is largely composed of high-boiling compounds. The presumption, therefore, is that by adding a small amount of coal tar to creosote oil the antiseptic value of the mixture is not reduced but may be enhanced.

One of the most important considerations, however, is that if the coal tar is used anywhere, it should be mixed with the creosote oil under the immediate direction of the railroad company and with its full knowledge. The practice which has come about in various quarters of selling creosote oil mixed with coal tar as a No. 1 specification oil should be stopped, and the caution is added that the greatest care should be taken, where timber is treated with creosote, where a No. 1 specification is called for, that the specification for such oil be rigidly enforced.

RAILS

The committee reported that failures in the bases of rails having a comparatively thick base have been few and some railroads using rails of the thin-base type have recently increased the fillet between the web and the base to secure additional material at that point. Work on this subject will be continued.

During the year reports have been made on a number of special investigations principally by M. H. Wickhorst, engineer of tests. These reports dealt with manufacturing processes and the causes and defects of seams in rails. Of particular interest is an elaborate investigation on the influence of aluminum and silicon on Bessemer ingots and rails. Aluminum was added in the mold up to 10 oz. per ton with and without silicon. The general conclusion was favorable to the use of aluminum.

The sub-committee on rail joints recommended standard drilling for six-hole and four-hole angle bars in the belief that the sentiment which caused the withdrawal of the recommendations of the committee on tracks, adopted in 1904, was based on prejudice and had no substantial foundation.

The subject of stresses to which rails are subjected in service had been referred to a special sub-committee which reported that no material benefit is to be gained by further mathematical investigation of the question unless accompanied by actual tests of the service conditions. It was suggested that a combination be formed of the rail committee with the roadway, track and ballast committee, for conducting such tests jointly with the tests proposed by the last-named committee, through the proposed joint committee from the A. S. C. E. and A. R. E. A.

As a result of the discussion between the rail committee and members of the manufacturers' committee as to some parts of the specifications for carbon steel rails, certain changes were suggested and a complete copy of the specifications as revised is appended to the report.

WOODEN BRIDGES AND TRESTLES

The committee report on wooden bridges and trestles recommended that the report at the last annual meeting on the use of guard rails be amended to read as follows:

"It is recommended as good practice in the installation of guard rails to extend them beyond the ends of the bridges for such distance as is required by local conditions, but that this distance in any case be not less than 50 ft.; that guard rails be fully spiked to every tie and spliced at every joint; that the guard rails be some form of metal section, and that the ends be beveled, bent down or otherwise protected against direct impact with moving parts of equipment.

"It is also recommended as good practice to use inner guard rails on all open-floor and on the outside tracks of all solid-floor bridges and similar structures longer than 20 ft. in main-line tracks and on similar bridges and structures in branch-line tracks on which the speed of trains is 20 m.p.h. or more."

IRON AND STEEL STRUCTURES

Appendix A in the report on iron and steel structures regarding methods of protecting against corrosion was of considerable interest. An abstract of the information contained regarding pigments is as follows:

Pigments may, in respect to their action upon steel in water, be divided into three classes, each of which merges into the next by easy steps, so that the line of demarcation is difficult to ascertain. These classes are the "inhibitive," the "neutral" (inerts or indeterminate) and the "stimulative." The "inhibitive" pigments retard rust, the "stimulative" hasten the corrosion, while the "inerts" are an intermediate class which apparently leave the material in much the same condition as it was originally.

Pigments may further be divided according to their ability to exclude and to shed moisture. A pigment may exclude the moisture and still be of such a surface character as to allow it to stand upon the surface until it evaporates or is absorbed, or a pigment may have such surface characteristics that the moisture will run off. A "shedding" pigment may be a greater absorber of moisture than an "excluder" and still be a superior protection, according to the conditions of location.

Pigments may have different coefficients of expansion and "drying" and different moduli of elasticity. In cases where great differences obtain in any or all of these properties, the surface may "alligator" or crack. The liability of some of the best "inhibitors" to crack or alligator is so great as to preclude their use in many cases. The chemical processes by which the pigments are prepared exert a marked influence in the action of the pigment on the metal.

The consideration of the conditions of exposure are also important in the selection of a pigment. The chemical composition of the pigment may be affected by either heat, light, moisture or gases, so that it would fail, whereas if one or more of these deteriorating influences was absent good service would be obtained.

The vehicle is as important as the base. While the vehicle may, on account of porosity or other features, be objectionable, yet the addition of the pigment will, by reason of the filling of the voids, produce a sucessful protective coating. Investigators have concluded that the size of the pigment particles is important, and that the law of minimum voids holds true in the preparation of protective coatings as well as in concrete. There-

fore, either various proportions of the same pigment, which have different degrees of fineness, or the mixing of pigments of different degrees of fineness, would seem to be advisable. The spreading value of a pigment is an important consideration, secondary, of course, to its protective action, but still influencing it. Too high a spreading quality causes films of paint too thin to withstand the actions of the deteriorating influences.

Investigators appear to have come to the conclusion that bituminous coatings protect metal better than any other, but that the action of sunlight readily destroys their life, and hence their value, and that, therefore, they are practically of no value as a protective agent where subjected to the action of light.

From the preceding it appears that: (1) Priming coats should always be inhibitors, whether or not they are excluders or shedders. (2) Finishing coats should be excluders or shedders, shedders, preferably, whether or not they are inhibitors, neutrals or stimulators. (3) Care must be taken to consider the deteriorating influence and determine the chemical requirements of the pigment accordingly. (4) In cases where a pigment appears in more than one class, care should be taken to determine its process of manufacture before using it as a priming coat. (5) That the best results will probably be obtained by using an "inhibitive" and "excluder" or "shedder" pigment for both priming and finishing coats. The following table, due to Cushman, summarizes the matter.

CLASSIFICATION OF PIGMENTS

Inhibitors	Indeterminates	Stimulators
Zinc and lead chromate	White lead (quick process, basic carbonate)	Lampblack
Zinc oxide	Sublimed white lead (basic sulphate)	Precipitated barium sulphate (blanc fixé)
Zinc chromate	Sublimed blue lead	Ochre
Zinc and barium chromate	Lithopone	Bright red oxide
Zinc lead white	Orange mineral (American red lead)	Carbon black
Prussian blue (inhibitive)	Litharge	Graphite No. 2
Chrome green (blue tone)	Venetian red	Barium sulphate (barytes)
White lead (Dutch process)	Prince's metallic brown	Graphite No. 1
Ultramarine blue	Calcium carbonate (whiting)	Prussian blue (stimulative)
Willow charcoal	Calcium carbonate (precipitated)	Linseed oil
	Calcium sulphate	
	China clay	
	Asbestine	
	American vermilion	
	Medium chrome yellow	

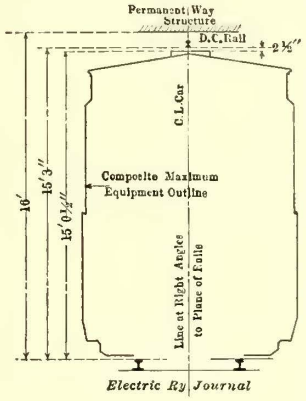
From this it is seen that the carbon and graphite paints should not be used as primers, that the zinc and zinc lead pigments are good primers, while the lead basis may belong to either class, according to their method of manufacture.

This report also contains a bibliography of articles and committee reports contained in the proceedings of the American Society for Testing Materials referring to preservative coatings for iron and steel. Other subjects dealt with at length in this committee's report include concrete incasements, column tests and secondary stresses.

REPORT OF THE COMMITTEE ON ELECTRICITY

The work of this committee was divided among six sub-committees as follows: committees on clearances, transmission lines and crossings, insulation, maintenance organizations, electrolysis and relation to track structures.

The sub-committee on clearances presented data from a large number of railroads showing present practice as to third-rail and overhead clearances. These were arranged in tabular form. A set of diagrams appended to the report showed suggested overhead clearances for permanent way structures and working conductors. Four of these diagrams were taken from the report prepared by the committee on electrical workings of the American Railway Association, and the statement was made that these are also being considered by a sub-committee of the American Electric Railway Association. These diagrams were reproduced in the issue of the ELECTRIC RAILWAY JOURNAL for May 24, 1913, page 935. A fifth diagram, showing recommended under clearance for overhead d.c. rail, was prepared by the sub-committee, based on the minimum under clearance of structures permitted by the New York State Public Service Commission. Reference was made in the report to the statement in the report for 1912 that information was not then sufficient to make recommendations of clearance for automatic stops. At a joint meeting held during the past year, attended by representatives of several associations, it was decided that the present state of development of automatic train stops or speed regulation devices is in an experimental stage, and since no such device has as yet been generally adopted by steam railroads, the joint committee should give no further consideration at this time to the location of such devices on the track structure and should so report back to the various associations. The joint committee recommended also to the clearance committees of the various associations that further study be made of the equipment clearance line shown on the third-rail clearance diagram adopted by the American Railway Engineering Association at its meeting of March, 1912. Following the meeting of the joint committee the sub-committee collected data on equipment clearance lines of various railroads and recommended a slight modification in the above-mentioned third-rail clearance diagram to provide for automatic stops or other structures of a similar nature. This study is to be continued.



A. R. E. A. Reports—Overhead D. C. Clearance Diagram

The other sub-committees reported simply progress on their work, the report of the sub-committee on electrolysis containing a report of the meeting on May 27, as published on page 1025 of the issue of this paper for June 7, 1913.

REPORT OF SIGNAL COMMITTEE

Because of the growing importance of the track circuit as a controlling agency for all signal appliances, the committee on signals and interlocking presented reports of various tests showing the conductivity of creosote and creosote-treated ties; also the effect of ballast and bonding conditions. The electrical resistances of smoothly hewn 7-in. x 9-in. x 8-ft. ties were investigated. These ties had been in the weather for approximately six months but had not been placed in the track. The pores seemed to be filled with creosote, but this was not oozing out as sometimes is the case in warm weather. Tests were conducted in the laboratory of the engineer of tests, Topeka, the air being warm and dry in all cases. In the tests 5-in. spikes were driven 4½ in. into ties at various distances apart and resistance readings were taken. Copper and brass plates were tried for cross-sectional measurements but without success, as the contact resistance formed too great a proportion of the total. Spikes also were driven part way into opposite faces and resistance readings taken.

The resistance with spikes 12 in. apart measured 12,000 ohms, spikes 4 ft. 8½ in. apart measured 42,000 ohms, and cross resistance between spikes 99,000 ohms. With spikes 12 in. apart the resistance measured 4200 ohms and with spikes 36 in. apart it measured 10,000 ohms. With the tie wet and with salt solution on its upper surface, the resistance with spikes 12 in. apart measured 54 ohms and with spikes 36 in. apart it measured 200 ohms.

In another test two sections of 90-lb. Santa Fé rail were firmly spiked at standard-gage distance, two spikes being used for each section. Each portion of rail was drilled, and No. 8 B.W.G. size copper bond wire was bonded thereto. Resistance readings were taken, first, with tie dry; second, after water had been poured over it, and, third, after a solution of 2 lb. of common salt in water had been poured over upper surface of each tie and around rail bases. An attempt to read resistance between rail and copper plate placed under the tie was not successful on account of high contact resistance. With one tie the resistance between rails was 13,000 ohms, but after about 1 gal. of water had been poured over its upper surface and the rails the resistance between rails was 12,000 ohms. After more water had been poured over the tie the resistance between rails was 11,000 ohms. After the salt water had been poured over the tie the resistance between rails was 1075 ohms.

The results obtained in this experiment indicated that dry creosoted ties in themselves did not possess very high conductance, nor was their conductance increased to any great extent by the addition of a slight percentage of moisture. The amount of water poured on in this test might be assumed as equivalent to a shower on ties in well-drained track. It was impracticable to reproduce conditions experienced in some locations, where the ties might be submerged for hours or days.

The addition of the salt solution brought forth such a great reduction in resistance as to brand this substance as a great detriment to successful track circuit maintenance. While it was assumed that 2 lb. of salt per tie represented an extreme case, yet the accumulation of brine from refrigerator cars year after year might mean that the residue remaining in the tie would eventually approach the amount used in this test. The cross-grain measurements tended to prove that the resistance was less with the grain than along the year rings or radial lines.

There were approximately 3200 cross ties per mile of single track. If all of these possessed the same resistance as the creosote mixture used in treating and there was leakage of current between rails through no other path, the resultant leakage resistance per mile of track would be 58.7 ohms or 310 ohms per 1000 ft. From the data obtained the following leakage resistances were calculated, it being assumed that all leakage was due to ties alone: Dry, 4.07 ohms per mile or 21.5 ohms per 1000 ft.; wet, 3.44 ohms per mile or 18.2 ohms per 1000 ft.; salt solution, 0.336 ohm per mile or 1.77 ohms per 1000 ft. A measurement of resistance of a man's body, between his hands (moist), was made and found to be 19,000 ohms. Between points on his arms where skin was thin the resistance was taken and found to be 10,000 ohms.

SIGNS, FENCES AND CROSSINGS

A sub-committee made a study of the proper qualities of fence wire, but was unable to secure any data of value. Another sub-committee investigated the relative values of concrete, metal and wood for signs and signals. A long table showing the results was presented. A digest of the law and the rulings of the public utilities commissions relating to the erection and maintenance of crossing signs was given as well as one on the law relating to trespassing on railroads and private property. Drawings of typical crossing and trespass signs were included in the report. An appendix to the report contained abstracts from statutes in regard to trespassing.

BUILDINGS

The report of this committee summarizes some of the important points to be considered in selecting a roofing as follows:

(1) Chance of leaks, due to character of construction.
(2) Probable life, including chance of damage by the elements and by wear from other causes.
(3) Fire-resisting value.
(4) Cost of maintenance.
(5) First cost.

The information collected on shop floors by the building committee was of special interest because it is applicable to street and interurban railway shops. This report says that the essential requirement of a shop floor is a good hard-wearing surface that is level, smooth, easy on the feet, easy to truck loads over and capable of carrying heavy loads. The advantages and disadvantages of the different typical types are as follows:

Cinder or gravel floor is a type in general use and is the one best adapted for blacksmith shops and foundries. It is often used where an inexpensive floor is required or where on account of a heavy fill inside of foundation walls a more expensive floor would fail on account of settlement.

Plank floor on cinder or gravel is often found desirable where a heavy fill inside of foundation walls is required, where settlement may occur, and where other types of floors would not answer on account of the volume of trucking required or on account of the necessity of gathering and saving scrap material, as in a machine shop. It consists of planking spiked to sleepers resting on the filled material between the foundation walls.

Wood block floors have the advantage that they can be easily repaired, are easy to work and truck on and do not damage falling tools. They need a concrete base to distribute heavy loads which may bear on a few blocks only. Asphalt block floors are sometimes used to advantage, as the blocks come ready to be laid, and they can be laid like wood blocks or like brick.

A concrete floor makes a cheap and fairly permanent floor. It is easy to truck over, is easily cleaned, is sanitary and has the advantage that no special foundations have to be provided, except for the heavier types of machinery. Light machinery is simply bolted to the floor. Industrial tracks may be cheaply installed in the floor with the head of the rail flush with the top surface. This floor, however, damages falling tools, it is hard to work on and becomes worn in spots. Sometimes granite screenings are used instead of torpedo sand to give additional wearing life. Ordinary concrete floors are porous and constant wear results in granulation and abrasion, starting holes which rapidly increase in size and gradually make the floors useless. Heavy wear, trucking and constant hard usage also make them wear unevenly.

Concrete floors may also be laid with special finish designed to be more lasting than the usual concrete floor. There are several special materials on the market that are used for the top finish which give good results. These generally consist of some mineral powder mixed with other substances. When applied the particles of this powder expand, filling the porous places in the concrete and give a surface of flint-like hardness, making a dustproof, wear-resisting and waterproof floor. One advantage is that this topping can be applied after the base is set without materially hurting

its efficiency. These special top dressings may also be used to advantage in patching old damaged concrete floors without renewing them.

An asphalt floor is considered to be an ideal floor for shops, if properly laid, with the correct materials and mixtures. Many floors of this character are in service and in fair condition after having been laid twenty-five years. They are easy to walk on and truck over and become more dense and durable as traffic increases. They do not grind away material under truck traffic, they do not easily wear uneven, do not easily crack or disintegrate, are noiseless and dustless, and can be kept clean with broom or mop, or by flushing with a hose. They are sanitary, waterproof and fireproof, and are easily repaired.

A brick floor with a concrete base is easily repaired, easily cleaned, sanitary and fairly cheap, but it is hard to truck over, hard for men to work on and hard on falling tools. The filling, concrete base and 1-in. sand cushion are placed in the same manner as for a wood-block floor.

In the report are given numerous drawings of floor cross-sections with dimensions.

RECORDS AND ACCOUNTS

In view of the fact that the Interstate Commerce Commission has prescribed the use, as far as they are applicable, of the conventional signs or symbols of the American Railway Engineering Association on the maps and profiles required by the commission, the committee on records and accounts has carefully revised those now in the manual and submitted the revision of the symbols for approval. Tables of these symbols showing the old as well as the newly recommended symbols were given.

One item of the work laid out for the committee was the recommendation of feasible and useful subdivisions of Interstate Commerce Commission classification Account No. 6, dealing with roadway and track. The commission does not specify as to the number of subdivisions in this account, provided the account is charged with all elements of expense that the classification indicates should be charged to it. The committee recommended ten subdivisions of this account as follows: track maintenance, applying track material, cutting weeds and general cleaning, ditching and bank widening, changing grades and alignment, flood damage, bank protection, filling, other care of roadway and track, and work-train service.

COPPER STATISTICS FOR 1913 AND PROSPECTS FOR 1914

The production of copper in the United States during 1913 was 612,000 tons, of which 200,000 tons are credited to Arizona and 140,000 to Montana. Michigan and Utah contributed more than 75,000 tons each. Domestic delivery for the same period came to 349,000 tons and export delivery to 395,000 tons. While a considerable proportion of the copper mined here is exported, the United States imports also a large quantity of copper, amounting in 1913 to 180,000 tons. Since 1860 copper prices have varied from 55 cents in 1864 to 9 cents in 1894, and the average price for the last thirty years has been 18.84½. In 1913 the average price for lake copper was 15.70, for electrolytic 15.52, for casting 15.33 and for standard 15.07. Judging from the behavior during the past year and from the present outlook, it seems likely that the average price of copper for the year 1914 will not be much above the thirty-year average of 18.84½ cents which has already been given.

QUARTERLY MEETING OF RAILWAY SIGNAL ASSOCIATION

The quarterly meeting of the Railway Signal Association was held in Chicago on March 16, 1914, and was devoted largely to the approval of various standards and forms of specifications being prepared by standing committees. The report on signaling practice included some interesting tests upon the use of creosote in treating cross-ties. The results obtained in electrical tests indicated that dry creosoted ties in themselves possess a high resistance and that this resistance is not decreased to any great extent by the addition of a slight percentage of moisture. The addition, however, of a salt solution brought about a great reduction in resistance, so much so that it was found to be a great detriment to successful track circuit maintenance. This condition was one which might be expected, from the accumulation of brine drippings from refrigerator cars year after year. Electrical measurements across the grain of the tie tended to show that the resistance was less with the grain than along the annular rings of radial lines. As a result of this test it was calculated that the leakage resistance per mile of track, under normal conditions, would be 58.7 ohms or 310 ohms per 1000 ft., the resistance being inversely proportional to the length of track.

Signal requirements of electric railways, including the rules adopted by the American Electric Railway Association, were submitted by a special committee composed of J. M. Waldron, chairman, R. C. Johnson, John Leisenring and C. H. Morrison. In presenting this report Chairman Waldron stated that it was the purpose of the committee to bring the peculiar requirements and conditions of electric railway signaling to the attention of the signal association, and he called special attention to the extensive use of light signals by electric lines. He reported that a special committee hoped to present the result of experience with this type of signal in its next report to the association.

Upon the question of approval of this committee's report the question arose as to whether it should be accepted as information only, or whether it should be discussed in detail at this time so that it could be approved by the association. In this discussion it was brought out that it would be well to accept the report as information at this time, but in view of the possible steam road electrifications, as well as those already electrified, such modifications as are necessary to this report should be made so that both steam and electric railroad signaling would be uniform. At the close of the discussion the report was accepted as information, and the board of direction was instructed to bring about a scheme which would meet with the approval of the American Electric Railway Association, as well as the Railway Signal Association for making such modifications as are necessary.

ENERGY FIGURES IN COLUMBUS

In the article on the use of the double-deck car in Columbus published in the last issue of this paper a typographical error occurred in the table on page 582 in the line referring to the cost of energy for the different types of cars. These figures should have been stated to be cents per car mile and not cents per kw-hour.

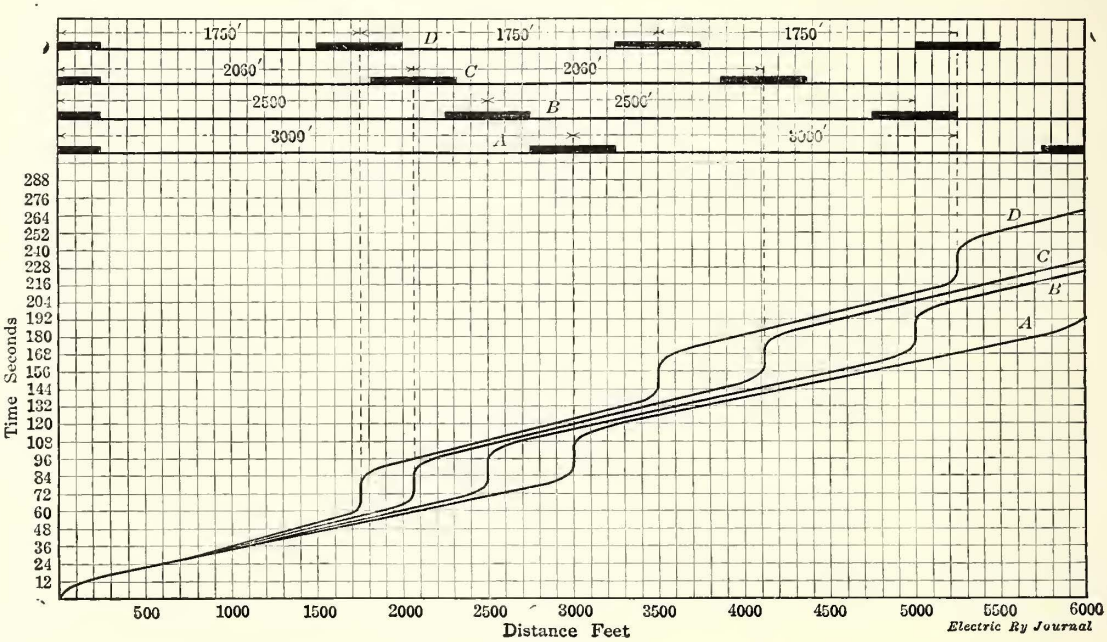
As amended, these figures, all in cents per car mile are: double-deck car, 1.602; single motor car, 1.144; two motor cars with multiple unit control, 2.288; single-ended two-car trains, both motor cars, 2.038; one motor car, one trailer, stepless, 1.976.

EFFECT OF STATION SPACING ON SCHEDULES

BY C. W. SQUIER, E. E.

Public-spirited citizens and organizations frequently recommend more stops on local electric railways without full consideration of the effects of such on schedule speeds.

In studying the operating conditions of different lines with a view of obtaining the highest schedule speed possible, I have found to what extent stops prevent rapid transit. Fast operation of express trains is not obtained by a high maximum speed so much as by the time saved in eliminating stops. A certain distance is necessary for a train to reach maximum speed. The greater the distance between stops the longer that maximum speed may be maintained. and the shorter will be the resulting running time between terminals. A short distance between stops is one of the great difficulties under which electric railways operate.



Curves Showing the Effect of Different Spacing of Stations on the Time Required to Travel a Certain Distance—Station Stop, 15 Seconds

The following comparison of operating conditions on three elevated lines which have the same equipment and service requirements is made from actual tests. It will serve as an example of the relation between running time and distance between stops:

Average Distance Between Stops, Ft.	Schedule Speed, M.p.h.
1859	13.5
1926	13.7
1972	13.8

A comparison of these figures shows how the schedule speed drops off as the distance between stops decreases. The line with the greatest distance between stops, 1972 ft., has a schedule speed of 0.3 m.p.h. greater than the line with 1859 ft., or there is an increase of 0.3 m.p.h. for an increase of but 113 ft. between stops.

To follow the comparison further, I have drawn the four distance-time curves shown in the accompanying diagram. These are plotted with the same operating characteristics so that the resulting running time is comparable with the distances between stops, which have been taken as 1750 ft., 2060 ft., 2500 ft. and 3000 ft. respectively. The results are also tabulated above.

If we assume that with any increase in the distance between stops a passenger will have to walk one-half this increased distance, and if we add this time to the time taken by the train, we find that a person traveling 7 miles will save 1 minute 37 seconds when the distance between stops is increased from 1750 ft. to 2060 ft., 3 minutes 9 seconds when the distance between stops is 2500 ft., and 4 minutes 5 seconds when the distance between stops is 3000 ft.

A further betterment of the service will be brought about by the decreased headway and increased number of passenger seats which would result from this greater distance between stops. With a line 10 miles long and stations spaced 1750 ft. apart, seventeen trains would be required to maintain a 5-minute headway. With the distance between stops increased to 3000 ft. the same number of trains would be able to maintain a 4-minute headway. Thus the time between trains and the consequent delay occasioned by waiting for them is reduced one minute. This saving will offset some of the extra time taken to walk the increased distance.

TABLE SHOWING RELATION BETWEEN LENGTHS OF RUN, SPEED, NUMBER OF TRAINS REQUIRED TO MAKE SCHEDULE, ETC.

Run No.	Feet Between Stops	Schedule Speed M.p.h.	Time Necessary to Travel 7 Miles	Time Necessary to Walk Half the Increased Distance Over Run No. 1	Time Saved in Traveling 7 Miles with Increased Distance Over Run No. 1	No. Trains Required to Maintain 5 Minutes Headway with 10 Miles Length Line	Layover Period
1	1750	15.1	27 min. 48 sec.	.....	.....	17	5 min. 33 sec.
2	2060	16.3	25 min. 40 sec.	..... 31 sec.	1 min. 37 sec.	16	6 min. 40 sec.
3	2500	17.9	23 min. 24 sec.	1 min. 15 sec.	3 min. 9 sec.	15	8 min. 28 sec.
4	3000	19.5	21 min. 33 sec.	2 min. 10 sec.	4 min. 5 sec.	14	8 min. 54 sec.

This decreased time between trains will give three more trains per hour passing any point on the line. If we assume that each train is capable of seating 500 passengers, then by increasing the distance between stops we would provide 1500 more passenger seats per hour and thus add to the comfort of travel.

So far I have referred only to such points as might be of advantage to the traveling public. The operating company would also be benefited by an increased distance between stops. Energy consumption would decrease as the total number of stops would be less, and the rheostatic losses during acceleration would be proportional to the number of stops. Finally, for the same service the same headway could be maintained with fewer cars. This would mean less capital invested and lower maintenance costs.

COMMITTEE MEETINGS A. E. R. A.

A meeting of the passenger traffic committee of the Transportation & Traffic Association was held jn Cleveland on March 17. Those in attendance were E. E. Soules, Peoria, chairman; C. R. Gowen, Syracuse; E. R. Kelsey, Toledo, and E. B. Burritt, secretary of the association. At the meeting the committee developed a line of procedure and decided to include a consideration of motor buses.

The meeting of the 1914 convention location committee was held in New York, March 14. No definite decision was reached. The committee will hold another meeting in New York, March 27.

The joint sub-committee made up of the rules committee of the Transportation & Traffic Association and the block signal committee of that association and of the Engineering Association met in Chicago March 16. Those in attendance were L. H. Palmer, New York; C. P. Wilson, Indianapolis; F. W. Coen, Sandusky, and J. W. Brown, Newark. The instructions of this committee were to develop standard rules for a signal system other than track circuit systems. The members also discussed signal rules and definitions. The committee had before it the rules disseminated by several trolley contact signal manufacturers including the following: United States Electric Signal Company, Boston; Nachod Signal Company, Inc., New York; Electric Railway Signal Company, represented by Charles N. Wood Company, Boston; Automatic Signal Company, Cleveland. With these rules and definitions and those of several roads the committee considered the ways and means for obtaining uniformity. After the rules have been revised and new rules and definitions have been decided upon the joint sub-commission will present them to the block signal committee and to the signal manufacturers for confirmation.

CENSUS REPORT ON ELECTRIC RAILWAYS

The remaining preliminary figures for the forthcoming five-year report on the electric railways of the United States have been given out by the Bureau of the Census, Department of Commerce. Statistics for various individual states have previously been given in the issues of the ELECTRIC RAILWAY JOURNAL of Jan. 10, 1914, Jan. 17, 1914, and Feb. 7, 1914. Statistics for the fourteen remaining states have now been issued by the Bureau of the Census and many be secured from Washington.

The statistics given in the accompanying table are a summary of all the individual state reports for the years ended Dec. 31 in 1912 and 1907 and June 30 in 1902. The totals include electric light plants operated in connection with the electric railways and not separable therefrom but do not include reports of mixed steam and electric railways or railways under construction during the census year which had not begun operations. There has been inserted in the table as prepared by the government a column showing the per cent of increase for the various items from 1907 to 1912 in order that there may be a basis for comparing the development of electric railways during the first and second five years of the decade.

The figures as presented for the continental United States show general gains for the decade 1902-1912. The number of operating companies increased from 817 in 1902 to 975 in 1912, or 19 per cent. There were 41,065 miles of track in 1912 as compared with 22,577 in 1902, or an increase of 82 per cent. The persons employed numbered 282,461 in 1912 as compared with 140,769 in 1902, or an increase of 101 per cent. The revenue passengers carried in 1912 numbered 9,545,554,667 as compared with 4,774,211,904 in 1902, or an increase of 100 per cent. The gross income in 1912 amounted to $585,930,517 as compared with $250,504,627 in 1902, or an increase of 134 per cent. The operating expenses amounted to $332,896,356 in 1912 as compared with $142,312,597 in 1912, or an increase of 134 per cent. The total horse-power of the power plants was 3,665,051 in 1912 as compared with 1,349,211 in 1902, or an increase of 172 per cent. The horse-power of the waterwheels increased from 49,153 in 1902 to 471,307 in 1912, or 859 per cent. The output of stations increased 168 per cent, rising to 6,952,699,008 kw-hr. in 1912 from 2,161,484,397 in 1902. The current purchased in 1912 amounted to 2,967,318,781 kw-hr., the figures for 1902 not being available.

OPERATING AND FINANCIAL STATISTICS FOR ELECTRIC RAILWAYS IN THE UNITED STATES

	1912	1907	1902	Per Cent of Increase 1902-1912	Per Cent of Increase 1907-1912
Number of companies.	1,260	1,236	987	27.7	1.9
Operating	975	945	817	19.3	3.2
Lessor	285	291	170	67.6	—2.0
Miles of line	30,437	25,547	16,645	82.9	19.1
Miles of single track[2]	41,064	34,381	22,576	81.9	19.3
Cars, number	94,016	83,641	66,784	40.8	12.4
Passenger	76,162	70,016	60,290	26.3	8.7
All other	17,854	13,625	6,494	174.9	31.0
Electric locomotives	277	117	3	...	...
Persons employed	282,461	[3]221,429	[3]140,769	100.7	28.5
Salaried employees	23,271	11,700	7,128	226.5	98.9
Wage earners	[4]259,190	209,729	133,641	93.9	23.6
Power:					
Horse-power, total (in thousands)	3,665	2,476	1,349	171.6	47.9
Steam and gas engines (including turbines)—					
Number	2,312	2,552	2,351	—1.7	—9.4
Horse-power (in thousands)	3,193	2,384	1,300	145.7	33.9
Waterwheels—					
Number	383	228	159	140.9	24.1
Horse-power	471,307	91,961	49,153	858.9	412.5
Capacity of dynamos, kw (in thousands)	2,508	1,723	898	179.2	45.0
Output of stations, kw-hr. (in millions)	6,052	4,759	2,261	167.6	27.2
Current purchased, kw-hr. (in millions)	2,967	[5]	[5]	...	...
Passengers carried (in millions)	12,135	9,533	5,836	107.9	37.7
Revenue (in millions)	9,545	7,441	4,774	99.9	28.2
Transfer (in millions)	2,423	1,995	1,062	128.1	21.5
Free (in millions)	165	96	[5]	...	72.2
Car mileage (passenger, express, freight, etc.) (in millions)	1,921	1,617	1,144	67.9	18.8
Income statement:					
Gross income (in thousands)	$585,930	[3]$429,744	[3]$250,504	133.9	36.6
Operating revenues (in thousands)	$567,511	$418,187	$247,553	129.2	35.9
Transportation revenues (in thousands)	$520,184	$390,276	$235,997	120.4	33.3
Non-transportation revenues[6] (in thousands)	$47,326	$27,911	$11,556	309.5	69.5
Income from other sources (in thousands)	$18,418	$11,556	$2,950	524.2	59.4
Operating expenses (in thousands)	$332,896	$251,309	$142,312	133.9	32.5
Gross income less operating expenses (in thousands)	$253,034	$178,435	$108,192	133.9	41.2
Deductions from income (taxes and fixed charges) (in thousands)	$191,123	$138,094	$77,595	146.3	38.3
Net income (in thousands)	$61,910	$40,340	$30,596	102.3	53.4
Dividends (operating companies) (in thousands)	$51,650	$26,454	$15,882	225.2	95.2
Surplus (in thousands)	$10,260	$13,885	$14,714	—30.3	—26.0

[1] A minus sign (—) denotes decrease.
[2] Includes track lying outside the United States, namely, 1912, 31.91 miles; 1907, 27.52 miles, and 1902, 4.20 miles, and exclusive of track not operated.
[3] For 939 companies in 1907 and for 797 companies in 1902.
[4] Number employed Sept. 16, 1912.
[5] Figures not available.
[6] Income from sale of current included: In 1912, $36,500,030; in 1907, $20,093,302; and in 1902, $7,703,574.

TRIBUTES TO GEORGE WESTINGHOUSE

In the current issue of the *Electrical World* appears a series of tributes of appreciation from a number of men who knew Mr. Westinghouse most intimately. Below are given extracts selected from these which serve to present a composite picture of his predominant characteristics.

William Stanley telegraphed that Mr. Westinghouse possessed three salient characteristics, "a strong, vigorous purpose, a wonderful grasp of the opportunities of life and a high courage that overcame all obstacles."

Nikola Tesla gave his impressions of Mr. Westinghouse at the time of their first meeting in 1888. "Then," said Mr. Tesla, "his tremendous potential energy had only in part taken form, but even to a superficial observer the latent force was manifest. A rare example of health and strength, like a lion in the forest he breathed deep and with delight the smoky air of his factories. His bearing was perfect, but he was a fierce adversary when aroused, a giant when confronted with difficulties which seemed unsurmountable."

E. M. Herr wrote that "great as was Mr. Westinghouse as an inventor, to those closely associated with him he was even more remarkable for his splendid courage, quickness of perception and far-seeing and accurate judgment of future needs and tendencies in the world's progress. These characteristics made him always an optimist. He was always open-minded and quick to see the good in the work of other inventors. In dealing with others he was eminently fair and liberal, but independent and courageous in his own work, never hesitating to assume the entire responsibility for anything he undertook, impatient of interference and rarely accepting or adopting suggestions from his engineers or associates. His kindly courtesy and consideration for all endeared him to his employees and inspired in them a spirit of great loyalty and affection for their chief."

Peter Cooper Hewitt sums up Mr. Westinghouse's characteristic qualities as "an appreciation of nature's forces and a love of mankind." "As the problems involved in nature's secrets unfolded themselves before him he strained every effort to turn their use to the benefit of mankind. He appreciated the enormous danger to humanity that accompanies the harnessing of vast forces and by his foresight and skill prevented disasters which might conceivably have been of enormous extent."

W. M. McFarland said that "one could not be with Mr. Westinghouse and know him without feeling that he was in the presence of one of the world's great and wonderful personalities. This was not because of any peculiarity of manner, for he was singularly unaffected and simple in his dealings with everybody and one of the most approachable of men. The mental qualities which brought about the success of his wonderful career were numerous and diversified. Imagination, organization, executive ability, foresight, courage, tenacity of purpose and cheerfulness were the great qualities that were all his." From personal association and knowledge of his history Mr. McFarland placed tenactity of purpose first, and then courage and foresight. No man ever inspired his subordinates and associates with more affectionate admiration and respect.

Charles A. Terry placed as prominent among the qualities which distinguished Mr. Westinghouse from other great inventors "his powerful intellect, his tremendous will power, his indomitable courage, all different manifestations of his strong personality. His quick insight into the verities of any problem enabled him to arrive rapidly at conclusions, and when convinced of the justice and feasibility of the end to be attained and satisfied as to the course to pursue he trained the full force of his will upon its accomplishment. Back of his persistence and courage was a far-sighted apprehension of not merely the possibilities but the certainties of future scientific and industrial development."

Calvin W. Rice was impressed by the expression of Mr. Westinghouse's character in his home life in which his tremendous capacity for work and power of concentration were manifested. "He followed with precision his program for the day but was so gentle and gracious withal that one yielded as a matter of course to his plans. He was always most considerate of the welfare of his family and his guests. He had the gentleness of strength under complete control."

L. B. Stillwell analyzes Mr. Westinghouse's qualities as "intellectual vigor, dauntless courage and tireless energy. From the start his influence upon the young men associated with him was extraordinary. His lieutenants inevitably partook of his own buoyant hopefulness and his determination to find the solution of the many problems encountered in his development work. He never preached, save by example, but his preaching was remarkably effective."

The following has been received by this paper from N. W. Storer, general engineer of the electric railway department of the Westinghouse Electric & Manufacturing Company, stating the relation of Mr. Westinghouse to the development of electric traction:

"In all the railway world there is no name that comes so near being a household word as that of Westinghouse. It is eminently fitting and proper, therefore, that railway people should, in noting the passing of this great inventor and captain of industry, consider what his life meant to the business of transportation.

"While the field of activity covered by Mr. Westinghouse was remarkable for its breadth, there is no doubt that his greatest interest lay in railroading. From the time his great brain conceived the idea of the air brake and foresaw its possibilities, he was always thinking out new plans for increasing the capacity, efficiency, reliability and safety of our railroads. The air brake and the automatic block signal system have always been popularly considered as safety appliances, but these words do not in any sense express the meaning and value of these inventions to mankind. Not only have they made all railway traffic safer and more reliable, but they have doubled, tripled, quadrupled—increased the capacity of railroads beyond the wildest dreams of fifty years ago.

"When Mr. Westinghouse decided to enter the electric railway field his influence was immediately felt, and from that day to the present his high ideal has always spurred on the engineers of his company to the best that was in them. With them, under his leadership, it has never been a question of simply meeting contract specifications, but of furnishing apparatus that would do the work better, if possible, than it had ever been done before.

"Quick as Mr. Westinghouse was at developing ideas of his own, he was equally quick to appreciate the inventions of other men, and to see in them possibilities far beyond the conceptions of the original inventors. Notable examples of this are found in his purchase of the Goulard & Gibbs transformer patents and the rights to the Parsons patents on steam turbines. While these inventions apply to electric railway work only indirectly, their development has greatly extended its field. His work in the application of the principles so successfully established by the Air Brake Company and the Union Switch & Signal Company led Mr.

Westinghouse to the development of the now well-known electro-pneumatic system of remote control for railway motors. As showing still further his far-seeing mind, we need only instance his letter to the New York papers concerning the necessity for guarding against danger from fire in the subway which was then under construction. The wisdom of this was shown by the almost immediate trend of all designs toward fireproof construction for railway cars.

"His purchase of the three-phase railway patents of von Kando, his development of the single-phase system, and the steady improvement of direct-current apparatus of both low and high voltage to its present state of perfection, all point to his breadth of view and his desire to get the best out of every system and apply the proper system in each place. At the same time he has always emphasized the necessity for an early standardization of systems to permit the maximum interchangeability of equipments.

"In a brief sketch of this kind it is impossible to more than mention a few of the more important achievements, but I think that all will agree that the railway world owes probably as much to George Westinghouse as to any other man who ever lived."

WESTERN SOCIETY OF ENGINEERS DISCUSSES PUBLIC-UTILITY REGULATION

Public-utility regulation was discussed at the meeting of the Western Society of Engineers, of Chicago, on March 16, 1914. The subject of a reasonable charge for public-utility service, which was the theme of an instructive paper read by Dean M. E. Cooley, of the University of Michigan, at the annual meeting of the society and summarized in the ELECTRIC RAILWAY JOURNAL of Jan. 17, 1914, page 124, was discussed in three papers presented at this time.

The first paper was read by Andrew Cooke, Chicago, who considered public-utility regulation from the investor's point of view. Mr. Cooke spoke particularly of railroad investments, taxation, competition and rate regulation. He thought that where surplus earnings were reinvested in the property they should not be capitalized for rate-making purposes. He urged the safeguarding of railroad investments so that the interest paid for the necessary capital could be reduced. He closed by stating that government control seemed to be essential to this end.

Samuel O. Dunn, editor of the *Railway Age Gazette*, read a paper on public-utility valuation from the railway point of view. Mr. Dunn said that the fair present value of railroad properties is, in essence, the value which would be paid to owners under condemnation proceedings. He also discussed the general valuation of the railway properties about to be made by the Interstate Commerce Commission. In relation to the valuation of the land belonging to railways, he said that it should be included at its full present fair value. Constitutionally speaking, the so-called "unearned increment" in the value of land used for railway property cannot be confiscated any more than that for land used for any other purpose. Mr. Dunn agreed with Mr. Cooke about excluding from the valuation surplus earnings invested in business. Depreciation value should be figured in accordance with the existing potential service of the thing being valued. The speaker argued vigorously for a fair allowance for going value and concluded by saying that he felt very confident that when the government valuation of the railways of the United States is made it will result in an advance in rates rather than in a reduction. The railways of the country, therefore, could look with equanimity on the government's gigantic plan of valuing all the railway properties.

Harold Almert, a consulting engineer, was the third speaker. He discussed public-utility regulation from the points of view of the public and the engineer. The public's interest was in securing an adequate service at reasonable rates. The machinery of the public-utility commission had been created to accomplish this purpose. Mr. Almert said that the engineer who had had training in law and accounting as well as engineering training and experience was the man best qualified to get at the real facts in the broad questions of public-utility regulation. The helpful engineer must be nothing less than a publicist, and on him should rest, and no doubt in time would rest, the greatest responsibility in relation to these questions which is to devolve upon any class of American citizens.

John W. Alvord, past-president of the society, was called upon to open the discussion. He remarked that about $1,000,000,000 worth of property would be appraised annually in the next five to eight years. The fundamental principles of appraisal work rested in the law and in such questions as the definitions of property, value, etc. In this work the law should be regarded as the foundation, engineering judgment as the superstructure, and the work of the economist and business man as giving the finishing touches to the edifice. Mr. Alvord gave an amusing illustration of the manner in which the highly trained staff of a public-utility commission might go about the valuing of a horse. The staff would probably determine carefully the value of the iron in the shoes, the glue in the hoofs, the worth of the hide, etc. But they would be valuing a dead horse. Going utilities are to be compared to live horses, and the speaker pointed out the wide variation of valuation of going concerns—a variation often difficult to define by formula and method. But for the most part the commissions were doing their work with great care and great patience.

William B. Jackson, consulting engineer, said that what the utility earned was not so important to the citizens as what it did with its earnings.

James E. Quan, chairman of the Illinois Public Utilities Commission, was called on, but retired in favor of Walter A. Shaw, the engineering member of the commission. Mr. Shaw spoke briefly, assuring his hearers that the Illinois commission believed that the utilities were entitled to fair rates on a fair valuation.

L. E. Cooley, consulting engineer and brother of Dean Cooley, said that if he had his way the utility would be financed with only one security. This one security would bear only a minimum rate of interest until the utility was a going concern and other issues of the security would be put out during the early years to cover possible losses. When the utility was on its feet and a prosperous going concern, the security would then receive a fair return, all over that to be turned into a surplus fund to provide for amortization or improvement to the property.

A. C. King, deputy commissioner of gas and electricity of Chicago, spoke briefly and was followed by Prof. Morgan Brooks, of the University of Illinois, who dwelt particularly on quality of service rather than reduction of rates.

The ELECTRIC RAILWAY JOURNAL has opened a permanent Pacific Coast office in Room 502, Rialto Building, San Francisco, Cal. The editorial work will be in charge of N. A. Bowers, who has been news correspondent for this paper for the past year in the Northwest with headquarters at Vancouver and previous to that time was connected with the *Engineering Record*.

COMMUNICATIONS

MR. WILSON DISCUSSES THE TENTATIVE SYSTEM OF ACCOUNTS

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION—COMMITTEE ON A STANDARD CLASSIFICATION OF ACCOUNTS

BOSTON, MASS., March 13, 1914.

To the Editors:

It is hoped that Accounting Series Circular No. 41, which has just been sent out by the Interstate Commerce Commission to all electric carriers, will prove to be acceptable to them. A great deal of time has been spent upon these classifications both by the representatives of the Interstate Commerce Commission and the members of the committee on a standard classification of accounts of the American Electric Railway Accountants' Association.

For several years there have been in use as standard practice classifications covering operating expense accounts, operating revenue accounts and road and equipment accounts. These have proved fairly satisfactory, but numerous questions have, of course, arisen as to the application of the accounts, and an endeavor has been made to word the new text so as to cover all of these matters. To provide for a complete system of accounting there have now been prepared classifications to cover income accounts, to cover profit and loss accounts and to cover general balance sheet or ledger accounts. Great care has been used to make these as complete as possible, and it is sincerely hoped that they will meet with the approval of all interested parties, whether company officials or others interested financially or otherwise in the railway properties.

The new classification covering operating expenses has been so changed that there are now ninety-nine accounts under six general headings where there were formerly eighty-eight accounts under five general headings, the additional general heading being that of "Power Account."

Under this general heading there has now been placed in addition to the items formerly coming under the sub-head of "Power" (which formerly came under the general heading of "Conducting Transportation") items previously chargeable to Account 22, "Transmission System," and Account 25, "Buildings and Structures," Divisions (a) "Power Plant" and (b) "Substations and Storage Battery Plants," formerly under the general heading of "Maintenance of Way and Structures," and Accounts 30, "Power Plant Equipment," and 31, "Substation Equipment," formerly under the general heading of "Maintenance of Equipment." It also includes that portion of Account 48, "Superintendence of Transportation," which included the salaries and other expenses of the superintendent of power. It is thought that the combination of all of these accounts under this new general heading will be found very advantageous when comparisons have to be made between different properties where the conditions governing the generation or purchase of power on these properties differ.

Under each of the general headings of "Way and Structures," "Equipment" and "Power" there have been added accounts entitled "Equalization." These accounts have been provided for use by such companies as may wish to distribute some of their operating expenses over a period of months rather than to include the total expenditure in the month when the work was actually done. By debiting or crediting these accounts one may see at a glance the actual expenditures that have been made during the month and yet distribute the expenditures over a longer period. It is provided, however, that this account must be cleared annually unless there is some good reason why a portion of the expenditure should be carried over.

Under the general heading of "Equipment" there has been added a new account numbered 40, "Equipment Retired," which has nine sub-accounts covering the different classes of equipment. This account was set up in order that the other maintenance accounts might show only the sums actually expended for maintaining the equipment still in use by the company and not include additional sums to cover the value of equipment which was no longer used by the company.

Under the general heading of "Traffic," a new account numbered 78, "Parks, Resorts and Attractions," has been added to cover such items as have been incurred primarily for the purpose of inducing travel.

Under the general heading "General and Miscellaneous" there has been added a new account, No. 87, "Valuation Expenses," to cover any expenditures to which a carrier may be put in complying with federal or state requirements in order to ascertain the value of the property under the control of the reporting company. There has also been added a new account, No. 88, "Amortization of Franchises," to which account shall be charged each month the proper proportionate expense of acquiring such franchises.

All officials interested should carefully consider the general instructions on pages 11, 12 and 13.

No new ruling has been made covering depreciation, the old provision that the company need not set up such an account unless compelled by state regulations so to do being still in force.

The operating revenue accounts remain practically the same. Account No. 103, "Parlor, Sleeping, Dining and Special Car Revenue," has been amplified, the old text having said nothing about sleeping and dining car expenses and receipts. Provision is now made for the charging of cost of supplies to this account and crediting thereto the receipts from the sales of these supplies.

The road and equipment accounts have received considerable attention. In the old steam railroad classification there was a separate schedule covering additions, betterments and replacements. Definite instructions relative to these accounts had never been promulgated for the use of electric carriers, and these carriers have always been allowed to make charges to the road and equipment accounts for work of this nature. I now understand that the steam railroads have decided it is better to have only one classification for property accounts rather than two and have done away with their separate text for additions, betterments and replacements and, in the future, are to include them in the regular road and equipment accounts.

The general instructions preceding the schedule of the road and equipment accounts, taken in connection with the text of the accounts, covers very comprehensively the treatment of all of the property accounts, and with these explanations it seems as though there should be no excuse for not properly classifying and taking care of all property items.

Three new accounts have been added entitled "Organization," "Unlimited Franchises" and "Limited Franchises." Items of this kind were previously included in the old Account No. 44, "Miscellaneous."

Attention is particularly called to Account No. 546, "Interest During Construction," which takes the place of the old Account No. 41, "Interest." The new account allows a more liberal treatment of this important item than in the old classification, inasmuch as it permits a proportion of the discount on funded debt issued for construction or additions and betterments purposes to be charged to this account.

It is to be regretted that these tentative schedules could not be put into the hands of those interested at n earlier date and more time be allowed to offer criticisms and suggestions. But this was found to be impracticable as it is the desire of the Interstate Commerce Commission to put all these schedules into effect with the year commencing July 1, 1914, and in order that this may be done it will be necessary to get the schedules into the hands of the printer at the earliest possible date. A meeting of the representatives of the Interstate Commerce Commission and the members of the committee on a standard classification of accounts has been called to be held in Washington on March 25 to consider criticisms and suggestions.

H. L. WILSON, Chairman.

PLATFORM ACCIDENTS IN MOSCOW

MOSCOW, RUSSIA, Feb. 27, 1914.

To the Editors:

I have just read with interest the article in your issue of Feb. 17 upon "The 'Safety First' Signs in Portland." I might state in this connection that on each motor and trail car of the Moscow Municipal Tramways is painted the following statement: "Boarding and alighting when car is running are forbidden." There is also a regulation of the Moscow Municipal Council forbidding the practice, and the violators of the law may be arrested. In spite of this fact passengers enter and leave the cars as they please. The number of the tramway fatalities is increasing from year to year and the percentage of the serious accidents is also increasing. A summary of the accidents to passengers for the year 1911 (the last year for which statistics are available) is shown in the following table:

TABLE SHOWING ACCIDENTS TO PASSENGERS, MOSCOW TRAMWAYS, 1911

	From Boarding and Alighting	Total
Fatalities	5	6
Serious injuries	107	132
Slight injuries	2520	2855
Total	2632	2993

As will be seen, the percentage of boarding and alighting accidents to the total was 88.

There were 265 car collisions, resulting in injuries to forty-three passengers. These figures are included in the table printed above.

The number of vehicles struck by cars was 1973.

The length of line is 56.8 miles, not including several horse lines.

The number of passengers carried was 209,000,000 and the car mileage was 23,500,000.

Some center-entrance motor cars have been run from the beginning of the municipal operation and some of a new type have recently been put in service, but neither type is particularly popular with the Moscow public.

M. SHEREMETEWSKY, Mechanical Engineer.

REPORT OF THE BOSTON JOINT COMMISSION

The report of the Massachusetts Public Service Commission and the Boston Transit Commission, acting jointly in its investigation of street railway service in Boston, was made public this week. A summary of the testimony at the hearings conducted during this investigation has been published in previous issues of this paper. The conclusion reached is "That to some public authority be committed a thorough and fundamental consideration of the whole metropolitan transportation problem, involving all street car systems which serve the metropolitan district and such railroad systems, or such parts thereof, as may be properly included within the same investigation, and involving not only a consideration of questions of fares and service, but also questions of the charter rights and property rights of the parties and the relations between the various companies concerned as well as the relation of the transportation system as a whole to the municipalties constituting the metropolitan district."

In discussing the subject the report says that the general cause of complaint has been the crowded condition of the cars and irregularity of service, especially during rush hours. The hearings developed the fact that the seats furnished by the Boston Elevated Railway and the Bay State Street Railway Companies, the two companies under investigation, equaled the number of passengers carried but that the difficulty experienced could not be met if additional cars were furnished because on many existing lines the facilities were being utilized to their full capacity. The report also refers to the rapid extension, especially during recent years, of the ride possible for a single fare, and the requirements upon the Boston Elevated Railway to make still further expenditures.

Referring particularly to this company the report says that in 1888 the capital invested per $1 of gross earnings on the Boston Elevated was $2.38. In 1913 it had risen to $6.22. Conversely the number of revenue passengers carried for each $1 invested has shown a great reduction. In 1888 for each dollar of investment 8.37 revenue passengers were carried, while in 1913 only 3.09 revenue passengers were carried. The number of free transfer passengers had increased from about 11,000,000 in 1893 to upward of 18,000,000 in 1913. These statistics show that the investment obligations of the Boston Elevated Railway have been increasing much faster than earnings, and the committee asks the question: "How far can the company profitably carry passengers for a 5-cent fare?" Statistics seem to warrant the inference that the limit of a profitable ride is 4¼ miles.

Continuing, the report says that the fundamental difficulty in attempting to deal in any flexible manner with inequalities and injustices in the present situation is the rigid provision in the Boston Elevated charter which guarantees the right to charge a fare of 5 cents for any passage in one direction on its lines and imposes upon the company the obligation of carrying passengers for a fare of not more than 5 cents. The question before the commissions was also complicated by the fact that lines which some complainants desired the Boston Elevated to assume belong to another corporation—the Bay State Street Railway. If it should be found desirable that the Boston Elevated's service should be extended beyond present limits it might be found that the only practicable method of providing these facilities was through an amendment of the company's charter which would relieve it from some of its present obligations.

For this reason the joint commission recommends the thorough consideration of the subject already mentioned, a consideration which might involve certain changes in the charters of the companies concerned and possibly their consolidation or combination.

The recently opened $6,000,000 power plant of the United Electric Light & Power Company, of New York City, has caused annoyance to neighbors by reason of excessive noise. Professor Sabine, of Harvard University, has worked out a plan on the principle of the Maxim silencer for reducing the roar, the air being drawn through a well provided with deadening partitions.

Equipment and Its Maintenance

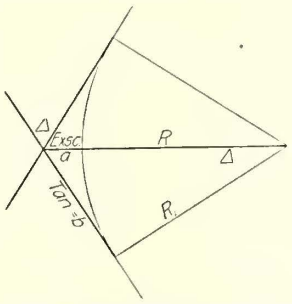
Short Descriptions of Labor, Mechanical and Electrical Practices in Every Department of Electric Railroading

(Contributions from the Men in the Field Are Solicited and Will Be Paid for at Special Rates)

A SURVEYOR'S SHORT CUT

BY M. BERNARD, ASSISTANT ENGINEER IN WAY AND STRUCTURE DEPARTMENT, BROOKLYN RAPID TRANSIT SYSTEM

It often happens that it becomes necessary to know both the radius and the △ angle of a curve of which only the tangent and exsecant are known. The simple method shown in the accompanying drawing has been devised by the writer.



Finding Radius and △ Angle

In this figure let R equal the unknown radius, △ equal the unknown central angle, a equal the known exsecant and b equal the known tangent. Then $(R + a)^2 = R^2 + b^2$. On solving this equation, $R = \frac{b^2 - a^2}{2a}$; substituting value of a and b gives R. With radius and tangent known, the central angle can easily be found.

DERAILMENTS AT FACING POINT SWITCHES

BY "CONTRIBUTOR"

The maintenance of way department of the Connecticut Company is investigating the cause of derailments at facing point switches. From a track standpoint, it finds that usually one of three different things occurs:

First—The movement of the switch tongue between the trucks causes the rear truck to take the other track.

Second—Wheels mount over the tongue.

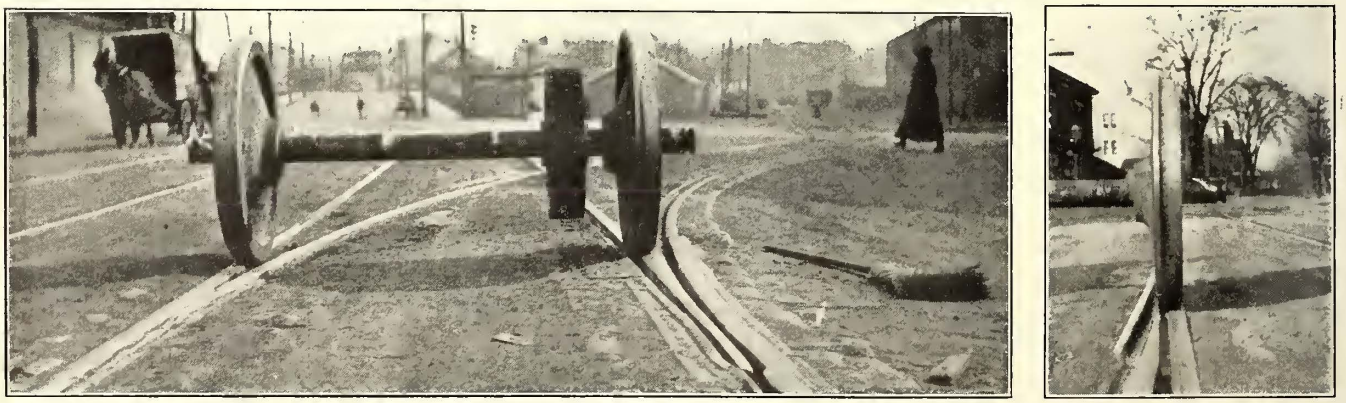
Third—Wheels mount over the mate point.

A close study of the cause of tongue movement between trucks shows some rather interesting results. While this action is usually reported as a loose switch tongue, it is rarely caused by the looseness of the tongue. The first fact considered when cars split switches is that the wheels are riding on the tongue, and the conclusion is that the real cause is inadequate flange room in the mate. When a pair of wheels enter into a switch riding on the tongue and attempt to pass the mate point the back of the flange rubs hard on the mate point. Now, as soon as guard action begins, the gage line of the wheel which stands away from the gage line of the mate in some cases will ride up and over the mate, thus derailing the car; or if the wheel keeps the groove, the guard action in the mate pulls both wheels sidewise and so pulls the tongue with them, thereby opening the switch and allowing the second truck to take the other track. We are endeavoring to meet this condition by designing new special work with wider flange room in the mates, while our old mates are ground out sufficiently to prevent this kind of trouble.

The cause for the mounting of wheels over the tongue may be either that the tongue is too blunt so that steel wheels more or less worn will ride over the point and leave the rails, or insufficient flange room in the switch piece. The latter trouble usually occurs in old special work which was designed for smaller wheels than are being operated over it now. The trouble with blunt tongues can easily be avoided by the use of a grinder. Insufficient flange room in a switch piece is more serious and calls for replacement with a new piece.

The cause for the mounting of wheels over the mate point is faulty equipment, wide gage or insufficient flange room in the mate. This occurs more often than is generally believed. All switch pieces must be set to neat gage when installed. In fact, great care must be exercised to see that this part of the special work is kept to good gage even though the rest of the layout may be laid to the ¼-in.-wide gage now used by some makers of special work.

From the car maintenance end, it is important to keep a standard distance back to back of the wheels.



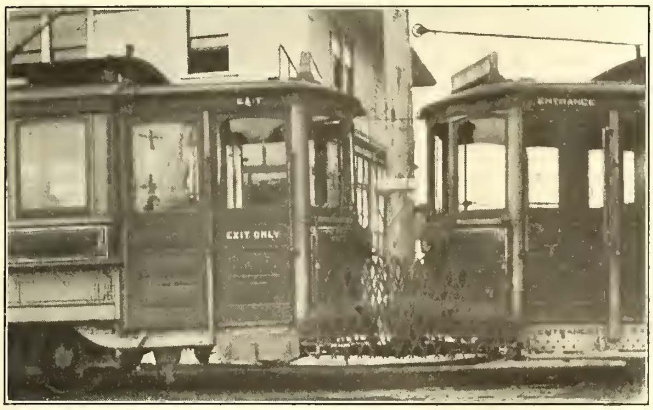
Left-hand view—The tongue is thrown half-way, allowing the second truck to take the other track. This is due to the fact that the guard action of the mate pulls the wheels sidewise when they ride on the tongue. The opening at the mate point is usually wider on account of wear, the groove narrowing toward the heel of the mate. Right-hand view—Note position of back of wheel relative to the mate points. If this wheel passes the wheel tolerance template, it is clear that there is not enough flange room in the mate. Grind mate to give more flange room.

The Correction of Switch Troubles by the Connecticut Company

SAFETY INTER-CAR GATE AND STREET SEMAPHORE AT PORTLAND, ORE.

BY B. F. BOYNTON, CLAIM AGENT PORTLAND RAILWAY, LIGHT & POWER COMPANY

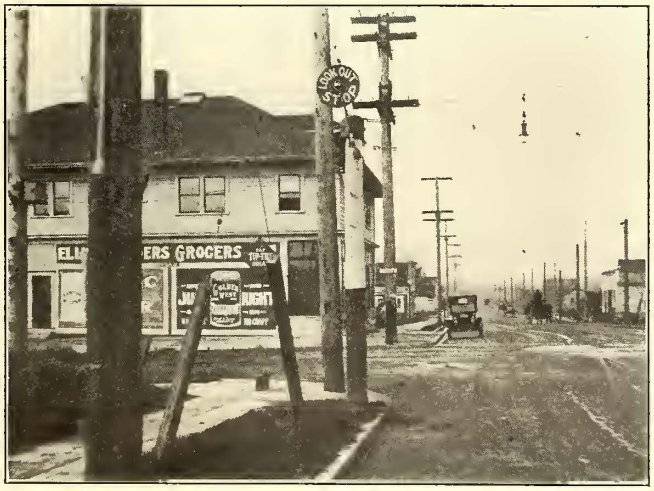
As shown in one of the accompanying illustrations, the Portland Railway, Light & Power Company has recently equipped all of its two-car trains with a collapsible gate which avoids accidents where people at-



Safety Gates of Collapsible Type Between Vestibules of Two-Car Train, Portland

tempt to board the front car and fall between the two cars. As the train rounds a curve the gate closes up on one side and opens out on the other side. We are more than satisfied that this device will prevent many serious accidents. The view of the train connection also shows that we use a lamp over the exit step at the front platform as an aid to alighting passengers.

The other view shows a new signal that we are installing at dangerous street crossings. We call this the "wigwag" signal. It is painted red for easy observation in the daytime, while a red disk light in the middle makes it prominent at night. It is also fitted with a



"Wigwag" Signal to Give Visible and Audible Warnings at Perilous Street Intersections

bell. When a car approaches a point within 1000 ft. of a protected crossing, the signal, which is painted "Look out! Stop!" begins to move backward and forward, the light burns and the bell rings. We got the idea of this signal from the Pacific Electric Railway, Los Angeles, Cal., and we think it is one of the best devices now available for the satisfactory protection of dangerous crossings.

A CAR CLEANER FORMULA AND A HOME-MADE VARNISH REMOVER

BY CHARLES A. INGLE, ASSISTANT PURCHASING AGENT ROCKFORD & INTERURBAN RAILWAY

The following formula has been found a very efficient and economical one for a car cleaner:

Dissolve 15 lb. of green-oil soap in 15 gal. of boiling water, add 30 gal. of mineral lard oil and 15 gal. of floated silica. Mix thoroughly. Always stir well before using. Apply with sponge and where necessary with a brush. Wipe perfectly dry with clean waste or cheesecloth.

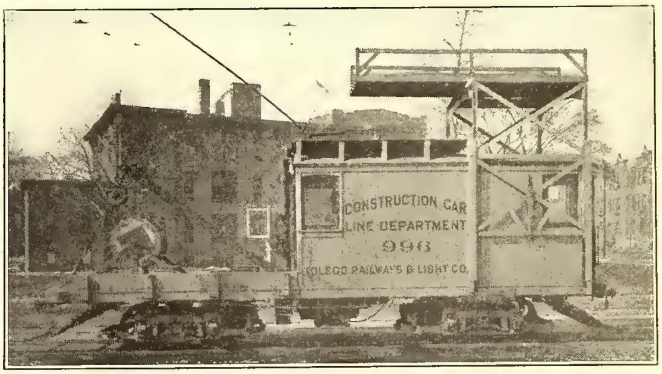
This formula was adopted by one of the large steam railroads after it had tried various cleaners on the market. It can be made for about 40 cents a gallon and is absolutely harmless to the finest varnish. In fact, it is beneficial to the varnish because it prevents checking. To obtain the best results the oil soap should be purchased from the Monahan Antiseptic Company, Chicago, and the lard oil from the Union Petroleum Company, Philadelphia, Pa., as by test these proved to give the best results.

Judging from our experience, the writer believes that other electric railways which use much varnish remover will find the application of the following formula to prove exceptionally efficient and economical: 1 gal. acetone, 1 gal. benzol and ½ lb. paraffin. These materials can be compounded at a cost of from 70 cents to 75 cents per gallon, as against $1.50 to $2 for most of the varnish removers on the market.

DERRICK LINE CAR WITH MOTORED TOWER, PUSH-BUTTON SIGNALS AND BREAKER LIFT CUT-OUT

An unusually effective line car, embodying both a derrick and a motor-operated tower, has been constructed by the Toledo (Ohio) Railways & Light Company after careful investigation of the good features embodied in the types used on other electric railways.

The Toledo line construction car includes a wooden underframe and floor, 30 ft. long x 8 ft. wide over all, 17 ft. of which is occupied by a cab and the remaining 13 ft. by a derrick and trolley wire reel jack. Doors at



Toledo Derrick Tower Car—View Showing Platform Raised and Addition of Derrick

each end of this cab and on one side of the car floor permit poles to be transported by leaving both doors open. This allows poles longer than the car body to be handled, and as many as seven have been carried at one time.

As noted, the cab is 17 ft. long x 8 ft. wide, with an over-all interior height of 7 ft. 7 in. One side of the body is furnished with a telephone, a first-aid cabinet

and a workbench equipped with a large vise and with drawers for tools. The wall space on the opposite side is occupied by large hooks on which the usual tackle and chains of a line car equipment are hung. The control equipment in the cab is arranged for double-end operation, each end being fitted with a controller and a motorman's air-brake valve.

While the design of the tower proper is not unusual, since it is of the ordinary Trenton type with a lifting range of 5 ft. 7 in., it is motor-operated by means of a worm gear and steel cables. One excellent feature is that the tower-operating motor is under the control of the motorman, who shifts its position as directed by a push button and bell signal operated by the man on the tower. Again, a good safety feature is that the lift of the raising mechanism is limited by equipping the mechanism with an automatic circuit-breaker which trips when the tower reaches its upper or lower limit. The tower platform is of the revolving type, reinforced by an over-truss rod. It is 14 ft. long x 8 ft. wide, thus permitting a lineman to work on the trolley wire over a parallel track when it has been revolved so that its length is at right angles to the car.

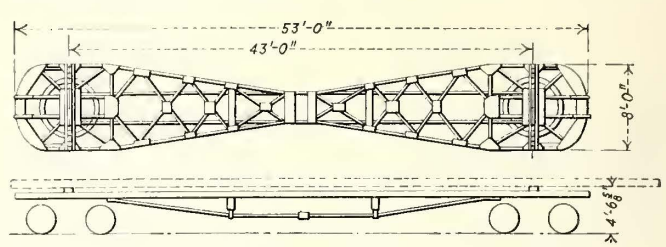
Toledo Derrick Tower Car—Interior View

This car body is mounted on Brill trucks equipped with two GE-57 motors and air brakes. Heat is provided in the cab by four electric car heaters. The derrick, which is also an unusual feature in cars designed for this purpose, is hand-operated by a two-handle winch. It was designed to lift 3 tons. The winch merely raises and lowers the boom, the load being elevated by means of a differential chain hoist swung from the outer end of the boom. The addition of the derrick to this car has materially increased its utility. Not only is it adaptable for loading poles and wire onto the car floor, but in emergencies it can be used for almost any purpase for which its capacity is fitted.

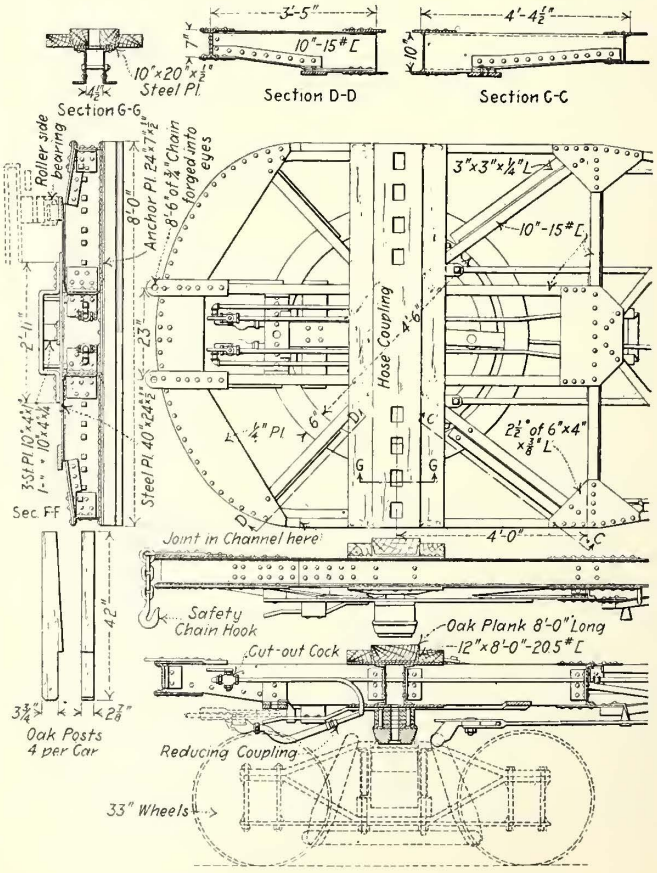
In service this car has proved very satisfactory in emergency repair and new construction work. It has been found, however, that about 10 ft. additional length in the car body would prove very advantageous, and that it would be desirable to increase the carrying capacity by equipping the car with heavier trucks and more powerful motors. These additional changes, it is believed, would make the car more adaptable for all conditions, although as it now stands it appears to embody more good features than any hitherto built by other electric railway companies. This car was designed by J. W. Sharp, general line foreman of the Toledo Railways & Light Company, assisted by L. L. Smith, designer, and constructed by C. A. Brown, master mechanic of the company.

A 25-TON RAIL CAR

The mechanical department of the Brooklyn Rapid Transit system has recently designed and built two structural steel rail-carrying cars of the unique hour-glass form shown in the accompanying drawings. The former rail cars consisted of the usual chained double truck, but this design has been superseded for the sake of greater safety and efficiency. As shown on the general plan, the trusses which constitute the framework are greatly narrowed toward the center so that the car, which is 53 ft. over all, will be able more readily to clear any poles, special work, etc., when carrying rails 60 ft. long. In general, this truss performs the work of a standard reach pole. The intermediate framing simply ties the structure together, as the load is taken by the bolsters. Perhaps the most interesting feature of the design is the use of a riveted circular side bearing of 5-ft. diameter which enables the truck to swing through an angle of 90. deg.



Plan and Elevation of Rail-Carrying Car, Showing Taper Toward Center



Detail of Rail-Carrying Car, Showing Circular Side Bearing

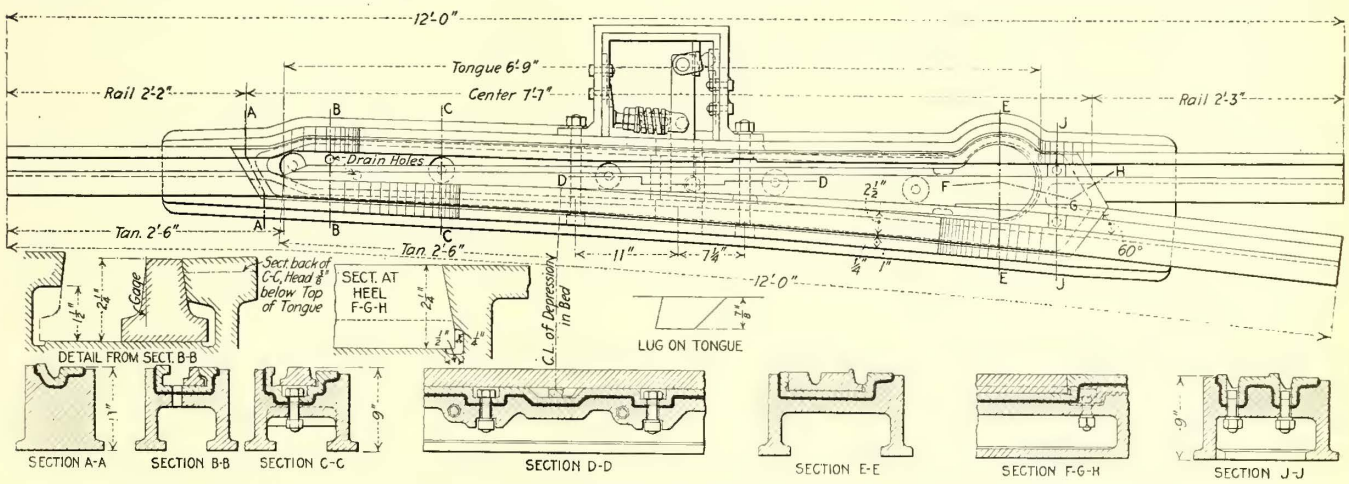
The car is built for trailer service. Its equipment includes semi-automatic air brakes, Peacock geared brakes and a safety chain in addition to the drawbar. As the swing of the trucks does not permit the use of

a center lever, side-hung brake rigging with radius-bar operation is used. The car structure alone weighs 5000 lb., and with trucks and equipment complete, 20,000 lb. The maximum load of rail is 25 tons. The rails are carried on wooden platforms, provided with stake pockets as indicated. Section GG of the detail drawing shows the location of the shelf which has been provided for getting a purchase under the loaded rails with a crowbar to move them to the unloading skid. The rails will be lowered to the ground by means of structural skids, and the speed of lowering will be controlled by block and tackle mechanism, including hooks or other grappling devices for making connection to the rails on the skid.

IMPROVED ANTI-STRADDLING TONGUE SWITCH

The constant tendency on almost every electric railway to increase the size and weight of cars and the amount of service over a given piece of track has led the New York Switch & Crossing Company, Hoboken, N. J., to improve still further its well-known anti-straddling tongue switch. The anti-straddling device was first brought out by this company in 1905, and it has proved ever since to be one of the most meritorious features of its special work. The design illustrated embodies several important improvements to meet the present heavy day service.

The switch bed is manganese steel for the entire length of the tongue. The manganese tongue is heavily reinforced with an enlarged circular heel. It is absolutely pinless not only in name but in fact. There is no bolt, lug or other projection at the heel, and the bearing efficiency at this vital point is 100 per cent. The large end of the tongue cannot be driven down, as it rests on a perfectly level foundation of manganese steel. The wear between the tongue and the bed is therefore minimized. The spring mechanism in the switch box performs three functions. It holds the tongue back at the heel, down on its bed and locks it always in such a position that a car cannot straddle the switch. The idea of locking the tongue in a practical way prevents straddling and is an excellent example of the application of the "safety first" idea to track work.

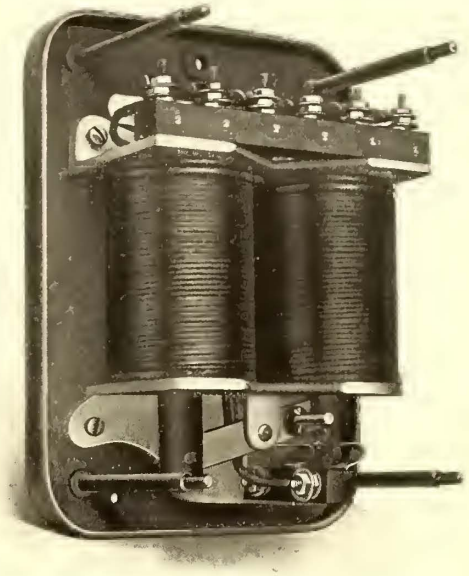


Anti-Straddling Tongue Switch with Manganese Bed and Enlarged Circular Heel at the Tongue

A recent report of the City Chamberlain of New York has recommended to the New York street cleaning department the method of snow cleaning used in Ottawa. He says that there an arrangement has been made with the street railway company to clean not only its roadway but the street surface for a distance of 14 ft. from the tracks. The work is done by an electric snowplow.

REVERSE-POWER RELAY

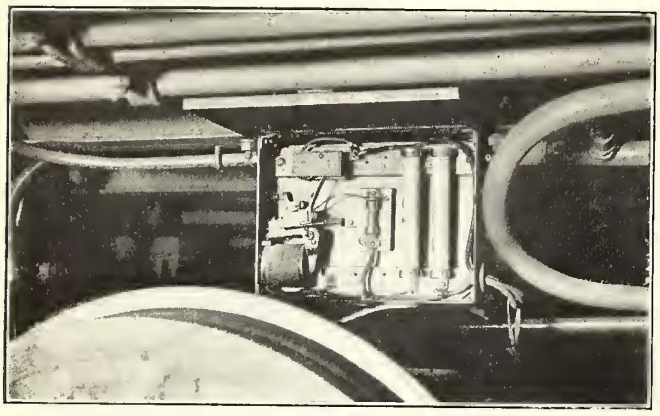
In the accounts given in this and preceding issues of the ELECTRIC RAILWAY JOURNAL of the progress in underground power distribution for electric railways the element most prominent has been the reverse-power relay. The lack of such a device until quite recently has made necessary the use of separate lines for individual rotary converters. Relays of this kind are desirable also between transformers connected in parallel in a bank. The Condit Electrical & Manufacturing Company, Boston, Mass., has recently brought out a relay for the latter purpose. The underlying principle is this: Two solenoids act on plungers connected to opposite ends of a lever which normally rests in one position. The solenoids are excited from series transformers, one connected on the low-tension and one on the high-tension side of a transformer. The connections are such that, under normal conditions, the pull of the two solenoids is balanced. If a short-circuit occurs between either series transformer and the main transformer, or in the main transformer, power flows into the short circuit from both sides and disturbs the balance in the relay. One solenoid overpowers the other and closes a switch carried by the connecting lever and operates the tripping coils on the circuit-breakers in the transformer circuit.



Relay with Cover Removed

OPERATING EXPERIENCES WITH AND IMPROVEMENT OF COASTING-TIME RECORDERS

The coasting-time recorder of the Railway Improvement Company, New York, was first placed in service in 1908 on the lines of the Interborough Rapid Transit Company. Since then its ability to cut down energy consumption and brakeshoe wear, aside from incidental savings, has resulted in its adoption on a large number of other railways, both city and interurban.



Installation Under Car of Relay Used in Connection with Coasting-Time Recorder

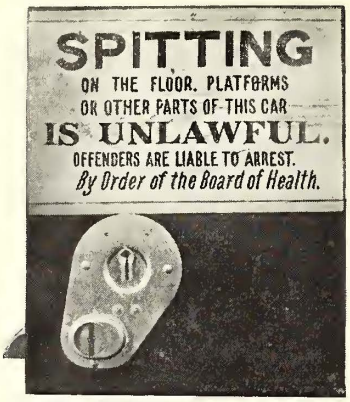
Although the coasting-time recorder "made good" from the start, its application to a wide variety of operating conditions showed that, like other human devices, it was subject to improvements in the light of greater experience. These improvements, as made, range from an entirely different scheme of clock operation to such minor matters as making the mechanism dustproof and more accessible. The following record of these changes shows how large a share the operator may have in helping the manufacturer perfect his product.

The one serious drawback of the original recorder was the possibility that a shrewd, unscrupulous motorman could make the machine record coasting time while the car or train was at a standstill. The reason for this lay in the fact that the circuits which controlled the starting and stopping of the clock movement were so interlocked with the master controller and air brakes that the recorder would continue to operate on line current as long as the brakes were not applied. Thus, by refraining from applying the brakes, the motorman could coast to a standstill at a station or in a blockade and keep the clock running by permitting only enough energy to pass through the controller for that purpose. If he overran his stop, he could simply reverse his controller to go back to it. In either case the coasting record was falsified. A similar trick was discovered on a surface line. On approaching the terminal, the motorman would permit his car to run to a friction stop, but as he did not apply the brakes, the trolley current still kept the recorder in operation.

The clock and its connections are now so arranged that the current can reach the controlling magnet on the clock movement only when the traction motors are running as generators, and this generated voltage during coasting furnishes energy for the clock magnet. The electric relay is so arranged that when the controller is "on" no current can possibly get through to the clock magnet from the traction motors. When the brakes are applied the clock circuit is opened. Consequently, a motorman must have the car moving without power or brakes on in order to get current into the magnet that operates the clock. It is therefore impossible for a motorman to coast to a standstill and obtain a fictitious record because the energy which operates the clock magnet ceases just when the motor stops.

On a straight-air-brake car the relay is installed at any convenient place, but where hand brakes are used exclusively the relay is installed under the car. A common method of installing the relay is shown below.

Another merit of the new scheme is that the clocks' operation does not require any line current, which is an economy of some importance on systems where hundreds of clocks are in use.

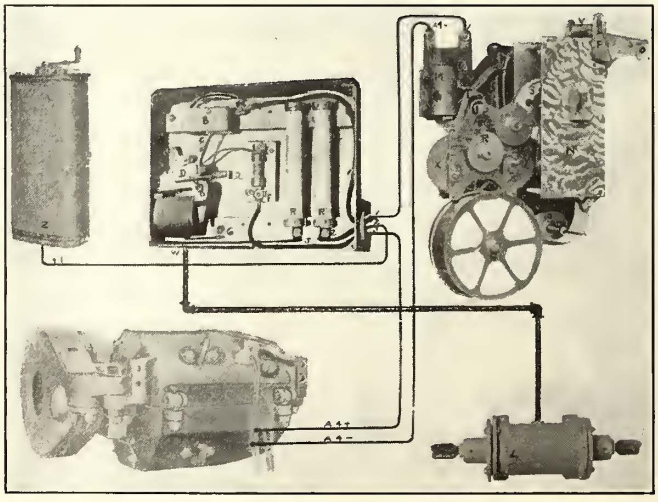


Recorder Reversed and Used as Health Sign

IMPROVEMENTS IN RECORD STRIPS AND CASES

The original form of tape record showed only the motorman's number and his coasting time. It was found that motormen would retain bad records until they could hand them in with the excuse that the record had been spoiled by some blockade. The new form of record shows not only the motorman's number but also that of the car on which the record was made. A motorman will not dare to hold this record back because other men might turn in records with the same car number at the same time. A most valuable by-product of the car number record is that the coasting efficiency of the cars themselves may now be compared. In fact, several companies keep coasting records on both the mechanical and human bases, so that they can now detect inferior running equipment as well as inferior men by the same means.

The tape on which the record is made was originally of one shade, white, throughout. Now the last 20 ft. are usually tinted pink so that when that shade appears the operating department can insert a new reel at once. Under the old scheme it was necessary for a man to inspect each recorder every day to care for replacements.



Connection of Coasting-Time Recorder and Its Relay with Motor Control and Air-Brake Equipment

On a large railway like that of the Third Avenue Railway System, which operates several groups of lines under various conditions, differently colored tapes are used so that the record of lines in each group can be recognized at once. Again, in a city where more than

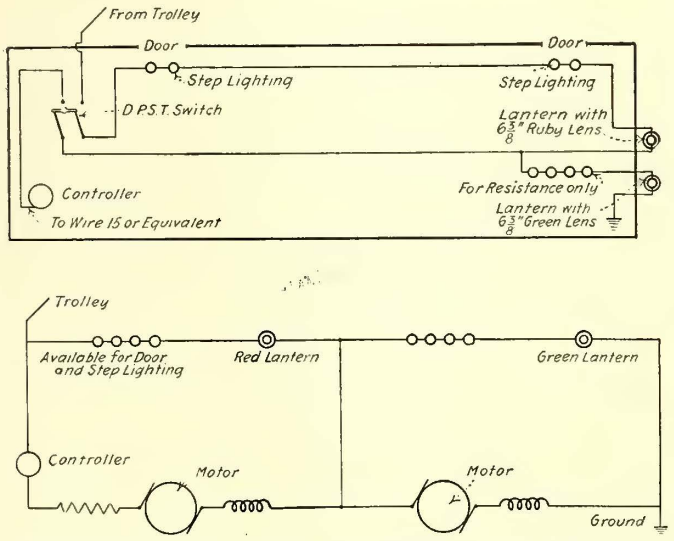
one railway system is operated with coasting recorders, it is desirable to make the type used on the recording tape in different styles to prevent the possible exchange of records among the motormen of the different companies.

Wooden cases were used in the first recorders, but at the request of the Pennsylvania Railroad, which operates steel cars on its Long Island division, the recorders were furnished with steel cases to match. The British Columbia Electric Railway found, however, that these steel cases were not entirely dustproof under its operating conditions. It therefore installed weather stripping for the edgings and furnished the keyhole with a spring shutter which blocks the hole when the key is withdrawn.

The very latest improvement made in connection with this recorder is one suggested by the Third Avenue Railway. In the ordinary arrangement both the keyhole and the paper outlet are at the top of the recorder case. This location was rather inconvenient for most motormen. Greater accessibility was secured by reversing a balance weight in the armature so that the clock could be installed upside down. This brought the keyhole 8 in. lower than before; furthermore, the paper outlet was placed at the side instead of at the front of the case. These changes left the upper part of the clock free to be painted with a spitting sign by means of the "decalcomanie" system of cold transfer painting which is similar in principle to the transfer picture books so popular with children.

ELECTRIC TAIL LIGHT AND INDICATING TRAIN SIGNALS

A simple system to enable the motorman of a following car to distinguish the movements of the car ahead is the electric tail light and indicating signal equipment of the Nichols-Lintern Company, Cleveland, Ohio.



Diagrams of Signal Wiring for Single-End Car and of Its Relation to the Motor Circuit

The material consists of one or two lanterns, as the case may be, with safety fuses, switch, resistance units (lamps) and the necessary wire. Typical wiring plans showing the relation of this equipment to the other apparatus are presented in the accompanying cuts.

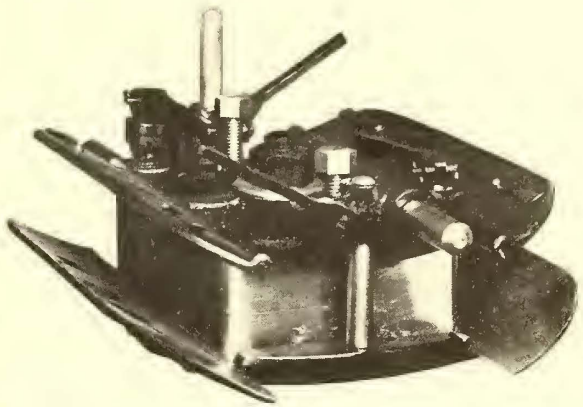
The Lintern signal is entirely automatic in operation. Its cardinal principle is that the character of the signal displayed depends upon the use of the different voltage combinations available on a car. The tail lamps are used in this way as speed indicators by the display of the red light alone at full voltage with the controller "off," of the red and green lights together at half voltage and of the green light alone at full speed with the controller "on."

The system, however, is not confined to the foregoing operations. For instance, the "power-on" signals can be displayed on full voltage at all positions except "off." Some operators prefer this modification as one desirable for lines with close headways. The "power-on" signal can also be operated in the daytime, and it is possible to use the "power-on" signal and the indicating tail light alone or together. As indicated in the diagrams some of the resistance lamps which are used in series with these signals may be used to serve other purposes, as for step lighting. With tail-light signals like these the motorman behind can follow the car ahead with increased safety at the least expenditure in power, braking and personal tension.

FORM FOR CURVED FIELD COILS

The accompanying illustration shows a form for winding the curved field coils of Westinghouse 38B, 49, 68 and similar motors as brought out lately by the Comstock Manufacturing Company, Wilkes-Barre, Pa. This form is exceptionally useful in that the coil is wound and formed to proper shape at the same time, so that no pressing is required. Ordinarily this type of coil is wound on a straight or flat form, and afterward it is pressed in its proper shape. The latter operation may injure the insulation and otherwise damage the coil. The Comstock form eliminates the danger of injured insulation and thus avoids a large proportion of short-circuits.

This form is made of bronze, with a parallel parting in the center. It is provided with two backing-off screws which permit the coil to be released after winding. To hold the wire in place while winding from the convex to the concave side of the form, an adjustable guide is provided on both ends. These guides are adjusted at each turn of the wire. Cam levers are used to hold the guides secure at each adjustment. The outer



Form for Winding Curved Field Coils of Westinghouse 38B, 49, 68 and Similar Motors

faces of these guides are convex to conform to the proper radius of the coil. Small flat springs are installed at each of the corners to hold the tape while it is being woven into the field and to hold it together after the coil is removed from the form. This manufacturer also makes a complete line of armature and field coil forms, including armature coil-pulling machines, strap coil forms and winding machines for either light or heavy work.

BOND TESTERS WITH SAW-CONTACT BLADES

The Roller-Smith Company, New York, has improved its bond-testing apparatus recently, as shown in the accompanying views. The first illustration shows a section of rail and the new saw-blade contact on the contact bar. It can readily be seen that if the contact bar is moved backward and forward exactly as a saw is

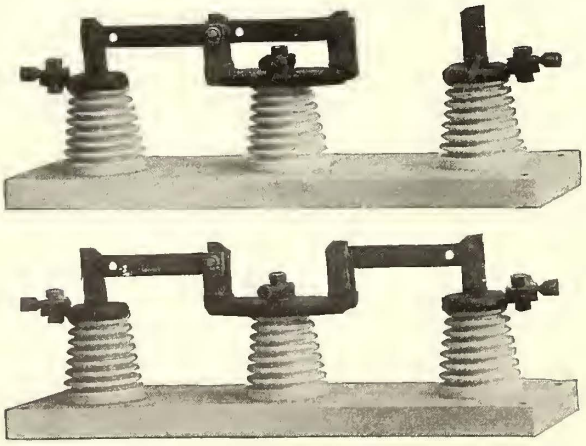
Saw Contact Blade

Making a Test

used, the contacts will saw right into the rail so that good contact is absolutely certain. Thus the saw blade is a great improvement over the old style where the contacts were dropped on the top of the rail and where there was sometimes difficulty due to the failure to establish proper conductivity. The other illustration shows the contact bar complete, together with the bond tester and the method of using this equipment.

SELECTOR-TYPE DISCONNECTING SWITCHES

The selector type of disconnecting switch is a transfer switch which does not require the circuit to be interrupted while making a change. It can also be used to connect two independent circuits in parallel. However, it is not designed for opening under load, and



Selector Disconnecting Switch, Open and Closed

therefore no attempt should be made to open it with current on the line. These switches are in effect two single-throw, single-pole disconnecting switches with the hinge jaws connected together and mounted on the same insulator. The hinge jaw is also provided with dummy jaws to hold either blade of the switch in the open position.

Two types of these switches are made by the Westinghouse Electric & Manufacturing Company. Type M is intended for wall mounting, the live parts being mounted on porcelain insulators carried on a cast-iron yoke or base. This forms a simple but substantial construction that is neat in appearance and moderate in price. All parts of this switch except the porcelain insulators are finished in black marine. Type D is designed for indoor mounting on marble bases or switchboard panels. It is made for either front or rear connection or for any combination of front and rear connection desired. The copper parts are dipped and lacquered.

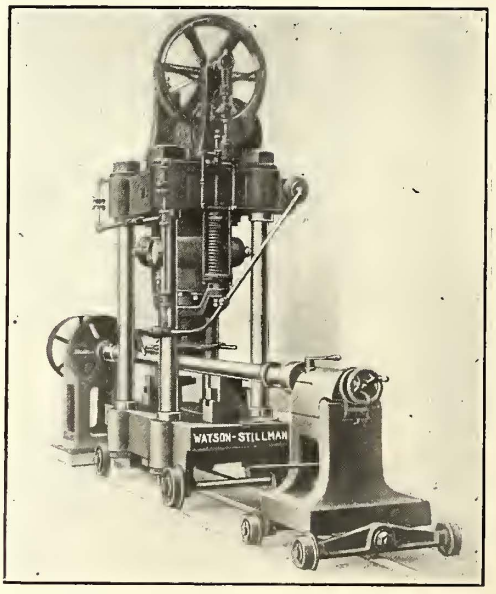
SHAFT STRAIGHTENING WITH A 325-TON HYDRAULIC PRESS

The Watson-Stillman Company, New York, recently produced a hydraulic press that has a capacity of 325 tons. This capacity is sufficient to take the bends out of any steel shaft up to 10 in. diameter, the length being limited only by the extent of the foundation provided. The new tool, as shown, is a motor-driven self-contained unit, requiring no outside air or hydraulic system. It has three independent parts, namely, the headstock, which is stationary, and the press and tailstock, which are on rollers to permit their adjustment to varying lengths of shafts.

The bed rails are flush with the floor so that when not in use the movable parts can be rolled to one side, leaving the floor clear of obstructions. The headstock and tailstock are similar to those of a lathe, except that the centers are hinged to follow the movement of the shaft ends when the bend is made.

The shaft is revolved from the headstock and the "high point" marked. The press is then moved to that point and the bending blocks are adjusted.

The ram has a maximum movement of 2 in., and screwed concentrically into it is a square-threaded ad-



Hydraulic Type Axle Straightener

justment screw which compensates for the different diameters of the shafts and also enables the operator to predetermine the flexure desired. This adjustment eliminates all danger of overbending.

The entire hydraulic power plant, including a 5-hp motor, pump, reservoir, etc., is mounted on the top platen of the press. The floor space required is 3 ft. 6 in. wide by the length of the shaft plus 6 ft. The total net weight of the press is 19,300 lb.

News of Electric Railways

The Detroit Valuation Report

The principal items in the report fixing the reproduction value of the physical property of the Detroit (Mich.) United Railway in the one-fare zone at $31,028,982, which was submitted to the Municipal Street Railway Commission on March 11, are as follows: straight track construction, $9,668,966; special track work, curves, etc., $1,785,220; cars, $7,736,345; land, $2,989,318; paving, $1,154,720; buildings other than power, $1,943,033; overhead feeder lines, $1,034,838; power stations A and B and power department buildings, $2,583,818.

The appraisal does not include franchise values, material on hand or a number of construction works under way. As noted in the ELECTRIC RAILWAY JOURNAL of March 14, 1914, the company estimates that the reproduction value will be between $36,000,000 and $37,000,000, franchises included, when final. No attempt was made by the company to determine the amount of depreciation from the figures submitted, it being assumed by the company that that work can be best undertaken in connection with the investigation of the engineers to be appointed to represent the city.

The present appraisal is practically $5,000,000 greater than the appraisal submitted to the committee of fifty in 1909. The company explains, in *Electric Railway Service*, its weekly publication, that the increase is due to the construction of several miles of new track, the replacement of many miles of track with new rails and foundation, the purchase of much additional real estate, the erection of new shops and the purchase of several hundred new cars including all the pay-enter cars now in use.

The company has been asked to indicate formally to the Street Railway Commission the selling price of the property. What this price will be when depreciation is allowed is a matter of conjecture at this time. It is not expected that any important action in connection with the appraisal will be taken until such time as the commission appoints its engineers to make an appraisal for the city.

Conferences are being held between the members of the Municipal Railway Commission and F. W. Brooks, general manager of the Detroit United Railway, in regard to the construction of a new cross-town line over a route the details of which have yet to be determined. The line will be practically 2 miles north of the existing east and west cross-town lines and will connect with the proposed Junction line on the east and the Harper line on the west, making an outer belt which would be of great assistance in relieving downtown congestion. Under the low-fare agreement of Aug. 7 the company is supposed to extend the Kercheval line and effect a connection between the Mack and Myrtle lines, but the cross-town line is suggested as an alternative for the extension named in the agreement.

Increase in Stock of Cleveland Company Authorized

The Public Utilities Commission of Ohio has granted permission to the Cleveland (Ohio) Railway to issue $2,141,100 of stock to be sold at not less than par to provide funds to build extensions and make other improvements which have already been noted in the ELECTRIC RAILWAY JOURNAL.

W. R. Hopkins of the Cleveland Underground Rapid Transit Company promises that work on the proposed underground railway will be begun by Jan. 1, 1915. Councilman Stolte had prepared an ordinance for submission to Council, repealing the grants to the company, and he, in company with Assistant City Solicitor Joseph Hostetler, called upon Mr. Hopkins in connection with the matter. Mr. Hopkins told the city officials that $100,000 had been spent upon the plans and investigations. Peter Witt, street railway commissioner, is opposed to the repeal of the grant. He says that underground tracks would relieve the surface lines of much of their long haul and reduce the company's expense. It is probable that the proposed ordinance will be held up until the first of the year in order to give the company an opportunity to carry out the promise made by Mr. Hopkins.

An employee of the Cleveland Railway was arrested on March 12 on the charge of robbing fare boxes. He had been under suspicion for some time and at last was found selling tickets at Superior Avenue and East Fifty-fifth Street. This man had access to the room in which the magazines are kept after being taken from the fare boxes at night.

J. J. Stanley, president of the Cleveland Railway, and Peter Witt have inspected the new double-deck car which is being operated in Columbus. This car was described and illustrated in the ELECTRIC RAILWAY JOURNAL of March 14, 1914.

Strike on Local Terre Haute Lines

The Amalgamated Association called a strike of the city car service men in Terre Haute, Ind., on Saturday night, March 14. Only three men left their cars, but riotous mobs dragged crews from the cars and broke windows. Cars were operated under police protection in the city, but the police would not permit passengers to ride and even compelled passengers on the interurban cars to alight at the city limits. The company operated its cars all day Sunday, with the regular crews, but the authorities still refused to allow the company to carry passengers.

Judge Baker of the Federal Circuit Court sent deputy United States marshals to Terre Haute to serve summonses on the various labor leaders to appear before the Federal Court at Indianapolis on March 16 to show cause why they should not be held in contempt of court. The complaint shows that the strike is in violation of the agreement of Jan. 3, on the hearing in the Federal Court at Indianapolis of the petition of the Fidelity Trust Company for an injunction against certain labor leaders and officials of the Amalgamated Association, who it was charged were attempting, in violation of the company's agreement with its employees, to cause a strike which would imperil the property of the company in Terre Haute. The labor leaders declared they were not responsible for the strike and that it had no official sanction.

On Monday, after the hearing in the Federal Court at Indianapolis, Judge Baker issued an injunction forbidding the employees of the Terre Haute, Indianapolis & Eastern Traction Company who have entered into an agreement for the arbitration of differences from going on strike or quitting work in a body. It also enjoins all the labor leaders mentioned in the complaint, and a number of union employees, from in any way coercing or attempting to induce the employees of the company to strike or quit work. It further enjoins any and all persons from gathering in the streets for the purpose of interfering with the operation of cars.

M. L. Clawson, the labor attorney, stated in defense of the labor men that the signature of the employees to the contract made with the Governor which stipulated that no strikes were to be called had been obtained under duress, and that the company had broken the contract by discharging men because they had joined the union. Judge Baker offered to go to Terre Haute and investigate the matter. He said, however, that even admitting Mr. Clawson's statement that some men were discharged, the contract between the company and the men was broken only in regard to these one or two men, and that it was still in full force and binding on the majority of the employees. Judge Baker contended that a contract such as that made between the company, the employees and Governor Ralston has full force in the eyes of the law and that the labor men are compelled to respect it. On the question of responsibility for violence, Judge Baker said that the labor leaders could be held for the acts of rowdyism of crowds on the streets unless they took affirmative action to discountenance the strike.

There were no further acts of violence on Monday, and Monday evening the city authorities stated that passengers would not be further prevented by the police from riding on the cars in Terre Haute. On Tuesday, March 17, the company resumed operating its full schedule of cars in the city with regular crews.

The Public Service Holding Company

A series of ten lectures is to be delivered before the public utility section of the West Side Branch of the Young Men's Christian Association of New York on successive Monday nights. The public utilities will be dealt with from the standpoint of their relation to the consumer, the State and the investor, and the speakers, as previously announced in the Electric Railway Journal, will include some of the foremost men in their respective lines of endeavor. The first lecture, which was introductory in its character, dealt with the magnitude of the public utility business. It was delivered on March 9, 1914, by T. Commerford Martin, secretary of the National Electric Light Association and special officer of the United States Census Bureau. Mr. Martin traced the development of the electrical industries from 1877.

The speaker on the evening of March 16 was Francis T. Homer, of Bertron, Griscom & Company, New York, N. Y., bankers. His subject was "The Holding Company." Mr. Homer said that the first notable holding company was the Northern Securities Company. This company was organized to control and dominate two parallel railroads and its purposes were altogether different from the motives which have prompted financiers to organize holding companies in the public utility field. Public utilities were a natural monopoly and separate companies were undesirable. Mr. Homer illustrated this point by referring to two gas companies operating in one community with duplicate plants. The cost of duplication had to be met ultimately by the consumer. A public utility was obligated to provide good service whether or not requirements as to service were written into the franchise or operating grants. Unfortunately holding companies which controlled interests in fields of business where restraint was harmful were not differentiated from the class of holding companies dealing in lines where the accumulated power thus secured could not be used except for good, instead of evil. Such were the holding companies that have been becoming more and more popular and effective in meeting the requirements of public service corporations. So far from holding companies in this line of activity endeavoring to become interested in competitive situations and thereby restrain competitive activity, the purpose of the holding company was to acquire interests in companies widely distributed, serving different communities and localities, so that, through the joint control and management, the aggregate result would show not isolated conditions of prosperity or depression, but the more stable average incident to serving widely separated communities.

Mr. Homer said that the arguments most frequently advanced against the holding companies were that they were likely to be over-capitalized; that investors were likely to be misled by holding company financial statements; that holding companies acquired only the majority of stock in the separate companies and worked to the detriment of the minority holders, and that the owning company was out of touch with local spirit. The charge of over-capitalization was not well founded. In the case of holding companies the various issues of bonds and the preferred stock were placed with the public while the bankers or organizers accepted the common stock or prospects as their share in participating in the merger. The holding company must of necessity be capitalized conservatively or the failure to earn a return on the preferred stock or the bonds would result automatically in the organizers of the company losing their control over the property. Even under the adverse conditions of 1913 only one large holding company became involved in financial difficulties. This company embarked in irrigation projects—a work beyond its province.

In regard to the likelihood of people being misled by holding company financial statements, Mr. Homer said that complete statements of the stocks and bonds owned by holding companies were more frequent in their reports than were summaries of the properties of the railroads in their reports. In regard to holding companies acquiring only a majority of stock of the companies which they desired to take over, Mr. Homer said that an effort was usually made by the holding company promoter to acquire all of the stock of the companies to be taken over, but that holders of stock in the companies to be taken over frequently demanded an excessive price for their stock. In regard to the officers of the holding companies being out of touch with local spirit in towns in which their subsidiaries operated, Mr. Homer said that the reverse was a fact. The officers of public service holding companies realized that it was essential to have local men interested in the subsidiaries and that such local men could not afford to remain directors if the property was mismanaged because the reflection would be directly on them.

He summarized the advantages of the public service holding company as those that result from combined operation, purchasing and financing. In the holding company operating competition was comparative. The results obtained by resident managers of subsidiary companies were compared not with one or two other companies, but with many other similar companies, depending on the size of the holding company and the number of its subsidiaries. Nowhere else was there the same chance for advancement for men as with a holding company. The officers and directors were experts and made the business their lifework. On the other hand, in independently operated companies, particularly in cities of moderate size, the principal officers of the utilities were usually interested in them merely as an incident to some other business. Comparisons of service and management of two cities of the same size in one of which a holding company operated and in the other an independent company showed that the service and management in the city in which the holding company operated were better than in the city in which the independent company operated.

The speaker said that the engineers connected with holding companies planned for standardization and were necessarily familiar with conditions which confronted the separate local companies and were better fitted on that account to make recommendations than were outside consulting experts even if the independent company could afford to hire the best engineering talent. In the case of the floods in Ohio and Indiana last year, the subsidiary companies of the holding companies had experts at their service at once, whereas the independent companies had to compete for competent help in a market already depleted. The same advantages of organization obtained as regards the legal end. Management organizations had similar advantages to the public service holding companies except as regards finances and the marketing of securities. The large issues of the securities of the holding companies necessarily commanded broad markets. Mr. Homer closed his remarks with references to the relative increases in population of cities and in the gross receipts of public utility companies. He estimated that between $500,000,000 and $600,000,000 a year would be needed by the public utilities for each of the next five years to meet natural growth.

Government Ownership of Telephone Lines

In the annual report of the American Telephone & Telegraph Company for the year ended Dec. 31, 1913, Theodore N. Vail, president of the company, discusses very definitely the general subject of government ownership. In summing up the attitude of his company toward this subject, Mr. Vail says in part:

"Our opposition to government operation and ownership is prompted because of our interest in the upbuilding and preservation of a great public utility. The efficient operation of every utility is necessary to the public and efficient, progressive or permanent service cannot be rendered by companies not making a fair profit. No government-owned telephone system in the world is giving as cheap and efficient service as the American public is getting from its telephone companies. We do not believe that similar service furnished by our government would be an exception."

Mr. Vail raises the question whether government operation should be maintained out of its own revenue or whether the properties should be operated at a charge on the general revenue at the cost of the whole public for the benefit of a part. There may be some things which should be made free and convenient for the whole public, even at the expense of the public revenue, but the telephone and telegraph are not among them.

Mr. Vail continued in part as follows:

"A thorough study of all available reports and official

information on the operation of government owned and operated telephones and telegraphs shows that the combined telegraphs and telephones are without exception operated at a deficit. These deficits are not the result of a definite policy to give a cheap service to individuals at the cost of all, but are due to errors in management, such as underestimates of values and cost of new construction, disregard of maintenance and depreciation and particularly of obsolescence, impossible theories of operation, and a mistaken policy founded on promises, prophecies and assertions exactly the same in character as those now being used to bring about government ownership in this country. There are no sound reasons given for real advantages promised for government ownership and operation which do not apply to or cannot be secured by government regulation."

Progress with New Haven Segregation Negotiations

It is understood that at the conference in Washington on March 14, 1914, between the representatives of the federal Department of Justice and the officers of the New York, New Haven & Hartford Railroad the latter agreed that the electric railways in Connecticut should be placed in the hands of trustees. The conference was to be resumed on March 21. There is no foundation for the statements made unofficially following the conference on March 14 that new demands have been made on the company by the department. In this connection Attorney-General McReynolds authorized the following statement:

"Several newspapers have published statements to the effect that in the pending negotiations between the Department of Justice and the New Haven Railroad the government is making new demands upon the New Haven company not covered by the general agreement reached on Jan. 10, 1914; that it is demanding that the New Haven part with its holdings in dock and wharf properties at New Haven, Providence, Fall River and other Sound and river ports in New England, and that the department is attempting in the pending negotiations to recede from the general understanding that the Interstate Commerce Commission shall pass upon the right of the New Haven to retain its Sound lines. There is no foundation for these statements and this intimation."

Administration Holding Company Bill Made Public

On March 17, 1914, Judge Henry D. Clayton, chairman of the House committee on the judiciary, made public the text of the administration bill relating to holding companies. The bill provides that it shall be unlawful for any corporation engaged in interstate or foreign commerce to acquire directly or indirectly the whole or any part of the stock of another corporation also engaged in interstate and foreign commerce where the effect of such acquisition would be to eliminate or lessen the competition existing between the two companies or to create a monopoly of trade in any community. The bill exempts from its provisions corporations that purchase stock solely for investment and do not use the same by voting to diminish existing competition. It is stated furthermore that nothing in the act shall be taken to prevent a corporation from causing the formation of subsidiary corporations for the actual carrying on of its lawful business or from owning and holding all or any part of the stock of the subsidiary corporations when the effect of the formation is not to eliminate or lessen pre-existing competition.

The House committee on interstate and foreign commerce has prepared a bill which will be incorporated in the anti-trust program of the administration in place of the Sims bill, which provides for the regulation of railroad capitalization. This newer bill provides that every dollar borrowed, paid, earned and spent shall be accounted for to the Interstate Commerce Commission and that the commission may regularly make public the facts procured from the companies. It contains a provision which greatly extends the powers of the commission in regard to its right to prescribe what information annual railroad reports should contain, particularly with reference to the issuance of new securities. The only part of the measure that has been criticised by any members of the committee is the paragraph which makes the publicity discretionary with the commission, some of the members insisting that it should be mandatory. The bill was prepared with the assistance of Interstate Commerce Commissioner B. H. Meyer.

Public Service Commission Upheld

The Court of Appeals of New York handed down a decision on March 17, 1914, sustaining the appeal of the Public Service Commission of the Second District of New York, in the matter of the joint application of the Westchester Street Railroad and the New York, New Haven & Hartford Railroad. The Westchester company was organized to take over the property of the Tarrytown, White Plains & Mamaroneck Railway sold at public auction in foreclosure of a mortgage. The New York, New Haven & Hartford Railroad owned 247 out of 300 bonds of $1,000 each against the Tarrytown Company and it purchased the principal part of the property, paying therefor $912,023. Application was made by the Westchester company and the New Haven company for a stock issue to that amount, but the commission found the value of the property to be only $434,067 and limited the stock issue to that sum. The Westchester and the New Haven companies took the matter before the Appellate Division upon a writ of certiorari, and the Appellate Division annulled the order of the commission and directed it to sanction the issue of the full amount of stock prayed for. The Court of Appeals has reversed the Appellate Division, holding that under the circumstances of the case the amount paid for the property was not controlling upon the commission, and sent the matter back for further hearing, giving all parties the right to introduce further evidence as to value.

Northampton Arbitration Hearing

The arbitration board sitting in the Northampton (Mass.) Street Railway wage increase controversy began its hearings on March 15 in the Superior Court room in Northampton. The full board was present. Martin J. Hennessey, Springfield, Mass., represented the employees; T. G. Spaulding, Northampton, represented the company, and City Solicitor Thomas McDonald, Chicopee, Mass., was the third member. E. L. Shaw appeared as counsel for the company, with L. D. Pellissier, general manager, and H. J. Campbell, cashier. J. H. Reardon, Worcester, Mass., represented the Amalgamated Association. The employees' case was first considered. It was stated that the men desire a wage scale of $2.50 per day for motormen and conductors for the first six months' service, $2.75 for the second six months, and $3 thereafter, other employees to be granted an increase of 10 per cent.

Testimony was chiefly confined to evidence regarding the increased cost of living in the last few years, the contention being that a family of five could not be supported adequately in Northampton on less than $963 a year. Mr. Spaulding pointed out that the men are living on less than this wage at present. Comparisons of wages in other occupations were submitted, those selected having shorter hours and higher pay than work on the company's lines. Under the present schedule of wages, first-year men are paid 21 cents an hour, with increases to 26 cents beyond the fifth year. The average earnings of forty-nine men have been $2.40 a day or $876 for 365 days' work. With one day off a week the average earnings are $751.20. The present compensation is as follows for different groups of men: Twenty-two men receive $2.60 per day; three receive $2.45; five $2.40; six $2.30; one $2.25; twelve $2.10. From Jan. 1 to Feb. 12 last the average fares collected by a conductor were $25.33 a day. The gross revenue of the company increased 20 per cent between 1909 and 1913; the passengers per car-mile increased 17.35 per cent, and the net operating revenue increased by $51,452 between 1909 and 1913. Detailed testimony was also presented bearing upon the duties of conductors and motormen and the contention was made that the maximum rate of pay should be reached in one year instead of in six. It was brought out by the company that those supporting the plan to have the wage schedule work up to the maximum in one year knew of no other company which paid its highest wage at the end of twelve months.

Cedar Rapids & Iowa City Railway Opens Extension

The Cedar Rapids & Iowa City Railway, which operates between Cedar Rapids and Iowa City, Ia., has completed an extension of some 15 miles to Mt. Vernon, northeast of Cedar Rapids. A special excursion train consisting of four cars was run over the line on March 11.

The road from Cedar Rapids to Iowa City has been in operation since September, 1904. This portion is some 30 miles in length. The road now connects two college towns with Cedar Rapids, which has a population of about 35,000. Iowa City, the home of the State University of Iowa, is a town of 10,000 inhabitants. At the other end of the line is Mt. Vernon with a population of 1500, and an additional student population of 600 or 700 attending Cornell College. The resultant student passenger traffic is very large.

The new line parallels the double-track main line of the Chicago & Northwestern Railroad from Cedar Rapids to Mt. Vernon, but the interurban has the shorter route by 1 mile. The station of Bertram and the proposed new towns of Trachta, Gardendale, Palisades and Cornell are between Cedar Rapids and Mt. Vernon. The sites are platted for most of these places. When all adjustments are made, hourly service will be established from Mt. Vernon through Iowa City. A shuttle service is now operated between Cedar Rapids and Mt. Vernon. The line is to be extended from Mt. Vernon to Lisbon, Ia., 2 miles. There is a bridge 500 ft. long over Big Creek. The station in Vernon is in the center of the city.

Progress on the Line Between Kalamazoo and Grand Rapids

All the grading on the new line of the Michigan & Chicago Railway has been completed from Kalamazoo, Mich., to the junction of the Grand Rapids, Holland & Lake Michigan Railway near Grand Rapids. The exact location of the carhouses and the shops in Grand Rapids has not yet been made public. Towers for carrying the high-tension wire have been placed along the route and the third-rail equipment is being distributed. The work of completing the tracklaying will be taken up before April 1, weather permitting. The electrification of the Allegan & Battle Creek line, crossing the main line at Montieth, is under way. It is intended to connect the Kalamazoo-Grand Rapids line with the lines via Flint, Saginaw and Bay City. The Michigan & Chicago Railway will probably arrange with the Michigan United Traction Company, operating from Kalamazoo to Jackson and Lansing, for linking these lines. The Michigan State Railway Commission has under consideration the application of the Michigan & Chicago Railway for permission to issue $1,000,000 of bonds and $1,000,000 of stock to take over the Saginaw & Flint Railway. The contracts which have been placed with the General Electric Company by the Michigan & Chicago Railway for equipment call for twenty four-motor, 2400-volt car equipments, thirteen 500-kw motor-generator sets, eight 500-kw rotary converters and one 7500-kw turbine and switchboard equipment.

Municipal Ownership Vote in Menasha.—The Common Council of Menasha, Wis., has passed a resolution to submit the question of purchasing the property of the Wisconsin Traction, Light, Heat & Power Company in Menasha to a vote of the people at the spring election.

Utility Commission Recommended for Cincinnati.—A public utilities commission, composed of three members appointed by the Mayor, with almost autocratic powers, has been recommended by the committee on public utilities and franchises to the Cincinnati charter revision commission.

Hearing on Uniform Accounts in Missouri.—April 15 has been set as the date for a hearing at Jefferson City, Mo., where a system of uniform accounting will be discussed by the Missouri State Public Utilities Commission and representatives of utilities, both municipally and privately owned.

Railway Company Awarded Power Contract.—The contract for furnishing current for the operation of the railway systems in the central portion of Dayton, Ohio, was awarded to the Dayton City Railway on March 12. It covers a period of ten years and involves an aggregate of $300,000. The plan was evolved through a desire to eliminate the network of wires at the street crossings in the central portion of the city.

Estimate of Cost of Municipal Line Between Pasadena and Los Angeles.—D. J. MacPherson, the engineer who was engaged by the city to make a preliminary survey of the proposed municipal railway between Pasadena and Los Angeles, Cal., via the Arroyo Seco Canyon, has submitted the results of his survey to the board of city commissioners. According to Mr. MacPherson it will cost $2,089,164 to build and equip a new line between the two cities. The length of the line will be about 10 miles.

Decision in Arizona Extension Case.—The Phoenix (Ariz.) Street Railway was ordered some time ago by the State Corporation Commission to double-track a portion of its line extending ten blocks and connect with another portion in the business section already having a double track. The company applied for an injunction to prevent the commission from enforcing the order. The United States District Court has refused to grant the injunction and has declared that the order was not an unreasonable one.

English Municipal Trading Undertakings.—United States Consul Halstead, at Birmingham, Eng., has prepared a report concerning the results of municipal operation of public utilities in English cities. It covers the street cars, gas and electric lighting, water, markets, etc., and shows the profits and losses, rates levied for all the different purposes, etc., in the cities of England and Wales. The report was transmitted by the Department of Commerce to Congress, and has been printed as House Document No. 710.

New Pittsburgh Subway Ordinance Drawn.—A new ordinance authorizing the construction of a subway system in Pittsburgh, Pa., was submitted to the members of Council for their inspection at the meeting of the committees on March 11, 1914. The measure was drawn by Assistant City Solicitor C. K. Robinson and it was expected that it would be introduced at the meeting of the Council on March 17. The bill is in blank as to the route of the subway, and also as to the name of the company to which the grant is to be made.

Price of Union Street Line, San Francisco, Fixed.—The price to be paid for the Union Street line, San Francisco, Cal., which the city purchased from the Presidio & Ferries Railroad, has been fixed at $312,322 by City Engineer O'Shaughnessy, of San Francisco, and T. C. Mullen, the company's representative. The company received $50,000 of the amount when the agreement to purchase was made, leaving $262,332 due, with an additional allowance of $3,483 for interest at 5 per cent for ninety-seven days from Dec. 10, 1913, when the road was taken over for operation by the city.

Resolutions of Railway Business Association.—At a meeting of the executive committee of the Railway Business Association held in Chicago on March 18, 1914, resolutions on the death of Mr. Westinghouse were unanimously adopted. The resolutions referred to Mr. Westinghouse's invention of the air brake which "accelerated immeasurably the growth of the country and its transportation system." It also referred to his achievements in other fields. Resolutions were also adopted on the death of E. L. Adreon, who had been an executive member of the association since its organization.

Provisions of Interstate Trade Commission Bill Decided Upon.—The bill providing for the creation of an Interstate Trade Commission was agreed to by democrats and republicans of the House committee on interstate commerce on March 16, 1914, and favorably reported to the House. The measure, which would create a new commission to take over the powers and duties of the present Bureau of Corporations, has been submitted to the full committee by the subcommittee which framed it, made up of democrats and republicans, of which Representative Covington, of Maryland, was chairman.

Report Regarding Increase in Fares on Toronto Civic Lines.—Commissioner of Works Harris of Toronto, Ont., reports the deficit of the Toronto Civic Railway Lines for 1913 to be $84,712. In consequence, the advisability of increasing the fare has come before the transportation committee of the Board of Control and rates of fare have been

suggested by members, varying from 5 cents and six tickets for a quarter to three tickets for 10 cents and ten tickets for a quarter. It has finally been decided to have Mr. Harris report on the receipts likely to accrue from the operation of the civic lines at 3-cent, 4-cent and 5-cent fares, respectively.

Amortizing Excess Capitalization.—At the suggestion of the Public Service Commission for the First District of New York the Brooklyn Borough Gas Company has voluntarily agreed to write off $428,428 of its excess capitalization. It proposes to charge off at once $178,428 and to amortize the remaining $250,000 by setting aside each year a special fund equal to 5 cents for each 1000 cu. ft. of gas sold during the year. In a rate case conducted by the commission, it was found that the company's capitalization was in excess of the fair value of its property, and Commissioner Milo R. Maltbie, who conducted the rate case, suggested to the company the advisability of revising its balance sheet for this purpose.

Decision in Dallas Fare Case.—On March 4, 1914, the Texas State Supreme Court declined to grant the application of the city of Dallas for a writ of error to review the decision rendered by the Court of Civil Appeals of the Fifth District on June 14, 1913, in favor of the Dallas Electric Corporation. As noted in the ELECTRIC RAILWAY JOURNAL of June 28, 1913, page 1173, the decision of the Fifth District Court was an affirmation of a decision by Judge Foree of the Fourteenth District Court, who granted an injunction restraining the enforcement of the initiative ordinance passed at the special election on April 2, 1913, providing for the sale of seven tickets for 25 cents and for 3-cent fares where passengers had to stand.

Bids Opened for New York Subway Section Contract.—During the week ended March 14, 1914, the Public Service Commission for the First District of New York opened bids for the construction of Section No. 6-A of Routes No. 4 and 38, the new Seventh Avenue subway in Manhattan. The lowest bidder was the Oscar Daniels Company at $305,-261. The Rapid Transit Subway Construction Company, which is owned by the Interborough Rapid Transit Company, was the third lowest bidder at $498,038. The chief difference in the bids was for the item of protecting the existing subway and the safety of the passengers and other persons therein, for which the Daniels Company bid $12,-000 and the Rapid Transit Subway Construction Company $135,000. The commission has received a letter from the Interborough Rapid Transit Company asking to be heard before the commission awards the contract.

Employees Petition Commission.—The Public Service Commission of the Second District of New York has been petitioned by the secretary of the joint conference board of the Amalgamated Association in regard to the complaints of representatives of eleven cities of the State in relation to improvements in the operation and equipment of cars. A conference with this board was held by the commission on Jan. 20, 1913, at which various matters connected with the comfort and safety of street railway employees throughout the State were discussed. The number of employees represented in the joint conference board, parties to these complaints or requests, totals 6000. The improvements which they desire are as follows: the vestibuling of all closed cars on conductor's end, a vestibule or storm front to be placed on all open summer cars, all cars to be equipped with sand boxes and sand levers placed uniformly on all cars, uniformity in the placing of fender plunger and motormen's gong plunger on all cars, air brakes to be placed on all double-truck cars, elimination of the running board on all open summer cars, stools to be permitted for the use of motormen, seats for conductors on pay-as-you-enter cars, a place to be provided on interurban cars for conductors' signal lamps when not being used, block system on all interurban lines, a uniform headlight for city cars.

LEGISLATION AFFECTING ELECTRIC RAILWAYS

CANADA

It is understood that the Canadian government intends to introduce a special bill in the Canadian Parliament dealing with the subject of the control of the capitalization and bond issue of railway companies, instead of incorporating this in the new consolidation of the railway act. Hitherto it has been the practice to include in each act of incorporation a special provision dealing with the capitalization and bond issue of that particular railway.

MASSACHUSETTS

The Boston Transit Commission sent a special report to the Legislature this week answering inquiries of Representative McInerney regarding the personnel and work of the board. The commission held 121 meetings in 1913, averaging three hours in length. Much of the work is done outside the meetings, including views of subway construction, conferences with the Boston Elevated Railway, with public officials, contractors and others. Chairman Swain contends that a board of five members meets the varied demands more efficiently than the suggested commission of three. The committee on street railways has reported leave to withdraw the bill prohibiting the placing of boxes or other obstruction on the running boards of open cars. The committee on railroads has reported leave to withdraw the bill authorizing the employment of auditors to be at the service of petitioners to the Public Service Commission in certain cases, and has reported adversely on the bill establishing a commission on a tunnel to connect railroad systems entering Boston.

NEW YORK

Governor Glynn signed the workmen's compensation bill on March 16, 1914, and sent to the Senate nominations for four of the five places on the commission to administer the law. The constitutionality of the workmen's compensation act passed last December had been questioned, so, at Governor Glynn's request, the present Legislature re-enacted it, with one change—the Assembly amended the bill by providing that not more than three of the commissioners should be of one political party.

The policy of having the State develop its own water-power resources instead of leaving that work to private enterprise is recommended strongly in the report of the Velte legislative committee submitted to the Legislature on March 12. This committee, appointed a year ago to investigate the present diversion and potentialties of the Niagara River water-power resources, does not commit itself to any particular development scheme, but commends on broad lines the Velte bills now pending, which embody the State-developing plan recommended by Governor Glynn.

It is understood that the Assembly ways and means committee has decided to disregard the resolution providing for an investigation of the Public Service Commission of the First District.

The following bills have been introduced in the Senate: To amend the labor law in relation to sanitation in mercantile establishments; to amend the rapid transit act of 1891 with reference to securing work and materials, with reference to security, with reference to contracts for limited amounts, and with reference to the acquisition of property; to amend the public service commissions law in relation to the issue of stocks by railroads and street railroads; to amend the laws in relation to the completion and operation of certain street service railroads; to amend the railroad law in relation to heating cars propelled by gasoline or oil engines; to amend the railroad law in relation to consolidated corporations; to amend the railroad law in relation to the minimum number of employees to be employed in the operation of street service railroads; to amend the public service commissions law in relation to the interchange of transfers between certain railroads in cities of the first class.

The following bills have been introduced in the Assembly: To amend the public service commissions law in relation to the suspension of orders of the commission and power of the commission to suspend rate schedules; to amend the railroad law in relation to rates of fare on certain railroads; to amend the penal law in relation to advertising for laborers during strikes or lockouts; to amend the public service commissions law in relation to the free transportation by common carriers of mail carriers in uniform; to amend the railroad law in relation to consolidated corporation; to amend the railroad law to provide for the transfer of property when the existence of a railroad corporation ceases.

Financial and Corporate

Stock and Money Markets

March 18, 1914.

In the early trading on the New York Stock Exchange to-day a strong tone prevailed with upturns helped materially by moderate buying for foreign account. The market was extremely sensitive to aggressive action either way and fluctuated within narrow margins except in a few issues. The volume of business was light and the final tone was steady. Rates in the money market to-day were: Call, 2 per cent; sixty days, 2¾ @ 3¼ per cent; four months, 3 @ 3¼ per cent; six months, 3¼ @ 3½ per cent.

In the Philadelphia market to-day dealings were light. Interest centered locally in the transit stocks.

In the Boston market to-day Boston & Maine was the feature. In the early trading this issue gained five points, but later reacted two points. The general list was higher to-day than it was yesterday.

The volume of trading on the Chicago Exchange was extremely small to-day. The bulk of the bond transactions was in the Metropolitan West Side Elevated 4's.

Trading was fairly active in Baltimore to-day in a broad market, but the volume of transactions was small. The bond transactions totaled $71,000, par value.

Quotations of traction and manufacturing securities as compared with last week follow:

	Mar. 11	Mar. 18
American Brake Shoe & Foundry (com.)	93	91½
American Brake Shoe & Foundry (pref.)	141½	140
American Cities Company (com.)	36	36
American Cities Company (pref.)	61½	64
American Light & Traction Company (com.)	365	365
American Light & Traction Company (pref.)	107	107
American Railways Company	38	*38
Aurora, Elgin & Chicago Railroad (com.)	38	35
Aurora, Elgin & Chicago Railroad (pref.)	79½	77¼
Boston Elevated Railway	82	82
Boston Suburban Electric Companies (com.)	7	7
Boston Suburban Electric Companies (pref.)	60	60
Boston & Worcester Electric Companies (com.)	*6¼	*6¼
Boston & Worcester Electric Companies (pref.)	39	38
Brooklyn Rapid Transit Company	92⅜	92
Capital Traction Company, Washington	109½	108
Chicago City Railway	170	170
Chicago Elevated Railways (com.)	20	20
Chicago Elevated Railways (pref.)	65	65
Chicago Railways, ptcptg., ctf. 1	92	91
Chicago Railways, ptcptg., ctf. 2	31	30¾
Chicago Railways, ptcptg., ctf. 3	6½	6½
Chicago Railways, ptcptg., ctf. 4	3	3
Cincinnati Street Railway	105	105
Cleveland Railway	104	103½
Cleveland, Southwestern & Columbus Ry. (com.)	4	4
Cleveland, Southwestern & Columbus Ry. (pref.)	23	23
Columbus Railway & Light Company	20½	13
Columbus Railway (com.)	62	53
Columbus Railway (pref.)	81	79½
Denver & Northwestern Railway	71	71
Detroit United Railway	85	a85
General Electric Company	148	147⅛
Georgia Railway & Electric Company (com.)	120	121
Georgia Railway & Electric Company (pref.)	87	87
Interborough-Metropolitan Company (com.)	14⅝	14⅝
Interborough-Metropolitan Company (pref.)	59¾	60
International Traction Company (com.)	30	*30
International Traction Company (pref.)	a85	*85
Kansas City Railway & Light Company (com.)	10	10
Kansas City Railway & Light Company (pref.)	25	25
Lake Shore Electric Railway (com.)	5½	*5½
Lake Shore Electric Railway (1st pref.)	85	*85
Lake Shore Electric Railway (2d pref.)	22	*22
Manhattan Railway	131	129
Massachusetts Electric Companies (com.)	11	11
Massachusetts Electric Companies (pref.)	62	61
Milwaukee Electric Ry. & Light Co. (pref.)	95	95
Norfolk Railway & Light Company	25¼	25¼
North American Company	76	76⅛
Northern Ohio Traction & Light Co. (com.)	63	70
Northern Ohio Traction & Light Co. (pref.)	98¼	98¼
Philadelphia Company, Pittsburgh (com.)	42⅛	42
Philadelphia Company, Pittsburgh (pref.)	42¼	42
Philadelphia Rapid Transit Company	18¼	18¼
Portland Railway, Light & Power Company	54	54
Public Service Corporation	112	111
Third Avenue Railway, New York	44¼	43¾
Toledo Traction, Light & Power Co. (com.)	20	20
Toledo Traction, Light & Power Co. (pref.)	75	75
Twin City Rapid Transit Co., Min'apolis (com.)	105¾	105¾
Union Traction Company of Indiana (com.)	11½	11½
Union Traction Company of Indiana (1st pref.)	80	80
Union Traction Company of Indiana (2d pref.)	14	14
United Rys. & Electric Company (Baltimore)	27	26½
United Rys. Inv. Company (com.)	20	18
United Rys. Inv. Company (pref.)	43¾	42½
Virginia Railway & Power Company (com.)	53	53
Virginia Railway & Power Company (pref.)	96	95
Washington Ry. & Electric Company (com.)	87⅜	87
Washington Ry. & Electric Company (pref.)	87	86¾
West End Street Railway, Boston (com.)	72	73
West End Street Railway, Boston (pref.)	94	93¼
Westinghouse Elec. & Mfg. Company	73	76¾
Westinghouse Elec. & Mfg. Co. (1st pref.)	116½	118

* Last sale. a Asked.

ANNUAL REPORTS

Atlantic Shore Railway

The statement of income, profit and loss of the Atlantic Shore Railway, Sanford, Maine, for the fiscal year ended Dec. 31, 1913, follows:

Operating revenue:	
Freight revenue	$35,023
Passenger revenue	307,885
Other revenue from transportation	19,834
Other operating revenue	8,738
Total operating revenue	$371,480
Operating expenses	$283,221
Net earnings	$88,259
Miscellaneous income	2,434
Gross income	$90,693
Deductions from income:	
Coupon interest	$94,225
Miscellaneous interest	57
Taxes	7,223
Profit and loss adjusting entries	147
Total	$101,652
Deficit for year	$10,958

The total revenue mileage operated by the company in 1913 was 1,344,707, as compared to 1,341,032 in 1912. The total car hours in 1913 were 117,511, in 1912 116,218; and the total passengers carried in 1913, 5,010,342, in 1912 4,892,371. Other comparative statistics are as follows:

	1913	1912
Average fare revenue passengers	.0794	.0788
Average fare, all passengers (including transfer passengers)	.0614	.0608
Gross earnings per car mile	.2761	.2688
Gross earnings per car hour	3.160	3.101
Operating expenses per car mile	.2106	.20
Operating expenses and taxes per car mile	.2159	.205
Operating expenses per car hour	2.41	2.314
Operating expenses per cent of gross earnings	76.24	74.61
Average number of employees, including officials	180	180

Toronto Railway

A statement of earnings of the Toronto (Ont.) Railway for the year ended Dec. 31, 1913, as compiled from information contained in the annual report, follows:

Gross earnings	$6,049,019
Operating expenses	3,123,308
Net earnings	$2,925,711
Deductions from income:	
Bond interest	$195,807
Payments to city:	
Percentage on earnings	939,991
Pavement charges and taxes	156,100
Total	$1,291,898
Surplus	$1,633,813
Balance from previous year	3,694,757
Total	$5,328,570
Dividends—2 per cent on paid-up capital	879,958
Surplus—carried forward	$4,448,612

A discrepancy is noticed between the figures for bond interest and for pavement and tax expenses as given in two places in the report. In the income account the interest on bonds is given as $195,807, and the pavement and tax expenses as $156,100, a total of $351,907. In the running report to the stockholders, however, it is stated that deductions from net earnings were made for bond interest to the extent of $188,807; for pavement expenses, $91,466, and for taxes, $58,251, a total of $338,524. Between these totals there is a discrepancy of $13,383. No explanation is offered regarding this inconsistency between the two sections of the report. The income account itself, or income statement, as it would properly be called, is deficient in that the operating and maintenance charges, interest on bonds, percentage on earnings, pavement expenses and taxes are all placed in one group as deductions from gross earnings, instead of being grouped as above to show net earnings from operation.

The gross passenger earnings of the company amounted to $5,980,695, as compared with $5,367,502 for 1912, an increase of $613,193. The operating ratio was 52.2 per cent. The payments made to Toronto in 1913, when compared with the payments made during the previous year, show an increase of $147,659.

William Mackenzie, president of the company, says in part:

"The third drawing of the company's currency and sterling bonds, under the terms of the mortgage deed dated Sept. 1, 1892, took place on June 27, 1913. There has been drawn to date a total of $562,512.

"The expenditure on capital account throughout the year amounted to the sum of $1,064,858. In addition to various extensions and improvements to certain of the company's shops, carhouses, etc., several buildings were erected.

"The Toronto & York Radial Railway reports very satisfactory increases, the gross earnings amounting to $584,491, compared with $492,923 for the previous year, an increase of 18.5 per cent."

Reorganization Plan of the American Water Works & Guarantee Company

The reorganization plan announced for the American Water Works & Guarantee Company, Pittsburgh, Pa., provides for the formation of a new company, to be known as the American Water Works & Electric Company, to take over the assets of the old corporation with the exception of cash, stock, notes and floating indebtedness of four subsidiary irrigation properties. The new company will have $10,000,000 of 7 per cent cumulative first preferred stock, of which $5,000,000 will be issued at once; $20,000,000 of 6 per cent participating preferred stock, of which $10,000,000 will be issued at once; $10,000,000 of common stock, of which $7,000,000 will be issued at present, and $20,000,000 of collateral trust 5 per cent twenty-year bonds, of which $6,250,000 will be issued now and $3,700,000 will be available as collateral. Of the collateral trust bonds to be issued at once, $5,733,300 are to be reserved for exchange, par for par, against the first mortgage bonds of the California-Idaho Company and $516,700 are to be used to pay indebtedness of subsidiary companies. The amount of the bonds reserved as collateral is to cover the indebtedness of subsidiary companies to bank creditors. Various banks holding paper of the subsidiaries indorsed and rediscounted by the company are to give an extension of paper covering in all six years.

The plan of reorganization has been approved by the bank creditors' committee, by the protective committee of the four irrigation companies, by the bondholders' protective committee of the California-Idaho Company, by other creditors and the receivers. More than 80 per cent of both classes of stock has been deposited with the stockholders' protective committee. Stockholders have already provided $4,500,000 in cash throughout an underwriting syndicate, which has agreed to take all securities not subscribed for by the present stockholders.

All stock of the new company, except directors' qualifying shares, for the period of five years from the reorganization is to be vested in five voting trustees to be chosen by the reorganization committee. This committee may appoint one or more of its own members as voting trustees. Each depositor of the preferred stock of the old company will be entitled, upon subscription and the payment of $35 per share, to receive $40 par value in first preferred stock and $100 par value in participating preferred stock of the new company. Each depositor of preferred stock who does not make such subscription and payment will be entitled to receive for each share of old preferred stock $50 par value in participating preferred stock on payment of an assessment of $5 on each share of old stock. Common stockholders will be entitled to receive $10 par value of first preferred stock and $70 par value of new common stock for each share of old stock on subscription and payment of $10. The common stockholders who do not subscribe will be entitled to receive for each share now held $10 par value in new common stock upon payment of an assessment of 50 cents a share.

Under the approved plan the four irrigation companies, the Twin Falls-North Side Land & Water Company, Twin Falls-Salmon River Land & Water Company, Twin Falls-Oakley Land & Water Company and the Sacramento Valley Irrigation Company, are to be turned over to a protective committee representing the bonds of the company and $1,000,000 is to be paid for the release of the guarantee of the irrigation companies' bonds. This money is to be used for the development of the irrigation companies' property, the equity in which will ultimately be divided 51 per cent to the bondholders and 49 per cent to the new company.

Babylon (N. Y.) Railroad.—In an order entered on March 17, 1914, Justice Chatfield, in the United States District Court, dismissed Ralph J. Hawkins as receiver of the Babylon Railroad. The court said: "The receiver in this case has done wonderfully well and has bettered the road by making it a usable property."

Carolina Power & Light Company, Raleigh, N. C.—The Electric Bond & Share Company, New York, N. Y., which controls the Carolina Power & Light Company, has recently issued a 43-page illustrated booklet, describing the properties and finances of this latter company and its subsidiaries. The Carolina Power & Light Company is a consolidation of the Raleigh Electric Company, the Central Carolina Power Company and the Consumers' Light & Power Company, and it controls the Yadkin River Power Company and the Asheville Power & Light Company.

Cincinnati, Dayton & Toledo Traction Company, Hamilton, Ohio.—A certificate was recently filed by the Cincinnati, Dayton & Toledo Traction Company, reducing its capital stock from $5,250,000 to $2,250,000, to consist of $250,000 of preferred and $2,000,000 of common.

Cleveland (Ohio) Railway.—The Cleveland Railway has received permission from the Public Utilities Commission of Ohio to issue $2,141,000 of stock to be sold at not less than par to provide funds for extensions and improvements under the conditions noted in the ELECTRIC RAILWAY JOURNAL of Feb. 28, 1914, page 488.

Columbus Railway, Power & Light Company, Columbus, Ohio.—An initial dividend of 1½ per cent has been declared on the preferred stock, series A, of the Columbus Railway, Power & Light Company, payable on April 1, 1914, to holders of record of March 15.

Des Moines & Central Iowa Electric Company, Des Moines, Iowa.—Bodell & Company, Providence, R. I., are offering at par and interest the entire present issue of $1,150,000 of 6 per cent sinking fund gold bonds, series A, of the Des Moines & Central Iowa Electric Company. These bonds are dated Sept. 1, 1913, and due Sept. 1, 1937, but subject to call at 105 and interest. This company controls the Iowa subsidiary properties of the Illinois Traction Company, including the street railway in Oskaloosa. The bonds are guaranteed as to principal, interest and sinking fund by the indorsement of the Illinois Traction Company.

El Paso (Tex.) Electric Company.—The stockholders of the El Paso Electric Company on March 9, 1914, voted to authorize an additional $1,000,000 of common stock, the present issue to be $375,000. The proposed basis of the offering will be eight shares of the old stock to one of the new pro rata to the present stockholders, as noted in the ELECTRIC RAILWAY JOURNAL of Feb. 28, 1914.

Hudson & Manhattan Railroad, New York, N. Y.—The Hudson & Manhattan Railroad has applied to the Public Service Commission of the First District of New York for authority to issue $154,000 of first lien refunding mortgage bonds. The application is made under the authorized mortgage to the Central Trust Company, New York, N. Y., for $65,000,000, of which $37,035,000 has already been issued. The additional amount is required for extensions and betterments and for refunding purposes.

Indiana Utilities Company, Angola, Ind.—The Indiana Utilities Company has petitioned the Public Service Commission for authority to issue bonds in the sum of $6,000.

Interstate Railways, Camden, N. J.—The directors of the Interstate Railways have decided to refund $42,000 ($6 per bond) to cover the expenses met by the bondholders who deposited their bonds with Edward B. Smith & Company, Philadelphia, Pa., as managers during the reorganization plan that was proposed but not adopted five years ago.

Knoxville Railway & Light Company, Knoxville, Tenn.—The Guaranty Trust Company, New York, N. Y., successor to the Standard Trust Company, which was trustee for an issue of forty-year 5 per cent consolidated gold bonds of the Knoxville Railway & Light Company, announces that it will receive proposals until April 3, 1914, for the sale to it of as many of the bonds as can be purchased for $18,339, at a rate not to exceed 107½ and interest accrued.

Manhattan Bridge Three-Cent Line, Brooklyn, N. Y.—The Public Service Commission for the First District of New York has authorized the Manhattan Bridge Three-Cent Line to issue common stock to the amount of $260,000 at par, the proceeds to be used to acquire property and increase facilities. The company at present has outstanding $190,000 of stock.

Monterey Railway, Light & Power Company, Monterey, Mex.—The Monterey Railway, Light & Power Company has been compelled to defer the payment of interest on its securities. The directors of the company have issued a notice that the payment of interest on the $6,000,000 of first mortgage debenture stock will be deferred until such time as financial and political conditions improve in the republic.

New York, Auburn & Lansing Railroad, Ithaca, N. Y.—The property of the New York, Auburn & Lansing Railroad was sold under foreclosure on March 6 to H. W. Fitz, chairman of the bondholders' committee, for $200,000. This was the only bid. A reorganization plan has been submitted to the Public Service Commission for the Second District of New York for approval and the purchase by the bondholders' committee is a step in the furtherance of this plan. The property will probably be turned over to the reorganized company early in April. The New York, Auburn & Lansing Railroad is a steam road, but its Ithaca terminal is operated by electricity.

Pacific Gas & Electric Company, San Francisco, Cal.—N. W. Halsey & Company and Harris, Forbes & Company, New York, N. Y., recently offered at 99½ and interest $5,000,000 of 5 per cent gold notes of the Pacific Gas & Electric Company dated March 25, 1914, and due March 25, 1915, but redeemable at any time at 102 and interest. This issue is subject to the approval of the California Railway Commission.

Petaluma & Santa Rosa Railway, Petaluma, Cal.—Plans are being considered for reorganizing the Petaluma & Santa Rosa Railway as the San Francisco & Northern Railway and extending the line from Santa Rosa north into Healdsburg and Lake County.

Porto Rico Railways, Ltd., Ponce, P. R.—At the annual meeting of the Porto Rico Railways held in Toronto, Ont., on March 11, 1914, Max Aitken retired as president of the company and D. E. Thomson, Toronto, Ont., was elected to succeed him. W. D. Ross, Toronto, Ont., was elected vice-president, to succeed Mr. Thompson. James Ryrie, Toronto, Ont., was elected to the board to succeed J. F. Remnant, London, Eng., who retired. Max Aitken, the former president, remains a member of the board. A short while ago I. Hamilton Benn, London, Eng., and Ramon Vaides, San Juan, Porto Rico, were succeeded as directors by V. M. Drury and F. W. Teele, the latter general manager of the company.

St. Joseph Railway, Light, Heat & Power Company, St. Joseph, Mo.—The Missouri Public Service Commission has authorized the St. Joseph Railway, Light, Heat & Power Company, a subsidiary of the Cities Service Company, to issue $162,000 of 5 per cent bonds, the proceeds to be used for extensions and improvements.

Third Avenue Railway, New York, N. Y.—The New York Stock Exchange has authorized to be listed on notice of sale $4,187,000 of additional first refunding mortgage fifty-year 4 per cent bonds of the Third Avenue Railway, making a total of $19,977,000. The proceeds of this issue will be used in part payment for the following securities, which will be deposited under the first refunding mortgage: $734,000 of Belt Line Railway Corporation stock and $1,750,000 of its first mortgage thirty-year 5 per cent gold bonds, and $4,221,000 of New York City Interborough Railway stock and $1,702,000 of its first mortgage 4 per cent sinking fund gold bonds.

Washington, Baltimore & Annapolis Electric Railroad, Baltimore, Md.—The managing committee of the funding trust of the Washington, Baltimore & Annapolis Electric Railroad, composed of George T. Bishop, George R. Sheldon and Frank H. Ginn, which expires by limitation on April 1, 1914, has issued a request to the stockholders for an extension of the agreement to April 1, 1916.

Woodstock, Thames Valley & Ingersoll Electric Railway, Woodstock, Ont.—Justice Kelly heard applications before him for the appointment of a trustee to manage this line and for the appointment of E. B. Stockdale of the Trust & Guarantee Company, Toronto, Ont., as receiver.

Dividends Declared

Arkansas Valley Railway, Light & Power Company, Pueblo, Col., quarterly, 1¾ per cent, preferred.

Asheville, Power & Light Company, Asheville, N. C., quarterly, 1¾ per cent, preferred.

Augusta-Aiken Railway & Electric Corporation, Augusta, Ga., quarterly, 1½ per cent, preferred.

Bangor Railway & Electric Corporation, Bangor, Me., quarterly, 1¾ per cent, preferred.

Cincinnati (Ohio) Street Railway, quarterly, 1½ per cent.

Cleveland (Ohio) Railway, quarterly, 1½ per cent.

Columbus Railway, Power & Light Company, Columbus, Ohio, 1½ per cent, preferred.

Frankford & Southwark Passenger Railway, Philadelphia, Pa., quarterly, $4.50.

Halifax (N. S.) Electric Railway, quarterly, 2 per cent.

Illinois Traction System, Peoria, Ill., quarterly, 1½ per cent, preferred.

Lake Shore Electric Railway, Cleveland, Ohio, quarterly, 1½ per cent, first preferred.

New York State Railways, Rochester, N. Y., quarterly, 1¼ per cent, preferred; quarterly, 1½ per cent, common.

Philadelphia (Pa.) Traction Company, $2.

Virgina Railway & Power Company, Richmond, Va., 1½ per cent, common.

Washington, Baltimore & Annapolis Electric Railroad, Washington, D. C., quarterly, 1½ per cent, preferred.

West End Street Railway, Boston, Mass., $1.75, common.

West India Electric Company, Ltd., Kingston, Jamaica, quarterly, 1¼ per cent.

ELECTRIC RAILWAY MONTHLY EARNINGS

AMERICAN RAILWAYS, PHILADELPHIA, PA.

Period			Gross Earnings	Operating Expenses	Net Earnings	Fixed Charges	Net Surplus
1m., Feb.,	'14		$382,145	.....	.....	.....	.....
1 " "	'13		368,187	.....	.....	.....	.....
8 " "	'14		3,697,728	.....	.....	.....	.....
8 " "	'13		3,429,906	.....	.....	.....	.....

CHATTANOOGA RAILWAY & LIGHT COMPANY, CHATTANOOGA, TENN.

1m., Jan.,	'14		$99,233	*$58,352	$40,881	$27,653	$13,228
1 " "	'13		95,633	*59,241	36,392	24,399	11,993
12 " "	'14		1,208,529	*716,738	491,791	301,335	190,456
12 " "	'13		1,079,302	*645,765	433,537	269,159	164,378

CLEVELAND, PAINESVILLE & EASTERN RAILROAD, WILLOUGHBY, OHIO.

1m., Jan.,	'14		$28,814	*$16,795	$12,020	$10,789	$1,231
1 " "	'13		28,095	*16,682	11,414	10,471	943

CUMBERLAND COUNTY POWER & LIGHT COMPANY, PORTLAND, MAINE

1m., Jan.,	'14		$184,509	*$119,731	$64,778	$63,576	$1,202
1 " "	'13		172,587	*101,605	70,982	56,733	14,249
12 " "	'14		2,366,719	*1,330,999	1,035,720	721,117	314,603
12 " "	'13		2,151,337	*1,218,568	932,769	653,348	279,421

EAST ST. LOUIS & SUBURBAN COMPANY, EAST ST. LOUIS, ILL.

1m., Dec.,	'13		$238,628	*$142,954	$95,674	$46,652	$49,022
1 " "	'12		228,509	*111,142	117,367	48,019	69,348
12 " "	'13		2,664,219	*1,567,656	1,096,563	589,134	507,429
12 " "	'13		2,452,451	*1,353,568	1,098,883	578,471	520,412

LAKE SHORE ELECTRIC RAILWAY, CLEVELAND, OHIO

1m., Jan.,	'14		$105,489	*$68,480	$37,009	$35,058	$1,951
1 " "	'13		100,992	*65,287	35,705	34,938	767

LEWISTON, AUGUSTA & WATERVILLE STREET RAILWAY, LEWISTON, MAINE

1m., Jan.,	'14		$45,299	*$39,359	$5,940	$15,338	†$9,398
1 " "	'13		44,952	*33,092	11,860	14,476	†2,616
12 " "	'14		675,901	*433,983	241,918	180,436	61,482
12 " "	'13		627,124	*389,247	237,877	173,105	64,772

MONONGAHELA VALLEY TRACTION COMPANY, FAIRMONT, W. VA.

1m., Jan.,	'14		$78,507	$33,269	$45,237	$25,567	$19,670
1 " "	'13		68,636	25,030	43,607	24,103	19,504

NORTHERN OHIO TRACTION COMPANY, AKRON, OHIO

1m., Jan.,	'14		$270,961	*$171,291	$99,670	$49,462	$50,208
1 " "	'13		237,466	*142,250	95,216	44,671	50,545

PHILADELPHIA (PA.) RAPID TRANSIT COMPANY

1m., Feb.,	'14		$1,779,010	$1,096,891	$682,119	$802,233	$120,114
1 " "	'13		1,775,158	1,104,541	670,617	767,505	96,888
8 " "	'14		16,025,075	9,434,982	6,590,093	6,401,075	189,018
8 " "	'13		15,703,350	9,419,447	6,283,903	6,097,427	186,476

*Includes taxes. †Deficit.

Traffic and Transportation

Report and Recommendations in Regard to Service in Schenectady

The Public Service Commission of the Second District of New York has received a report from Charles R. Barnes, electric railway inspector, concerning his investigation of traffic conditions in Schenectady and vicinity. A copy of the report has been submitted to the Schenectady Railway with a request for an answer as to compliance with the recommendations. The report embodies the following recommendations to the company:

1. That it construct and equip an additional substation with the feeders necessary for the additional power required. That it notify this commission within sixty days when such construction will be commenced.
2. That it cause the first step to be lowered on the twenty-six single-truck open cars and the twenty-five double-truck closed cars classified in this report as being too high.
3. That an automatic track switch be installed at the junction of State and Center Streets.
4. That it increase the service during the morning and evening rush hours on the Van Vranken Avenue, State Street, Rosendale Road, Crane Street, Albany Street, "A"-belt and "B"-belt lines, and report to the commission when it will increase the service on the lines mentioned, how much and in what manner.
5. That it increase the "limited" service on city lines in both directions during the noon hour and report to the commission.
6. That it increase the service to and from the General Electric plant during the morning and evening rush hours by the use of trailers on the different lines.
7. That the operating officials of the company confer with the officers of the American Locomotive Company in reference to increased facilities to and from that plant and report to the commission the action taken by the company.
8. That the present headway of fifteen minutes during the non-rush hours on the Rosendale Road, Van Vranken Avenue, Campbell Street, Crane Street, and Scotia lines be reduced to twelve minutes.
9. That it increase the service on the Ballston division during the morning and evening rush hours by the use of multiple-unit trains when necessary to prevent passengers being obliged to stand on any one run more than two days in the week.
10. That it increase the service on the Schenectady-Albany division during the morning and evening rush hours by the operation of not less than three two-car multiple-unit trains to be run at the times which will accommodate the travel best.
11. That it operate not less than ten trailers on the heavy carrying city lines during the morning and evening rush hours and at such other times as will best accommodate the travel.
12. That it procure eight new closed motor cars and ten trail cars as soon as possible.
13. That it withdraw from service all of the forty single-truck cars and replace them with cars with seating capacity of not less than forty by the purchase of new cars or the reconstruction of the old ones, the withdrawal and replacement to be completed not later than Nov. 1, 1914.
14. That it equip the Albany, Troy and Ballston-Saratoga divisions with modern track circuit-control block signals.

Practically 14 per cent of the passengers traveling on this system are obliged to transfer to reach their destination. This is considered a small percentage of transfers to cash passengers.

The popularity of the "express" service operated on the city lines during the noon hour is shown by the increase in the number of cars run for this purpose, which during the year 1913 was thirteen of the larger type. It was estimated that 1000 persons daily availed themselves of this service to go to their homes at noontime.

On account of the inadequate service as the result of limited track facilities an average of only 323 out of approximately 5000 persons employed in the locomotive works patronize the cars during the evening rush hour.

On the matter of block signals the report states:

"The three suburban lines, Albany, Troy and Ballston-Saratoga, are all double-track. The traffic on each has practically reached the limit of safety. Trains on all of these divisions are run at high speed and at times on short headways. Safety requires that all of them be equipped with a proper block signal system. The company has plans under consideration for the equipment of the Schenectady-Albany division with a modern block signal system."

The report calls attention to the desirability for additional crosstown lines and emphasizes the necessity for the widening of some of the streets in the business portions of the city as previously suggested by the commission. Pending such rearrangement of streets it is suggested that an equivalent to double-tracking Lafayette Street in Schenectady might be obtained by the construction of a track through Barrett and Romeyn Streets between State Street and South Avenue.

The number of passengers carried increased from 16,000,000 in 1907 to 22,000,000 in 1912, or 36.24 per cent. The car miles run decreased 13.58 per cent. During this period there was no change in the number of cars owned by the company or in their seating capacity. The passenger receipts increased from $1,015,000 in 1907 to $1,147,000 in 1912, or 13.01 per cent. The operating expenses increased from $743,000 in 1907 to $772,000 in 1912, or 3.27 per cent.

Summarizing, the report sets forth that proper transportation in Schenectady, present and future, is dependent upon the widening and extending of streets in the business section of the city.

Decision in Indiana Fare Case

During the latter part of January the Public Service Commission of Indiana, following a hearing on a petition from the Commercial Club of Carmel, Ind., ordered the Union Traction Company of Indiana to reduce its rate of fare from Carmel to Indianapolis from 30 cents to 25 cents, and from Carmel to Broad Ripple from 20 cents to 15 cents. The mileage from Indianapolis to Broad Ripple is 8 miles, and from Indianapolis to Carmel, 16 miles. For several years three passenger rates have been in effect between Indianapolis and Broad Ripple. On the local Indianapolis-Broad Ripple cars the fare is 5 cents; on local interurban cars, 10 cents; on limited interurban cars, 15 cents. The reduction in fare, on the commission's order, made the highest rate of fare between Broad Ripple and Indianapolis 10 cents.

A. W. Brady, president of the Union Traction Company, filed with the commission a request for a rehearing on the ground that under the decision of the commission a passenger could ride from Carmel to Broad Ripple on an interurban car for 15 cents, and by then taking the local car into the city for 5 cents would get the benefit of a 20-cent fare from Carmel to Indianapolis; that the Chicago, Indianapolis & Louisville Railroad, a steam railroad, was, under the 2-cent fare law, allowed to charge a 15-cent fare to Broad Ripple and 30-cent fare to Carmel, and that the limited cars of the traction company, giving practically the same service as the steam road, would be compelled to transport passengers to these points for 10 cents and 25 cents respectively. On March 12, 1914, the Public Service Commission affirmed its former decision in the matter, overruling several decisions which had been given previously by the Railroad Commission of Indiana, which was superseded by the Public Service Commission on May 1, 1913. In its decision the commission said:

"It is not a question of whether the 20-cent fare from Carmel to Broad Ripple is excessive. It is unreasonable even though it is not excessive. It is an unjust discrimination that ought to be prohibited. The company attempted to justify the additional charge of 5 cents on the principle that it was entitled to 2 cents a mile between the corporate limits of Carmel and Broad Ripple, and 5 cents for the carriage of an adult passenger through the corporate limits of the municipalities. This position is sustained by a number of decisions heretofore rendered by the Railroad Commission of Indiana. This commission, however, is of the opinion that such decisions are not correct statements of the law and the same are hereby expressly overruled."

The commission, however, ruled that the new rate should apply to local interurban cars; that the 30-cent rate on limited cars should be retained, and that there was no reason why the company should be compelled to perform the same service as the steam road at a lower rate of fare than charged by the steam road.

Complaint Against San Francisco-Oakland Terminal Railways Dismissed

The Railroad Commission of California has dismissed the petition of T. D. Johnston to compel the San Francisco-Oakland Terminal Railways, Oakland, Cal., to inclose all of its cars running on its suburban lines with vestibules. The commission in its decision says in part:

"Defendant operates both a city street car system and an interurban system, and while the complaint includes all of the lines operated by defendant, the testimony was confined to the line operated between Oakland, Emeryville, Albany and Richmond, a line about 12 miles long. The testimony shows that about one-half of the cars operated on this line are entirely inclosed, and the other half have open ends. There was some testimony by patrons of this line that during stormy weather the rain driven by the wind blew in upon passengers where they sat in these open-end cars, and of course if these ends were inclosed there would be protection against this discomfort. On the other hand, there were a large number of witnesses who testified that they preferred the open-end cars, even though at times of bad weather they were subject to slight inconvenience. No employee of the company appeared at the hearing, and there is no way of determining whether or not these employees are suffering discomfort except by hearsay statements made at the hearing.

"It is a question whether in this part of California the entirely closed interurban electric car is the more comfortable and pleasant for passengers, or whether the open-end car, affording as it does opportunity to ride in the air and to enjoy an uninterrupted view of the scenery, is preferable. I think it is obvious that in all parts of California there will be times when the weather conditions will make the open ends of cars somewhat uncomfortable for the traveling public, but considering the comparatively short period of stormy weather each year in this part of California, I think it is open to question whether all cars should be inclosed. The evidence in this case is altogether insufficient to warrant a conclusion that the cars should be inclosed. I therefore recommend that the complaint be dismissed."

Municipal Railway Employees Present Demands

Mayor Rolph of San Francisco, Cal., has transmitted to the Board of Supervisors, without recommendation, the report made to him by T. A. Cashin, superintendent of the Geary Street Municipal Railway, relative to the request of the platform men on the railway for one day off with pay every week, and for other concessions. In his report Mr. Cashin states that with the exception of the Butte (Mont.) Electric Railway, which pays its men, after five years of service, 45 cents an hour for a nine-hour day, and the San Francisco-Oakland Terminal Railways, which has a sliding wage scale of 40 cents an hour for a ten-hour day, there is no other street railway that pays the Municipal Railway's rate of $3 for an eight-hour day.

Mr. Cashin says that any arrangement by which every man shall be kept not more than ten hours on call for his eight hours of work a day would be very expensive. He submits four schemes for complying with the ten-hour demand of the men, the most economical of which will increase the operating cost $90 a day, or $32,850 a year. He points out that the railway will, after July 1, 1915, have to provide $101,000 a year for the bond sinking fund. The expense of giving the 130 platform men on the Geary Street road a day off every week would be $20,280 a year, and if the same privilege were allowed the shopmen and other employees the cost would be $15,015 additional. Concerning the request for uniforms Mr. Cashin says that private companies do not provide uniforms, but that on the Canadian municipal railways the men receive one uniform a year and an overcoat every two years.

Petition for Reduction in Fare in Massachusetts.—A petition has been filed with the Public Service Commission of Massachusetts asking for an order to require the Berkshire Street Railway, Pittsfield, to reduce to 5 cents the fare from Pittsfield to North Adams.

Route Numbers in Oakland.—The city cars of the San Francisco-Oakland Terminal Railways, Oakland, Cal., are to be equipped with route numbers similar to those now in use in San Francisco. The first signs will be put on the sixty new low-step pay-as-you-enter cars along San Pablo and Telegraph Avenues.

Reduction in Fare Under Consideration.—W. C. Fisk, vice-president of the Hudson & Manhattan Railroad, is quoted as authority for the statement that the company has under consideration the suggestion of Mr. MacGovern, the recorder of Hoboken, N. J., that the fare from Jersey City and Hoboken, to Ninth Street and to Christopher Street, New York, be reduced from 7 cents to 5 cents.

Local Fare Increase Approved in Massachusetts.—The Public Service Commission of Massachusetts has approved the establishment of a 6-cent local fare unit on the Providence & Fall River Street Railway and has dismissed the petition of citizens of Swansea and Seekonk for an order to require the company to retain the former 5-cent local fare unit.

Brooklyn Transfer Order Adopted by the Commission.—The order of the Public Service Commission of New York, First District, adopted on March 6, 1914, requires that the transfer plan worked out by it for the surface lines of the Brooklyn Rapid Transit System shall become effective on May 1. The conditions which the order prescribes were referred to in the Electric Railway Journal of March 14, 1914, page 610.

Freight Terminal Proposal in Louisville.—A proposal to turn over Main Street, the principal wholesale business thoroughfare of Louisville, Ky., during certain hours of the day to the use of the railroads, and to permit the placing of private switches, to be built for the use of freight cars propelled by electricity, has created considerable interest in that city. The plan was originated by the local leaf tobacco exchange, the members of which realize that Main Street has within recent years lost many business houses requiring trackage, by removal to other locations.

Progress with Uniform Rules for Michigan.—It is regarded as unlikely that the Railroad Commission of Michigan will have an opportunity to pass upon the proposed uniform rules for some little time. The meeting at Detroit on March 18, 1914, resolved itself into a conference of the committee on rules with the managers of the interurban properties in the State at which the draft prepared by the sub-committee was read and objections heard from the managers. The committee will pass upon the objections and the rules will probably then be submitted for action by the Railroad Commission.

Operation of Double-Deck Car at Columbus, Ohio.—The new double-deck car of the Columbus Railway, Power & Light Company, Columbus, Ohio, described in the Electric Railway Journal of March 14, 1914, page 582, was operated for the first trial on March 2. S. G. McMeen, president of the company, and a number of the city and county officials made up the party. L. E. Hamilton, an inspector of the company, acted as motorman, and Delbert Scott was the conductor. Mr. McMeen paid the first cash fare and Byron L. Barger, director of public safety, deposited the first ticket fare. The trip was made on the High Street line, on which the car will be operated in regular service.

Increase in Surface Car Service in Brooklyn.—The Brooklyn (N. Y.) Rapid Transit Company has announced that it will increase the service on fifteen of its surface lines, making in all about 400 additional trips, or an average of twenty-six new trips for each of the fifteen routes. The advisability of requiring the company to increase service on twenty other surface lines is under investigation by the Public Service Commission of the First District of New York. On March 19, 1914, the New York Municipal Railway Corporation carried in the Brooklyn papers an advertisement headed "Rapid Transit Progress" reviewing the extent to which it has discharged its contracts under the dual subway contracts.

Personal Mention

Mr. B. F. Meyers has been elected vice-president of the Harrisburg (Pa.) Railways to succeed Mr. Frank B. Musser, who has been elected president of the company.

Mr. D. E. Thomson has been elected president of the Porto Rico Railways, Ltd., Ponce, P. R., to succeed Mr. Max Aitken, who continues as a director of the company.

Mr. W. D. Ross, Toronto, Ont., has been elected vice-president of the Porto Rico Railways, Ltd., Ponce, P. R., to succeed Mr. D. E. Thomson, who has been elected president of the company.

Mr. George R. Sheldon, who has been treasurer of the North American Company, New York, N. Y., has been elected vice-president of the company to succeed Mr. J. D. Mortimer, who has been elected president of the company.

Mr. Frank B. Musser, who has been vice-president and general manager of the Harrisburg (Pa.) Railways, has been elected president of the company, in addition to general manager, to succeed Mr. H. D. Walbridge, New York, N. Y., resigned.

Mr. James S. Harlan has been elected chairman of the Interstate Commerce Commission to succeed Mr. Edgar E. Clark. Mr. Harlan's election is in pursuance of the policy adopted in 1911 to limit the term of office of the chairman to one year, the position to be filled by each commissioner in turn in the order of seniority.

Mr. L. O. Veser, chief engineer of the Mahoning & Shenango Valley Railway Light Company, Youngstown, Ohio, has tendered his resignation, effective April 1. Mr. Veser has been in the service of the company since 1909, previously to which time he was connected with various hydroelectric companies in Western States.

Mr. Peter M. Miller has been appointed assistant treasurer of the Jacksonville (Fla.) Traction Company, vice Mr. Arthur F. Butler, resigned. Mr. Miller has been with Stone & Webster for the last eight years, of which five and one-half years were served with the Savannah Electric Company as chief clerk. He was then transferred to Boston for a short while. Two years ago he was made assistant treasurer of the Key West Electric Company.

Mr. Charles N. Hebner has been appointed secretary of the Illinois Public Utilities Commission to succeed Mr. William Kilpatrick, resigned. Until recently Mr. Hebner was in charge of the assignment of expenditures of the Chicago (Ill.) Railways under Mr. John Z. Murphy, chief engineer. He was born in Chicago in 1876. After completing his education in the public schools Mr. Hebner served in various clerical positions until 1908, when he accepted a position with the Chicago Railways.

Mr. J. H. Larmonth, consulting engineer, Toronto, Ont., has been appointed superintendent of the Edmonton (Alberta) Municipal Railway System. Mr. Larmonth, who is at present in private practice in Toronto, will take up his new duties on April 1, 1914. He succeeds Mr. W. T. Woodroofe, who resigned recently. Mr. Larmonth was formerly with the Peterboro (Ont.) Street Railway. As engineer he supervised the construction of the road and later managed the property for a number of years. He was also general manager of the Electrical Power Company. Mr. Larmonth is a graduate of McGill University.

Mr. J. H. Trimingham has been appointed superintendent of power of the Sherbrooke Railway & Power Company, Sherbrooke, Que. Mr. Trimingham was graduated from the McGill University, Montreal, in 1908 in electrical engineering. He was attached to the electrical staff at the University as a demonstrator from 1908 to 1911. For the following eighteen months he was consulting engineer and superintendent of power of the Bermuda Electric Light, Power & Traction Company, Hamilton, Bermuda. During the latter part of 1913 he was engaged in work for the electrical commission of the city of Montreal.

Mr. James Campbell, who has for some time been president of the North American Company, New York, N. Y., has been elected chairman of the board of directors of the company. Mr. Campbell is also a director of the Utah Utilities Company, the National Bank of Commerce of St. Louis, the Mercantile Trust Company of St. Louis, the Southwestern Telegraph & Telephone Company, and numerous other public utility companies. He was born in Ireland and was brought to America by his parents when he was two years old. He was educated in the public schools at Wheeling, W. Va., and entered business in 1859 when he was eleven years old. During the Civil War he was attached to the staff of Gen. John C. Fremont as a messenger. After the war Mr. Campbell located in New York. He later engaged in engineering work in St. Louis. In 1876 he opened offices as a broker in St. Louis and since then has been prominently identified with the development of public utility properties.

Mr. George H. Binkley, whose appointment as engineer of the maintenance of way department of the San Francisco-Oakland Terminal Railways, Oakland, Cal., was noted in the ELECTRIC RAILWAY JOURNAL of March 7, 1914, was born in Richmond, Ind., and was educated at De Pauw University. Mr. Binkley commenced his engineering work with the Pennsylvania Railroad by which he was employed for five years on location surveys, construction and maintenance work. Subsequently he had charge of grading and field engineering work at the World's Columbian Exposition in Chicago and remained with the exposition for a year after its close to compile final reports to the director of works. He next became connected with the Michigan Southern Railway and the Chicago, Rock Island & Pacific Railroad in track elevation work, preparing subway plans for Chicago streets. After a short connection with the bureau of streets in Chicago, Mr. Binkley entered the employ of the Calumet Electric Street Railway, Chicago, with which he remained five years as chief engineer in charge of construction and maintenance. Later he was appointed chief engineer of the railway department of Kohler Brothers, Chicago, contracting engineers, and for four years served as vice-president and chief engineer of the American Engineering Company, Indianapolis, Ind. For four years prior to becoming connected with the San Francisco-Oakland Terminal Railways Mr. Binkley was with the Arnold Company, Chicago, Ill. He is a member of the Western Society of Engineers and the American Society of Civil Engineers.

Mr. Charles J. Witherwax has been appointed general passenger agent of the Schenectady (N. Y.) Railway, which operates 137 miles of line and 186 motor and thirty-three other cars. The office is a new one with the company, and Mr. Witherwax's jurisdiction will cover the management of Brandywine and Forest Parks, which are owned by the company. He will also look after all special car movements, excursions, chartered car service and will personally investigate all irregularities in service. For the last nine years Mr. Witherwax has been connected with the Schenectady Illuminating Company and the Mohawk Gas Company, and since 1908 has served the companies with marked success as an adjuster. Mr. Witherwax has, of course, a large acquaintance in Schenectady and vicinity and is particularly well fitted for the position to which he has been appointed on account of his wide experience in dealing with the public. Referring to his success in this particular, Henry W. Peck, general manager of the Schenectady Illuminating Company, said: "Mr. Witherwax has been a most valuable man to the company through his familiarity with the different departments of the company's work and especially his natural ability to judge fairly the merits of disputes or complaints on the part of consumers against the company. The company has lost a valuable man and one who has largely helped in bringing about the friendly feeling which exists towards the company."

C. J. Witherwax

Mr. **James D. Mortimer**, vice-president of the North American Company, New York, N. Y., and president of The Milwaukee Electric Railway & Light Company, Milwaukee, Wis., was elected president of the North American Company on March 19, 1914, to succeed Mr. James Campbell, who has been elected chairman of the board of directors of that company. Mr. Mortimer was born in Elmhurst, Ill., and was educated at the Throop Polytechnic Institute, Pasadena, Cal., and at the University of California, from which he was graduated in 1900. After completing his college course Mr. Mortimer taught for more than a year and then entered the service of the Tacoma Railway & Power Company, Tacoma, Wash. When Stone & Webster, Boston, Mass., took over the property of the Tacoma Railway & Power Company and the Puget Sound Electric Railway in 1903 Mr. Mortimer was retained as engineer. Mr. Mortimer became identified with the development of the property of the Telluride Power Company while Mr. James Campbell, chairman of the North American Company, was president of that company, and later he was elected first vice-president of the North American Company, which controls the railway and light properties in Milwaukee. Mr. Mortimer was also receiver of the Toledo & Chicago Interurban Railway, Kendallville, Ind., now the Fort Wayne & Northwestern Railway. He was elected vice-president and secretary of The Milwaukee Electric Railway & Light Company and the Milwaukee Light, Heat & Traction Company in February, 1910, and in 1912 was elected president of the companies to succeed Mr. Campbell, who was elected chairman of the board of directors.

J. D. Mortimer

OBITUARY

Alden E. Viles, treasurer of the Boston (Mass.) Suburban Electric Companies and a director of the Lexington & Boston Street Railway, the Middlesex & Boston Street Railway, and the Norumbega Park Company, died on March 15, 1914, at his home in Boston, after an illness of two weeks. Mr. Viles was born in Waltham, Mass., sixty-eight years ago, and aside from his business interests, which included the trusteeship of several large estates, was prominent in art and country club circles. He is survived by his widow, a son and a daughter.

Edward T. Moore, manager of the Dallas (Tex.) Consolidated Electric Street Railway, has outlined to the City Commissioners of Dallas the extensive program of improvements which the company already has under way and the betterments which have been decided upon for the near future. The main betterments of service which the company will make at the cost of $931,282 consist of double tracking the loop at Main, Elm and Lamar Streets, thirty-five new cars for operation east of Trinity and twenty new cars for operation on Oak Cliff lines, double tracking the north part of the North Belt from Ross and Pearl on out beyond State Street and other trackage and shop improvements. The cost of the thirty-five new cars will be $203,000—including the new Oak Cliff equipment the total expenditure in this respect will exceed $300,000. The cost of the loop improvements will be $32,000. A line will be built to the Southern Methodist University at a cost of $43,000. Car shops and paint shops for cars will cost almost $150,000. Some of the other improvements follow with their cost as estimated by Mr. Moore: Garrett, double track and paving, $27,000; concrete pits at barns for cleaning cars, $16,900; San Jacinto, retrack and paving, $26,000; double tracking and paving, Bryan, $92,000; block signal system, $3,200; new fare boxes, $1,000; tracking and paving on Peak from Elm to Ross, $88,000. Many of the improvements mentioned are already under way.

Construction News

Construction News Notes are classified under each heading alphabetically by States.

An asterisk (*) indicates a project not previously reported.

RECENT INCORPORATIONS

Churchill Southern Railway, Fort Churchill, Man.—The Manitoba Legislature has incorporated this company with power to build a railway to be operated by steam, electricity or any other motive power, from Fort Churchill, southerly to Kettle Rapids, on the line which the Dominion government is building from Pas to Port Nelson, Man., with branch lines to any point in the Province of Manitoba. The company is given authority to develop water powers, and to distribute electric energy for all purposes. The directors are: W. Beech, W. Chambers, T. Wright, C. Atchison, Winnipeg; W. Georgeson, Calgary.

***Batavia (N. Y.) Traction Company.**—Incorporated in New York to succeed to the property of the Buffalo & Williamsville Electric Railway in Batavia. Capital stock, $25,000. Incorporators: Stephen W. Brown, William F. Haitz, Michael H. Keogh, all of Batavia.

Blaine-Lynden Electric Railway, Blaine, Wash.—Application for a charter has been made by this company to build an electric railway between Blaine, Lynden and Bellingham. Capital stock, $250,000. Officers: John J. Pinckney, president; Lester Livingston, secretary, and James A. Willison, treasurer. [E. R. J., Feb. 21, '14.]

FRANCHISES

Los Angeles, Cal.—The Pacific Electric Railway has applied to the Public Utilities Commission for a forty-year franchise for an elevated structure from Sixth Street depot to San Pedro Street.

San Diego, Cal.—The Los Angeles & San Diego Beach Railway has received a franchise from the Council for an electric railway from Arctic Street to La Jolla in San Diego.

Stockton, Cal.—The Stockton Electric Railway has received a franchise from the Council for the extension of the El Dorado Street line to Tuxedo Park.

***Bradentown, Fla.**—M. L. Waggoner and associates have received a franchise from the Council to build an electric railway in Bradentown.

Miami, Fla.—An electric railway franchise in the city of Miami is offered for sale and proposals for construction will be received for thirty days by Mayor John W. Watson, Miami. The conditions under which the proposals will be received are referred to on page 96 of the advertising section of this issue.

Atlanta, Ga.—The Georgia Railway & Power Company has asked the Council for a franchise to extend its College Park line into Alabama Street as far as Broad Street in Atlanta.

Pascagoula, Miss.—The Pascagoula Street Railway & Power Company has asked the Council for a twenty-five-year extension of time on its franchise in Pascagoula.

Red Lodge, Mont.—The Red Lodge Electric Railway has received a franchise from the Council in Red Lodge. The company will ask the Council in Bearcreek for a franchise in Bearcreek. This is part of a plan to build a line to connect Red Lodge, Washoe and Bearcreek. C. C. Bowlen, president. [E. R. J., March 14, '14.]

Dobbs Ferry, N. Y.—At the election at Dobbs Ferry on March 17 the electors declared themselves in favor of the repeal of the Burns law, which prohibits the granting of a franchise for an electric line along the Boston Post Road in the villages along the Hudson.

Madison, Wis.—The Chicago & Wisconsin Valley Railroad has asked the State Railroad Commission for permission to build a line from Madison to Janesville.

Milwaukee, Wis.—The Milwaukee Traction Company has asked the Council for a franchise to build a one-mile line over certain streets in Milwaukee. This line will extend from Green Bay Avenue and the Port Washington Road to Evergreen Park. [E. R. J., May 3, '13.]

TRACK AND ROADWAY

Lethbridge (Alta.) Municipal Tramway.—Plans are being considered to extend this company's line to Hardieville during the year.

Little Rock Railway & Electric Company, Little Rock, Ark.—Work will be begun at once by this company relaying its track on East Markham Street between Main Street and Commerce Street in Little Rock.

***Blythe, Cal.**—An electric railway through the Parker Indian Reservation, the survey for which is now being made, will soon be built. The line will run from Parker, Ariz., to Ehrenberg, with possible extensions into Palo Verde Valley and Cibola Valley.

Marin County Electric Railway, Mill Valley, Cal.—This company has filed an amended application with the Railroad Commission asking for authority to issue $75,000 in stock for the purpose of building an electric railway in Mill Valley. It is proposed to run one branch from the Northwestern Pacific depot, in the center of Mill Valley, along Throckmorton Avenue to a point near the Cascade reservation and to extend a second branch from a point near the Northwestern Pacific depot to the high school between Mill Valley and Sausalito. [E. R. J., Feb. 14, '14.]

Oakland, Antioch & Eastern Railway, Oakland, Cal.—This company is asked to consider plans to extend its line into the business center of Oakland.

***San Francisco & Northern Railway, San Francisco, Cal.**—This company is being organized and financed by E. H. Rollins & Company, San Francisco, to succeed the Petaluma & Santa Rosa Railroad and build an electric railway which will afford a direct service between Petaluma and Healdsburg, with a steamer connection at Petaluma for San Francisco.

Georgia Railway & Power Company, Atlanta, Ga.—The Decatur Board of Trade has asked this company to extend its Druid Hills line to Decatur. The line now ends 2 miles from the DeKalb courthouse in Decatur.

Valdosta (Ga.) Street Railway.—Work will be begun at once by this company on the line through the western part of Valdosta.

Alton, Granite & St. Louis Traction Company, Alton Ill.—This company is negotiating for permission to cross the tracks of the Chicago & Alton Railroad and the Chicago, Burlington & Quincy Railroad, so that the electric line may be extended to the site of the proposed asylum east of Alton, Ill.

Kankakee & Urbana Traction Company, Urbana, Ill.—During the year this company plans to build 10 miles of new track between Ludlow and Paxton.

Louisville & Southern Indiana Traction Company, New Albany, Ind.—This company plans the extension of its Jeffersonville lines to Claysburg, a suburb of that town. The board of trustees of Claysburg, which has opposed granting a franchise, is now said to be willing to have the line built.

New Albany & French Lick Valley Traction Company, New Albany, Ind.—Contracts have been awarded by this company for the construction of the line between Greenville and Palmyra. This is part of a plan to build an electric line from New Albany to West Baden Springs and French Lick Springs via Mooreville, Greenville, Palmyra, Hardingsburg and Paoli. John H. Martin, Palmyra, president. [E. R. J., Nov. 22, '13.]

***Tipton, Ind.**—An electric railway will be built between Marion and Tipton, Ind., by E. N. Todd, T. E. Dean and D. G. Dean, Windfall, Ind. Lines from Marion to Hartford City and Logansport, Ind., are also contemplated.

Kansas City, Kaw Valley & Western Electric Railway, Bonner Springs, Kan.—Work will proceed as the result of an agreement reached between this company and the Union Pacific Railway. The electric railway signed a thirty-year lease on the right-of-way, which is claimed by the Union Pacific Railway under old Congressional grants. The Union Pacific Railway by this means protects its rights to the land where similar disputes arise in the future. The injunction secured by the Union Pacific Railway has been dissolved and work on the electric railway will be rushed. J. D. Waters, Bonner Springs, president. [E. R. J., Feb. 14, '14.]

Fort Scott & Pittsburg Railway, Fort Scott, Kan.—Surveys have been completed by this company for its 35-mile line between Fort Scott and Pittsburg, via Garland, Arcadia, Mulberry and Frontenac. It is not yet decided when construction will be begun. A. B. Dickman, Fort Scott, president. [E. R. J., Jan. 3, '14.]

Frontenac, Mulberry & Arcadia Electric Railway, Pittsburg, Kan.—At a stockholders' meeting held at Joplin, Mo., the name of the company was changed from the Frontenac, Mulberry & Arcadia Electric Railway to the Kansas City, Fort Scott, Frontenac & Pittsburg Railway. It was decided to expedite work on the proposed electric line between Frontenac and Fort Scott, Kan. [E. R. J., Feb. 14, '14.]

Louisville & Interurban Railway, Louisville, Ky.—This company is asked to consider plans to extend its Okolona line in Louisville.

Madisonville-Nortonville Light, Power & Traction Company, Madisonville, Ky.—Surveys have been completed by this company for its 11-mile electric railway to connect Madisonville, Victoria, Earlington, Barnsley, Morton's Gap and Nortonville. Contracts for the construction of the line will be awarded during April. [E. R. J., Jan. 10, '14.]

Minnesota Northwestern Electric Railway, Minneapolis, Minn.—Contracts will be awarded by this company on Apr. 1 for grading, track-laying and surfacing the first 20-mile section of its line to connect Thief River Falls, Germantown, North Silverton, Cloverleaf and Goodridge. H. W. Protzeller, general manager. [E. R. J., Nov. 1, '13.]

Twin City Rapid Transit Company, Minneapolis, Minn.—Work will be begun soon by this company on the construction of six extensions and a crosstown line in Minneapolis.

Frontier Electric Railway, Niagara Falls, N. Y.—Plans are being made by this company to begin work at once on its line between Niagara Falls and Buffalo. It is understood that the section between the Buffalo city line and North Tonawanda will be completed first. James S. Simmons, Niagara Falls, vice-president. [E. R. J., Feb. 28, '14.]

Black River Traction Company, Watertown, N. Y.—Plans are being considered by this company to build an extension on Washington Street in Watertown.

Piedmont & Northern Railway, Charlotte, N. C.—Plans are being considered by this company to extend its lines to High Point, Greensboro and Winston-Salem.

Cincinnati, Indiana & Louisville Railway, Cincinnati, Ohio.—Preliminary arrangements are being made by this company to begin work this summer on its 85-mile steam and gasoline-electric railroad to connect Cincinnati, Lawrenceburg, Aurora, Rising Sun, Detroit, Patriot, Vevay and Madison. L. S. Cook, Madison, is interested.

Chardon, Jefferson & Meadville Interurban Railroad, Cleveland, Ohio.—This company advises that it has as yet made no definite plans when work will be begun on its 30-mile line to connect Chardon, Hampton, Fontville, Rock Creek and Jefferson, Ohio, and Linesville, Pa. C. H. Felton, 735 Williamson Building, Cleveland, secretary. [E. R. J., Feb. 21, '14.]

Cleveland-Pennsylvania Interurban Railway, Cleveland, Ohio.—Contracts will be awarded and construction will be begun by this company within the next six weeks to build 23 miles of single track and 29 miles of double track between Cleveland and Sharon. A contract for 150,000 ties has been let. The power house will be located at Kinsman and the repair shops at Mesopotamia. It is planned to operate ten gasoline-electric cars. Capital stock, authorized, $50,000, to be increased to $2,000,000. Bonds, authorized, $2,000,000. Officers: E. C. Ashley, Cleveland, president; H. P. Smith, Cleveland, vice-president; John Lindy, Cleveland, treasurer; Harlan Sperry, Middlefield, superintendent, and F. B. Morgan, Cleveland, general manager, purchasing agent and chief engineer. [E. R. J., Feb. 28, '14.]

Goderich, Ont.—At a meeting of the Town Council and Board of Trade on March 11 the importance of the Hydro-Electric Radial Railway was recognized. The whole council, with five members of the Board of Trade, will attend a meeting of municipal representatives to be held

shortly to urge the building of a line from Goderich to Exeter and St. Mary's, with a connection to London, Ont.

*London, Ont.—It is understood that a charter will be applied for, by private interests, to build an electric line from London to Grand Bend to Stratford. It is also said that the ultimate plans include Woodstock, Guelph, Galt, Toronto and St. Catharines. This line would cover much the same territory as some of the lines projected by the municipalities and to be built by the Hydro-Electric Power Commission of Ontario.

Ottawa, Rideau Lakes & Kingston Railway, Ottawa, Ont.—The Ontario Legislature is being asked for an extension of time to build this projected railway from Ottawa to Kingston, Ont. G. L. Dickinson, Ottawa, secretary.

Toronto & Hamilton Railway, Toronto, Ont.—This company, which received its charter in 1903 with a capitalization of $500,000 to build an electric line from Toronto to Hamilton, has had its plans revived. It had power to enter into agreements for running rights or to lease or acquire other electric railways.

Hershey (Pa.) Transit Company.—Plans are being made to soon award contract to build its line between Elizabethtown and Hershey.

Montreal (Que.) Tramways.—Plans for an expenditure of about $2,000,000 during the present year, on improvements of its lines, are being prepared by this company. Among the improvements will be several extensions, double-tracking and the reconstruction with heavier rails of some of its lines in Montreal.

Northwestern Electric Railway, Easley, S. C.—This company advises that it has not yet decided when work will be begun on its line to connect Easley, Augusta, Anderson, Abbeville, McCormick and Edgefield. Capital stock authorized, $1,000,000, with the privilege to increase it to $2,000,000. James E. Leach, Easley, is interested. [E. R. J., Feb. 14, '14.]

Jackson Railway & Light Company, Jackson, Tenn.—Work has been begun grading and track-laying for the 2-mile extension from the present terminus on Main Street in Jackson to the Country Club.

Maryville-Knoxville Railway, Knoxville, Tenn.—Grading has been begun by this company on its line to connect Maryville, Rockford, Little Rock, Vestal and Knoxville. Arrangements have been made to connect this line with that of the Knoxville Railway & Light Company at Vestal. John M. Clark, Barryville, secretary. [E. R. J., Jan. 24, '14.]

Eastern Texas Traction Company, Dallas, Tex.—Work has been begun by this company on its line between Greenville and Dallas. J. W. Crotty, general manager. [E. R. J., Jan. 31, '14.]

Dallas Southwestern Traction Company, Dallas, Tex.—Preliminary plans for the construction of this railway from Dallas to Cleburne and Glen Rose are being made by this company, E. P. Turner, Dallas, president. [E. R. J., March 14, '14.]

Northern Texas Traction Company, Fort Worth, Tex.—Ties and rails are being purchased by this company preparatory to double-tracking its line through Arlington and on to Grand Prairie, when the paving of Abram Street is begun in Arlington.

Utah Light & Railway Company, Salt Lake City, Utah.—Material has been ordered by this company for the construction of 13 miles of electric railway, overhead and track, to cover the 5-mile proposed northern extension to Farmington, the 1-mile extension south on Seventh East Street, and the 5 miles from Holliday to the lower power house at the mouth of Big Cottonwood canyon, leaving the extra amount for sidings and connections.

Blaine-Lynden Electric Railway, Blaine, Wash.—This company, the incorporation of which is noted elsewhere in this issue, is securing the right-of-way for its line to connect Blaine and Lynden. John J. Pinckney, Blaine, president. [E. R. J., Feb. 21, '14.]

Wisconsin Electric Railway, Oshkosh, Wis.—Preliminary surveys are being made by this company for its line between Madison and Oshkosh.

SHOPS AND BUILDINGS

San Francisco-Oakland Terminal Railways, Oakland, Cal.—This company is making plans to build a three-story office at Twenty-second Street and Grove Street in Oakland.

Boston & Worcester Street Railway, Boston, Mass.—Plans are being considered by this company to build a new freight and express depot in Marlboro.

St. John (N. B.) Railway.—Plans for the construction of a new carhouse on Wentworth Street in St. John are being made by this company.

Cleveland (Ohio) Railway.—Plans are being prepared by this company to build stations similar to the one at St. Clair and 129th Street in Cleveland. The stations are to be located at Superior Avenue and East 123d Street, Harvard Avenue and East Forty-sixth Street, and Kinsman Road and East 105th Street, Cleveland. The first two will cost about $50,000 each, and the latter $30,000. They will be two stories high and the construction will be of brick and concrete. Morrow & Cross are the architects.

Montreal (Que.) Tramways.—Along the improvements planned by this company during the present year will be the construction of two new carhouses in Montreal.

POWER HOUSES AND SUBSTATIONS

Alexandria (La.) Electric Railway.—This company has entered into an agreement with the Bayou Rapides Lumber Company, whereby the railway company will move its power plant to the plant of the sawmill company, and the sawmill company is to furnish fuel to run the plant. The old power house in Thorn Street will be used as a carhouse.

Cumberland (Md.) Electric Railway.—Plans are being considered by this company to build a new power plant on a plot of ground of about six acres, just west of Cumberland, recently purchased by this company and the Edison Electric Light Company.

Holyoke (Mass.) Street Railway.—Plans are being made by this company to spend $100,000 for additional equipment for its power plant in Holyoke. Contracts for part of the work have already been awarded. Within a few days, it is expected, the contracts for the remainder of the work will be awarded. The plans call for the installation of a new generator, engine, boilers and automatic stokers for the whole battery of boilers in operation at the plant. The contract for the generator has been awarded to the General Electric Company, and the engine will be furnished by the Rice & Sargeant Engine Company, Providence, R. I. The present plant develops 4000 hp, and the new unit will increase the development to 6000 hp.

Public Service Railway, Newark, N. J.—This company has ordered from the General Electric Company one 1500-kw rotary converter outfit for its Hoboken substation, one 1000-kw rotary converter for its Camden substation, and five 500-kw converters for several other substations. The above orders include accessory transformer and switchboard apparatus, feeder regulators and lighting transformers. Other sundry equipment for forty-four substations has been ordered. This company expects to purchase shortly two 20,000-kw turbo-generators for instalment in the new Newark power station.

Piedmont & Northern Railway, Charlotte, N. C.—This company has placed in operation its new power plant in Burlington.

Porto Rico Railway, Light & Power Company, San Juan, Porto Rico.—This company has recently ordered, through its purchasing agent, the Electrical Engineering & Purchasing Company, New York, N. Y., some power station equipment for its new hydroelectric plant at the Comerio Dam in Porto Rico. This equipment, which will be shipped in about a month, includes one Westinghouse 2000-kva a.c. generator, two 2000-kva three-phase transformers, one 25-kw motor-driven exciter set, one battery-charging generator, one fourteen-panel switchboard and turbine equipment.

Utah Light & Railway Company, Salt Lake City, Utah.—Plans are being made by this company to build a new power house at Farmington. An additional motor-generator will be installed at the Cottonwood plant.

Manufactures and Supplies

ROLLING STOCK

Harrisburg (Pa.) Railways is contemplating the purchase of new cars.

Springfield (Ill.) Traction Company is reported to be considering the purchase of new cars.

Jefferson Traction Company, Punxsutawney, Pa., expects to purchase one combination double-truck car.

Kankakee & Urbana Traction Company, Urbana, Ill., expects to purchase one baggage and freight car.

Corning & Painted Post Street Railway, Corning, N. Y., expects to purchase about four second-hand cars.

Third Avenue Railway, New York, has ordered from The J. G. Brill Company a sample care equipped with Radiax trucks.

Havana Electric Railway, Light & Power Company, Havana, Cuba, is building about fifty passenger cars in its own shops.

Manhattan & Queens Traction Corporation, New York, N. Y., has ordered through MacArthur Brothers, contractors, one sprinkler from The J. G. Brill Company.

Morris County Traction Company, Morristown, N. J., has ordered through W. R. Kershner ten 36-ft. all-steel interurban car bodies from the Cincinnati Car Company.

Montreal (Que.) Tramways is preparing a budget calling for an expenditure of about $2,000,000, part of which amount will be used for the purchase of 100 new double-truck cars.

Wilkes-Barre Railway Company, Wilkes-Barre, Pa., is having plans submitted for ten center-entrance cars, which it expects to purchase within the next week or ten days.

New York, Auburn & Lansing Railroad, Ithaca, N. Y., has ordered two 70-ft. motor cars from the McKeen Motor Car Company, to be operated supplementing the present steam service between Ithaca and Auburn.

Lehigh Valley Transit Company, Allentown, Pa., is completing in its own shops one 50-ft. arched roof special parlor car, which is equipped with a kitchen and a smoking compartment. Automatic ventilators are specified.

Arkansas & Northwestern Railroad, St. Louis, Mo., a steam road, has ordered one storage-battery car from The J. G. Brill Company. Storage-battery equipment will be supplied by the Railway Storage Battery Car Company.

Southern Illinois & St. Louis Railway, Harrisburg, Ill., expects to be in the market in the near future for six 60-ft. motor passenger cars, three 60-ft. trail cars, three 50-ft. motor cars, two 50-ft. express trail cars, two 60-ton locomotives, twenty box cars and twenty flat cars.

Long Island Railroad, New York, N. Y., has ordered two 32-ft. 7-in. double-truck storage battery cars from The J. G. Brill Company for train operation on the New York Bay extension between Valley Stream and Mineola. One car will be straight passenger and one combination passenger and baggage. The cars will be equipped with Railway Storage Battery Car Company storage battery equipments, Westinghouse control and motors and Westinghouse air brakes.

Schenectady (N. Y.) Railway has been recommended by the Public Service Commission of the Second District of New York to add to its equipment as soon as possible eight new closed motor cars and ten large trail cars. The commission has also recommended that the company withdraw from service all of the forty single-truck cars and replace them with cars with a seating capacity of not less than forty by the purchase of new cars or the reconstruction of old ones. The withdrawal and replacement of this equipment is to be completed not later than Nov. 1, 1914.

Utah Light & Railway Company, Salt Lake City, Utah, noted in the ELECTRIC RAILWAY JOURNAL of Feb. 14, 1914, as having ordered twenty-four semi-steel closed cars from The J. G. Brill Company, has specified the following details for this equipment:

Seating capacity.....56
Weight of car body..23,500 lb.
Bolster centers, length, 24 ft. 2 in.
Length of body.....36 ft.
Length over vestibule..50 ft.
Width over sills.....8 ft. 4 in.
Width over all.....8 ft. 7 in.
Height, rail to sills, 2 ft. 10 9-16 in.
Height, sill to trolley base, 8 ft. 10 11-16 in.
Body .....composite
Interior trim.....cherry
Headlining .....Agasote
Roof.....plain arch
Underframe .....metal
Air brakes.....Westinghouse
Axles.....heat treated
Bumpers.....angle iron
Cables .....Westinghouse
Car trimmings.....bronze
Control.....West., 18 cars, K-28-B; 6 cars, HL
Curtain fixtures..Cur. Sup. Co.
Curtain material..Pantasote
Destination signs, Elec. Serv. Sup. Co.
Fenders, Hunter Car Sign Co.
Gongs.....Brill dedenda
Hand brakes.....Dayton
Heaters .....Consol.
Headlights.18 cars, Esterline "Golden Glow"; 6 cars, Gen. Elec. D-15
Motors...West., outside-hung
Registers .....Sterling
Sanders.....ry. design
Sash fixtures..O. M. Edwards
Seats.....Hale & Kil.
Seating material.....rattan
Trolley catchers, Trolley Supply Co.
Trolley base..Ohio Brass Co.
Trucks, type..Brill 27, GE 1 and Standard Truck Co. O-50
Ventilators...Ry. Utility Co.
Wheels.....rolled steel
Special devices, etc., Hedley anti-climber, Elec. Serv. Sup. Co.'s automotoneers

TRADE NOTES

Union Switch & Signal Company, Swissvale, Pa., has appointed Sidney G. Johnson as vice-president. Mr. Johnson was formerly general sales manager of the company.

Van Dorn & Dutton Company, Cleveland, Ohio, has opened a district sales office at 50 Church Street, New York, N. Y., in charge of M. P. Fillingham, district sales manager.

Mitsui & Co., Ltd., New York, N. Y., exporters, have recently exported 114 light signals, manufactured by the Union Switch & Signal Company, for installation on the Keihan Electric Railway, Japan.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will hold a meeting of its directors on March 25 at which consolidation with the Westinghouse Machine Company will be considered.

Pyrene Manufacturing Company, New York, N. Y., has received recent orders for extinguishers from the Morris County Traction Company, Albany Southern Railroad and New York, New Haven & Hartford Railroad.

Siemund Wenzel Electric Welding Company, New York, N. Y., has appointed George Hills as general sales agent, with headquarters at 30 Church Street. Mr. Hills recently resigned as president of the Welding Materials Company, New York, N. Y.

Great Western Smelting & Refining Company, St. Louis, Mo., has appointed J. B. Mendenhall, formerly with the National Lead Company, St. Louis, Mo., to a position in which he will handle a line of metals and materials similar to those he handled in his former position.

Railway Storage Battery Car Company, New York, N. Y., has been organized at 30 Broad Street. The new officers are well known in the railway field and are prepared to take orders for storage battery cars, having been given exclusive license under the Thomas A. Edison patents for the use of Edison batteries for electric car service.

Westinghouse, Church, Kerr & Company, New York, N. Y., have been retained by the Canadian Pacific Railway as engineers to investigate the matter of the proposed electrification of the new double-track, 5½-mile Selkirk Tunnel in British Columbia. The investigations will cover in general the type of system to be installed, the relative economies of steam and water power and the effect of the electrification upon operating conditions.

McGuire-Cummings Manufacturing Company, Chicago, Ill., has elected Calvin T. Biddison as vice-president. Mr. Biddison has been an employee of that company, serving in various positions, for the past twenty-five years, being advanced to the position of vice-president from that of general superintendent of the company. John T. Giblin, who has served in various positions for the past ten years, has been advanced from the position of purchasing agent to that of secretary of the company.

Esterline Company, Indianapolis, Ind., manufacturer of curve drawing instruments, has recently opened the following additional branch offices: F. C. Morton, Walker Bank

Building, Salt Lake City, Utah; G. W. Pieksen, Room D-19, Railway Exchange Building, St. Louis, Mo.; J. S. Black, 908 Hennen Building, New Orleans, La.; W. W. Geisse Company, McKnight Building, Minneapolis, Minn.; General Supplies, Ltd., 122 Eleventh Avenue, West Calgary, Alta.; G. L. Priest, 229 Sherlock Building, Portland, Ore. The above offices are equipped with an expert engineering staff, full set of samples, together with all information necessary for promptly taking care of any questions that may arise in connection with the sale or use of graphic instruments.

Clark Electric & Manufacturing Company, New York, N. Y., has received an order from the Chile Exploration Company, New York, N. Y., for a large quantity of seamless splicing sleeves to be used on the latter company's copper transmission and steel ground lines in South America. Last week, at the New York testing laboratories, a ⅜-in. Siemens-Martin steel cable, twisted into a standard seamless tinned copper splicing sleeve, broke outside of the sleeve before pulling out from it and developed approximately 99 per cent of its ultimate tensile strength. No. 000 stranded copper conductor developed practically its full 100 per cent ultimate tensile strength. Another large shipment of sleeves will be made to the Ebro Irrigation & Power Company in Spain on order from the Pearson Engineering Corporation, New York, in the near future. Recent orders have been received from the Connecticut River Transmission Company, Eastern Pennsylvania Railways Company and American Gas Company for overhead protective clamping sets for use at railroad right-of-way, telephone crossings, etc.

ADVERTISING LITERATURE

National Scale Company, Chicopee Falls, Mass., has issued a folder describing its counting machines and elevating trucks.

Monarch Refillable Fuse Company, Buffalo, N. Y., has issued Bulletin No. 20 describing its ferrule and knife blade contact type refillable fuses.

McGill Manufacturing Company, Valparaiso, Ind., has issued a catalog listing its complete line of lamp guards, portables and other electrical specialties.

Esterline Company, Indianapolis, Ind., has issued a folder containing letters referring to the order for 240 Golden Glow headlights recently placed by the San Antonio Traction Company.

Lamb Railway Service Company, Cincinnati, Ohio, has issued a catalog describing its weed burners and burners for melting snow and ice from railroad switches, interlocking devices and tracks.

Hess-Bright Manufacturing Company, Philadelphia, Pa., has issued a number of advertising sheets describing its ball-bearing mountings for vertical armature shafts of electric motors and for various other kinds of shafts.

National Tube Company, Pittsburgh, Pa., has issued Bulletin No. 11B, describing in a comprehensive and carefully compiled manner the history, characteristics and advantages of its pipe. The superiority of its quality over wrought-iron pipe is shown by illustrations of comparative tests of corrosibility, tensile strength, ductility and bursting pressure.

National Malleable Castings Company, Cleveland, Ohio, has issued Circular No. 51, describing and illustrating a few of the various designs of its rail braces and tie plates. Attention is drawn to the better rust-resisting quality of malleable iron than steel, which is invaluable for track fastenings, both because of the effect of atmospheric conditions and more especially from the brine drippings from refrigerator cars. Circular No. 65 describes safety brake levers. Circular No. 66 describes the safety clevis and pin for uncoupling rods.

Fonger Fender Company, Chicago, Ill., has issued a catalog describing and illustrating its tip-tilting automatic fenders. The fender is so hung on the car that its position may be governed from the platform by the motorman. Gravity with slight assistance swings the fender under the car or projects it within a fraction of a second. On encountering a person a tip-tilting or overturnable shield mounted on the front of the fender automatically and instantly tips backward and overturns to the street, thereby forming a scoop. The result of this operation is to trip up the person struck and land him safely on the fender screen without allowing any part of his body to become wedged beneath the fender.

Link-Belt Company, Chicago, Ill., has issued a link-belt data book No. 125 on silent chain drives. Besides giving complete engineering information on silent chain driving in simple and compact form, the book describes many uses of silent chain for the efficient transmission of power and gives specific reasons and illustrations showing application in a large variety of uses. This chain is a series of links connected by joints which consist of segmental case-hardened bushings and case-hardened steel pins. The chain is as flexible as a leather belt and as positive as a gear. Its rated efficiency is 98.2 per cent on actual test. It will transmit any amount of power quietly. Over 200,000 installations were drawn upon for the information contained in the book, which is the only work of its kind and consists of 112 pages, bound in flexible red cover.

Hunter Illuminated Car Sign Company, Flushing, N. Y., has issued a folder containing illustrations of the instalment of its car signs on one of the 175 New York Railways stepless cars and on a Boston Elevated Railway car, an order for which company is now being executed specifying 12,000 signs on 3000 cars. Other large orders are now being acted on for the Third Avenue Railway, Public Service Railway, Connecticut Company, Philadelphia Rapid Transit Company, International Railway, Pittsburgh Railways, Winnipeg Electric Railway, Bay State Street Railway, Rio Janeiro Tramways, Pernambuco Tramways, United Railways & Electric Company, Virginia Railway & Power Company, Washington Railway & Electric Company, Montreal Tramways, Portland Railway, Light & Power Company, Los Angeles Railway, Chicago City Railway, Chicago Railways, San Francisco Municipal Railway, Detroit United Railway, and Memphis Street Railway.

General Railway Signal Company, Rochester, N. Y., has issued Bulletin No. 106-A, describing its Model 1B lightning arrester. This arrester is the same in principle as the Model 1A arrester, but embodies several improved features in the construction and arrangement of the ground and line plates. Bulletin No. 130 describes EZ motion plate rail clips. This appliance provides a firm and substantial support for the detector bar, eliminating lost motion and reducing wear. There are two types of this rail clip, the web bolt type and hook bolt type. The former is bolted to the web of the rail and the latter to the flange of the rail. Five types of motion plates are furnished to provide for the various conditions of throw. Bulletin No. 115-C describes Model 2A signal with illustrations of the signals in service on several railways. Pamphlet 2019 (pocket size) also describes this signal, with the addition of instructions relative to its installation, maintenance and operation; diagrams showing dimensions and clearances of the high and dwarf signal mechanisms; diagrams showing R. S. A. standard foundations, signal masts, semaphore spectacles, signal blades and torque curves, and a number of typical circuit diagrams for interlocking a.c. and d.c. block signaling.

General Electric Company, Schenectady, N. Y., has issued Bulletin No. 45,601, describing its aluminum lightning arresters for alternating-current circuits and choke coils and other connections for use with them. The important features in electrolytic lightning arrester design and embodied first in G-E arresters are as follows: oil as a heat-absorbing and insulating medium, insulating barriers between cone stacks and tank, iron pipe work throughout for horn gap structure, charging contacts, charging resistances, transfer switch for interchanging cone stacks for charging, handwheel for operating transfer switch, steel tanks, rim separators for cones, and grounded tank on very high voltages. Bulletin No. 45,600 describes aluminum lightning arresters for use in connection with railway signal circuits. Bulletin No. 44,590 describes Type ML governor for motor-driven air compressors. The function of this governor is to automatically control the operation of either stationary or railway motor-driven air compressors in order to maintain air pressure in a storage reservoir between predetermined limits. Bulletin No. 47,400 describes Type F, Form K12, oil switches, for use on circuits not exceeding 22,000 volts. Bulletin No. A4200 describes strain insulators and strain clamps suitable for insulating and supporting power house wiring and overhead distributing cables and wires.