ANNUAL MAINTENANCE NUMBER

Electric Railway Journal

Published by the McGraw Publishing Company, Inc.
Consolidation of STREET RAILWAY JOURNAL AND ELECTRIC RAILWAY REVIEW

Vol. XLVII NEW YORK SATURDAY, MARCH 18, 1916 No. 12

SCARCITY OF TRACK LABOR

Track labor efficiency must of necessity receive more attention in this year's construction and maintenance programs than ever before. The colossal struggle in Europe has depleted the ranks of the American army of common laborers, and since these losses cannot be replaced entirely, in so far as cheap track labor is concerned, greater efficiency and an increased number of labor-saving tools appear to afford the only solution of the problem. Added to these difficulties is the fact that the wages paid for ordinary labor in this country have been greatly increased, particularly for that class of labor capable of assisting in the manufacture of munitions and other war materials. This has had a demoralizing effect on other industries to say the least, and when construction work opens this spring the indications are that the labor situation will be as critical as the delivery of some classes of materials. While this is a very satisfactory condition for labor, it presents a prospect for those requiring labor which will be difficult to surmount. Not only will increased efficiency and a reliance on more labor-saving tools be necessary, but it will be difficult to hold the labor obtained if competition is keen. Under these conditions it is perhaps fortunate that the policy of retrenchment, particularly in track construction and maintenance, effective during the past few years has forced the way departments to increase their efficiency and look with greater favor upon labor-saving tools.

ORGANIZATION OF TRACK GANGS

In an effort to push construction work, the sizes of the gangs are too frequently increased to a point where it is practically impossible to obtain a day's work from every man. A careful study of construction organization, with particular reference to the sizes of the various units going to make it up and the amount of supervision they require, is certain to produce good results. The trite saying that "too many cooks spoil the broth" applies to track work as well as it does to culinary operations. Greater efficiency may generally be had with small gangs than with large ones, due largely to the fact that they have better supervision. But if the same attention should be given to supervising a large force, there is absolutely no reason why the amount of work per unit should not be the same. Some men are born leaders, and they are endowed with the ability of obtaining the maximum amount of work out of a force of any size. It is apparent, therefore, that a careful study of the qualifications of the men in charge of construction forces is of utmost importance. In this day and age it is not the "driver" who is needed, but the leader who can maintain the proper *esprit de corps* within his organization. If the greater use of machinery this year means a larger outlay for tools than has been necessary heretofore, it is well then to become reconciled to the fact immediately. Otherwise, those who fail to recognize existing conditions will doubtless be delayed in supplanting a shortage of labor with labor-saving equipment, because prompt deliveries will be out of the question in the height of the construction season.

DETROIT TUNNEL MAINTENANCE

In many respects the Detroit tunnel electrification, whose maintenance practices are described elsewhere in this issue, is a remarkable installation. Its success has been notable, notwithstanding its handicap of small size and the extraordinary severity of the operating conditions involved by the transfer service making up its traffic. An operating record of 26,000 miles per locomotive failure is an evidence of that fact, and this very satisfactory figure is accompanied by a maintenance cost that is regularly close to 5 cents per locomotive mile in spite of the low mileage of individual engines, only about 50 miles per day. The most prominent feature of the repair method, perhaps, is that the engines are never overhauled. It is true that they are given what is locally known as an overhauling about once each year, but this is really nothing more than a glorified inspection, since none of the engines has ever been completely dismantled. This practice, which is the same as that followed on the eminently successful New York Central electrification, may possibly be called the radical feature of difference between the maintenance of steam and electric locomotives. Of its soundness there can be no question, because after five years of operation the characteristic that is most in evidence about the Detroit installation is the lack of necessity for special performance records of the various parts of the equipment, maintenance of the control, for example, involving the

replacement of only six contact tips and six arc chutes during the five years' life of the installation. "Happy is the nation that has no history."

Cost of Urban Transportation

THE monograph on the "Cost of Urban Transportation Service," compiled under the direction of F. W. Doolittle by the Bureau of Fare Research and just now issued by the American Electric Railway Association, constitutes the best authority in book form dealing with the economics of electric railway transportation. In about a year and a half of assiduous effort the bureau has completed a work that covers broadly yet concretely the entire subject of the relation between the elements of cost and the elements of service in electric railway transportation. A great deal of the detailed data contained therein will not be new to electric railway operators, but the ensemble is new and as such should be of inestimable value to both railways and the public. To railway operators the book will serve as an encyclopedic summary of data, practices and theories that have heretofore existed in a very scattered form, while to the public, and to semi-public bodies like public service commissions, it will be an invaluable source of cost and service information, and one which cannot fail, if properly studied, to do much toward clearing up popular misunderstandings in regard to the financial results of electric railway operation under present conditions.

The book is too comprehensive in its scope to admit of any general digest by this journal, but we recommend that the officials of each member company thoroughly study the copy to be sent by the association. In the last decade, with ever-increasing force, electric railway operators have been confronted with the fact that their companies are failing in the selling price of their commodity to meet the cost of production, this failure being due largely to causes beyond their control, chief among which is the inadequacy of the rate of fare, fixed by legal restraints or by custom, to pay for the service rendered. The public, suspicious of corporate financing and operation, has belittled individual pleas for relief from this condition, but the time has come when public authorities must be made fully to understand this present fundamental tendency in utility operation if the electric railways are to receive their due share in the general prosperity of the country.

It has not been so long since the early days of the industry that the popular mind has been thoroughly disabused of the idea that electric railways are bonanzas. As a matter of fact, with an increasing investment per dollar of gross earnings upon which to pay an attractive return, the charge for service has remained practically the same, with the purchasing power of money depreciating, transfer privileges being made more liberal and service standards becoming more severe. Mr. Doolittle has ably compiled all available information on these points. It is now the duty and the privilege of the association and all its members persistently to spread the information in an intelligible and attractive form before the public.

Autogenous Welding in the Shop

THE importance of the relatively new practice of autogenous welding in electric railway repair shops can hardly be overestimated. The major reason for this is, of course, the fact that much of repair-shop work consists in the restoration of broken parts, which in many cases can be replaced only after much dismantling is done and generally involve enough machine work to give each piece considerable value. For such work autogenous welding appears at its best, in some cases even permitting the welding together of broken parts without their removal from the car. Of late, also, there appears to be a tendency to use it for building up metal upon worn parts, and here the welding process is a realization of the "putting-on tool" for which green apprentice boys were sent when they had spoiled a piece of machine work by making too deep a cut.

On another page of this issue appears an article descriptive of a number of more or less unusual jobs done by oxy-acetylene welding, and the list indicates the extraordinary variety of uses to which this process may be put. It may seem strange that oxy-acetylene apparatus should find a place in an electric railway repair shop where direct current for an electric arc is always available at a comparatively low price. Yet there are definite reasons for this paradox. The primary one appears to be the delicacy that is an inherent feature of the oxy-acetylene flame, which can be made to work in places where the rather bulky electrode of the arc-welding process would cover the whole job and prevent any possibility of the operator's seeing how the work was progressing. However, for heavy work, the arc welder is very popular, and, as a matter of fact, many electric railways use both the arc and the oxy-acetylene flame in their repair shops, dividing the work between the two in accordance with their individual advantages.

Of course, heavy work can be done with oxy-acetylene if desired, so that the basis for comparison between the two seems to come down to the question of cost. Since the electric-arc welder uses current only when an arc is actually struck, the draft of current for an arc such as is used for light work, which is of the order of 100 amp., does not last continuously. Instead the average draft of current over any extended period of time is more likely to be about 50 amp., which at ½ cent per kilowatt-hour would involve a cost of about 15 cents per hour for current. For the oxy-acetylene flame, the cost per hour is of the order of, say, 40 cents with the smaller tips used in light work, and although this is nearly three times the expense involved with electric light the actual expenditure is really immaterial in view of the amount of work that may be accomplished.

For heavy work, however, the large sizes of tips for the oxy-acetylene process must be used, and with these the cost per hour appears to run to, say, $1. With the electric arc, even on the heavier jobs, the average draft of current seems to be seldom beyond 100 amp., and the cost per hour should hardly exceed 30 cents. Here the matter of cost difference is an appreciable one and, besides, in the large jobs the matter of rapidity with

which the work can be done is of real importance. Here the electric arc seems to have somewhat the best of it, just as the oxy-acetylene flame is superior for small work.

In repair shops, of course, the electric arc is not really a portable outfit, and it must be used in a space that is partitioned off from the rest of the shop, not only because of the danger to the eyes of those who may look at the flame, but also because of the fact that it can be used only in those parts of the shop where overhead wires give a supply of current or where special wiring with the proper receptacles is installed. On the other hand, the oxy-acetylene apparatus is completely self-contained and lends itself readily to use as a portable tool, one especially handy scheme being that used in the shops of the New York Railways, where a sheet-iron cabinet 24 in. square and 5 ft. high has been equipped with wheels and handles so that one man can move it from place to place, a backward list provided in the mounting eliminating any tendency for the tanks to fall out when the door is opened. Such an equipment enables the apparatus to be used anywhere, and this, of course, is one of the most important of the factors which make all forms of autogenous welding so greatly superior to the old methods of the blacksmith shop.

Planning and Efficiency in Shop Work

AN interesting experiment in the way of adopting the principles of scientific management to routine car overhauling and special repair-shop work is described in an article by F. P. Maize in this issue. As the results have amply justified the effort and as the plan has been in operation for two years with increasingly satisfactory results, the description is well worth while. It is especially appropriate in our annual maintenance issue.

At first sight it would not appear that the electric railway maintenance shop affords a fertile field for a planning system. Much of the work is special, and the average layout is more that of a repair shop than a manufacturing establishment. However, overhauling is being done more and more systematically, and such work lends itself well to careful planning. As Mr. Maize shows, even irregular repair work can be taken care of by the plan which he has worked out. The crux of the situation consists in the existence or absence of lost motion in the shop processes. If there is much of it, a systematic planning system will reduce it. The Portland scheme is one such; the same fundamental principles can be applied generally.

As the article in question is read carefully, several points are like to impress the reader. One is that losses in labor and material of considerable magnitude may be exempt from detection by ordinary means. Comparison of detailed maintenance costs with respective costs on other properties are helpful but only in a general way. Analysis of local conditions is necessary also. A second point is that the scientific spirit which produces results in the laboratory is also applicable in prosaic shop work. The root of this spirit is analysis, and its crown is application. Both of these results are illustrated in the present instance.

The advocates of more elaborate schemes of scientific management will probably consider the Portland plan unnecessarily simple and tentative. It appears, however, to be founded on correct principles. Each successive step has been taken as it became necessary, and the results, the conclusion by which every premise and process must be tested, are plainly evident on the credit side of the ledger.

American Association to Conduct Exhibits

THE letter which is being sent by the executive committee of the American Electric Railway Manufacturers' Association to its members this week and which is published under "Association News" elsewhere in this issue, announces a very important change in the purposes and future of that association. It explains that the American Electric Railway Association has decided to take charge of the arrangements for the convention exhibits, entertainments, etc., for the 1916 convention and will appoint a committee for that purpose composed of representatives from railway companies and from manufacturing companies which have joined the parent association under the revised by-laws. Under these circumstances, the Manufacturers' Association, as it exists to-day, has little work to perform, and it is proposed to move the headquarters on May 1 to less expensive quarters and that there will be no necessity for the collection of the usual yearly dues.

We have already positively expressed our opinion that the changes in the constitution of the American Electric Railway Association, adopted at Chicago last month, were desirable and in the interests of the entire industry. They not only eliminate the waste of duplication necessitated by the conduct of two organizations when one will answer the purpose, but they enable the manufacturing companies to act, side by side, with the railway men, in the American Electric Railway Association and participate in its work as well as in its councils. No one will deny that the Manufacturers' Association, as an association, has been of great assistance to the industry in the past, but the time has come for a single association, and for one which can more closely knit together all of the various interests, than was possible under the old plan of organization.

We hope that the plan laid down by the executive committee of the American Electric Railway Manufacturers' Association in its letter to its members will receive general indorsement. It recommends unified endeavor in all branches of the industry and that the members of the Manufacturers' Association should show their willingness to co-operate in the purposes of the American Electric Railway Association by becoming "member companies" in that association. The time for divided councils has passed. There is now only one association representing the interests of the industry, and it should receive the cordial support of all of those manufacturing companies which have previously been members of the Manufacturers' Association.

Maintenance on the Detroit Tunnel Electric Zone

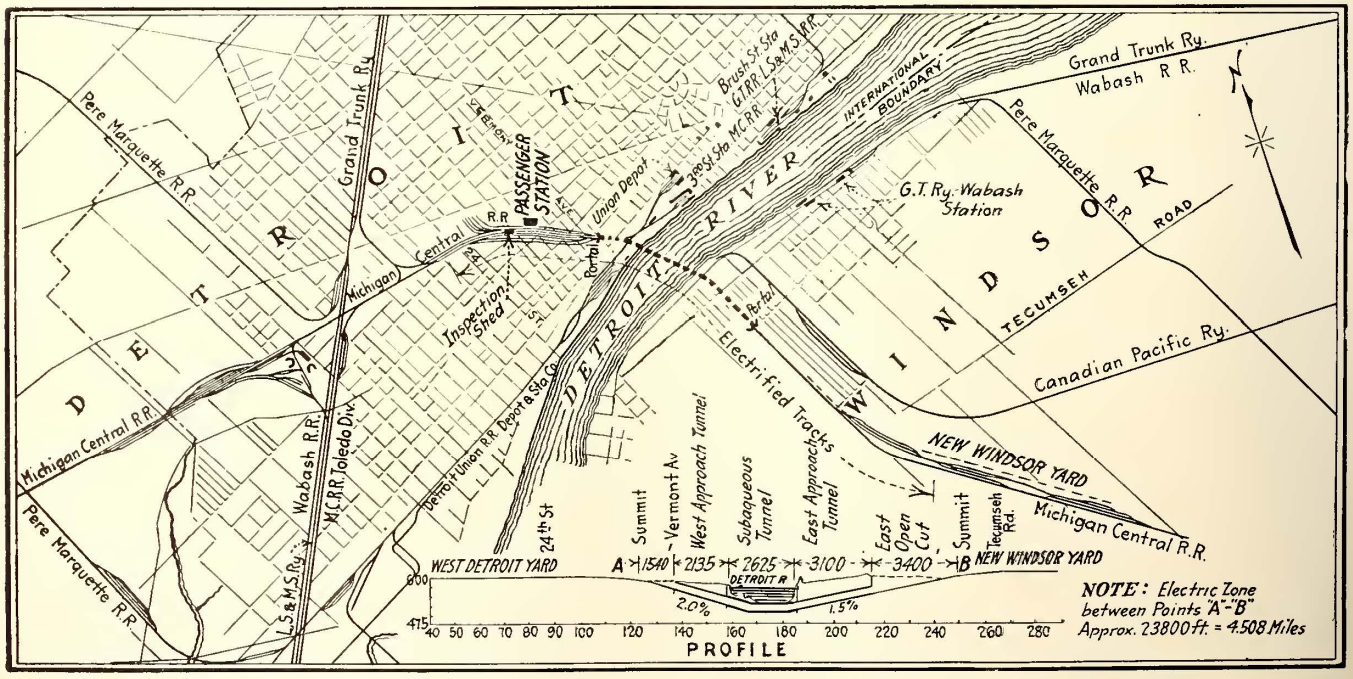
Five Years' Operation of Ten Electric Locomotives and Some 20 Miles of Third-Rail Have Shown Remarkably Successful Results, and an Outline Is Given of the Work and the Methods Involved in the Upkeep of the Installation

IN October, 1910, the Michigan Central Railroad placed in operation the now well-known tunnel between the cities of Detroit, Mich., and Windsor, Canada, for the purpose of eliminating the delays and expenses incident to the operation of car ferries over the Detroit River, and since that date the operations of the electric tractive equipment which was installed have been so remarkably successful that an account of the company's maintenance practices should be of interest. The electrification covers a zone of about 4.5 miles in length, including all of the track between the passenger stations in Detroit and Windsor, these buildings being located near the summits of the tunnel approach grades at either side of the river. Extensions of the electrified track are made beyond these points to provide yard trackage upon which trains may be set out and picked up by the electric locomotives after being made up in the near-by steam-operated classification yards.

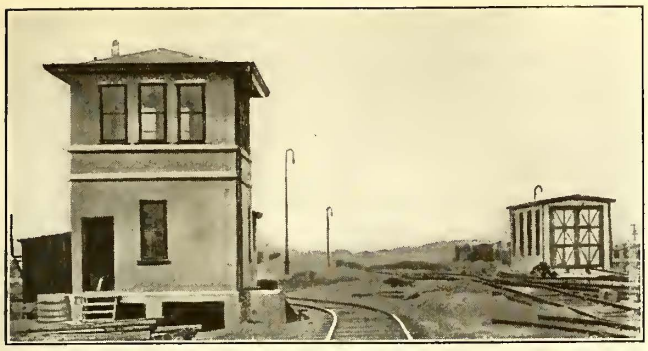
All classes of traffic are handled electrically through the tunnel, and the annual tonnage in both directions approximates 17,000,000, the maximum west-bound freight trains being 2000 tons and the maximum east-bound 2500 tons. The grades for the approach tunnels are 1.5 per cent east-bound and 2 per cent west-bound, three freight engines ordinarily being used on the heaviest freight trains, one at the head end and two behind. Passenger trains are hauled 2.3 miles for each trip and freight trains about 3.6 miles. A certain amount of switching is done in both classes of service—in part by the locomotives that haul the trains through the tunnel—and in consequence the mileage records of the tunnel locomotives are made up with a constructive 4 miles added to the actual mileage made each day. Mileage records for the regular switch engines are based upon the customary rate of 6 m.p.h. All locomotives are so assigned that they are practically pooled, and during the course of a year they operate indiscriminately in the different services. On the above basis the average annual mileage of each locomotive approximates close to 18,500, or somewhat more than 1500 miles per month.

All of the locomotives are of the four-axle, double-truck type with all weight on drivers, and they are designed to use 600-volt direct current collected from an under-running third-rail. Each is equipped with four General Electric motors of 280 hp., and these are geared direct to 48-in. driving wheels with a 4.37 ratio, there being two gears to each axle and a pinion on each end of the armature shaft. The motors have box frames, commutating poles and forced ventilation, which is applied at all times when the engine is in motion. The control is of the Sprague-General Electric multiple-unit type, with two master controllers in the main cab and the contactors in the auxiliary cabs, or housings, at each end of the locomotive. Three running positions for the controller are provided—series, series parallel or parallel.

At the present time ten engines are in service. Six of these are of the 100-ton type described in the ELECTRIC RAILWAY JOURNAL for June 19, 1909, and four are of a similar design but with slightly different details of motor and control construction, and with considerably more ballast, which brings the total weight to 120 tons. This equipment is somewhat more than enough to handle the existing traffic through the tunnel, there



DETROIT TUNNEL MAINTENANCE—PLAN AND PROFILE OF TUNNEL AND APPROACHES



DETROIT TUNNEL MAINTENANCE—SIGNAL TOWER AND EMERGENCY INSPECTION SHED IN WINDSOR YARDS

being regularly in operation five double-crewed engines that work twenty-four hours a day and two that are operated only for one shift daily. Of the remaining engines one serves as a spare to take the place of whichever road locomotive is turned in for regular inspection, and the other two are stand-by machines that can be used during periods of abnormally heavy traffic.

INSPECTION FACILITIES FOR LOCOMOTIVES

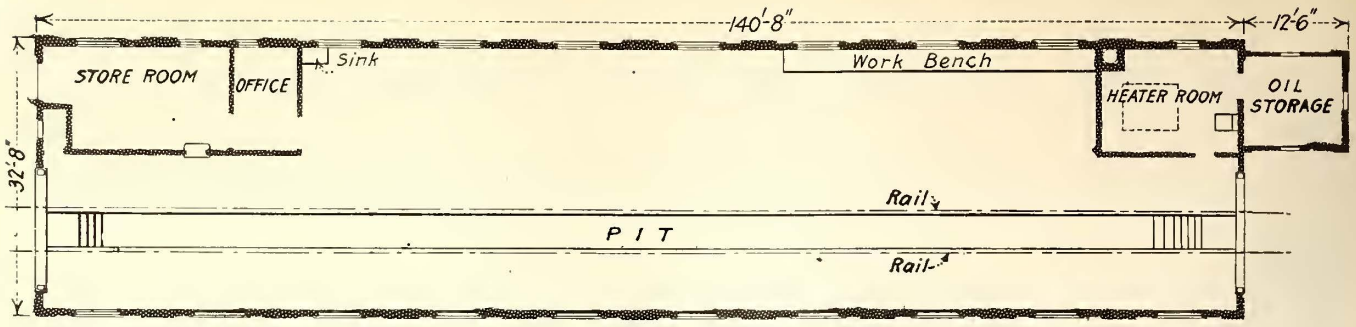
For the inspections, which are given to each engine at ten-day intervals, there is provided a small steel and concrete building in the yard at the Detroit end of the tunnel. This is approximately 140 ft. x 32 ft. in dimensions and it will hold three locomotives comfortably. It has a single longitudinal track along one side. A pit is provided for the whole length of the track, and this, it may be said, was very successfully built upon a gravel fill, which was introduced because suitable foundation material existed only at some distance below the level of the pit bottom. There is no transverse drop pit for wheels, all dismantling work being done from above with the aid of a 25-ton traveling electric crane which has a single trolley. This, it may be said, is capable of lifting the heaviest single piece that has to be handled in stripping the engine, but it is, of course, not capable of lifting the cab off its frame. The latter operation, however, has not yet been required, and when it is the engine will be hauled to one of the steam locomotive repair shops elsewhere on the system.

Along the side of the building opposite the track are work benches and space for storing heavy spare parts, and at one corner of the building is an office and storeroom, the other corner being occupied by another room that contains a small steam plant to heat the shop. An oil storage room is housed in a small addition. No machine tools are installed, as the small amount of machine work that is occasionally required is done in one of the steam locomotive repair shops at another point on the railroad. Neither the third-rail nor any overhead contact structure is extended inside of the inspection building, and engines are moved as required by means of a long, flexible, insulated cable and a contact piece that may be held on the third-rail shoe of a locomotive, this rig being made live by cutting in a hand-throw switch on a slate panel on the wall.

This covers the only facilities that are provided for inspection and repairs, except for a small shed on the Canadian side which is intended only for emergency use and which holds but one engine. It is provided with a pit so that locomotive running gear can be examined or a brakeshoe applied, but it is normally unoccupied. A live rail supported on an overhead structure permits engines to be moved in and out of the building under their own power through contact with either of the two small pantographs which are mounted on either side of the cab roof of each locomotive. It might be said here that the locomotives had originally a single pantograph in the center, but because of the adoption of train sheds at the new passenger station in Detroit which had ventilating openings along the center line of the track the double pantograph arrangement was introduced.

The entire shop force for electric locomotive maintenance is located in the Detroit inspection building and consists of five men. This number includes a machinist-foreman, an electrician, an air-brake specialist and two

DETROIT TUNNEL MAINTENANCE—FREIGHT TRAIN IN WINDSOR YARD



DETROIT TUNNEL MAINTENANCE—PLAN OF INSPECTION SHED AT DETROIT

wipers. No work is done at night, the surplus of equipment permitting overhauling to be carried on in the intervals between the regular ten-day inspections. Overhaulings are made dependent largely upon tire wear, the removal of tires being the heaviest routine job in connection with the locomotive maintenance. They come at intervals of from eight to ten months, and hold the engine for ten or twelve days. The inspections require about ten hours, and the engines are held for this purpose in regular order, being inspected first-in, first-out. After an inspection the engine is assigned to the crew of the next engine due for inspection, and this crew stays on it until its next inspection falls due.

Maintenance Practice and Results

From a maintenance standpoint the installation presents a record that is truly remarkable in view of the small number of locomotives, the grilling service and the low annual mileage per locomotive that is inevitable on account of the short route. The expenditures for locomotive maintenance remain very close to 5 cents per locomotive mile, the change from year to year being practically negligible. Figures for the year 1914 are given in Table I.

Table I—Expenditures in Cents per Engine-Mile for Repairs and Supplies, Detroit Tunnel Locomotives

Repairs to locomotives:		
Labor	2.27	
Material	2.69	
Total		4.96
Engine-house expenses:		
Labor	0.325	
Material	0.16	
Total		0.485
Lubrication		0.165
Other supplies		0.29

The costs shown under the heading "Repairs to locomotives" in Table I include all labor and material required to turn the engines out in good condition after inspections and overhaulings, and also the charges that are made against the electric locomotives for work done for them at the steam locomotive repair shops at other points. The costs appearing in the table under the heading "Engine-house expenses" cover the incidental supplies and the labor involved in the actual inspections.

At these inspections the locomotive is examined thoroughly and such work as is needed is done on the spot by the man who is doing the inspection. Separate inspectors who do no repair work are not employed, nor are the reports of the motorman that last ran the engine depended on for a complete statement of the locomotive's condition. However, the motormen turn in work cards in accordance with the form shown in an accompanying illustration, calling attention to any defects that have been found, and these, of course, receive due consideration by the repair force.

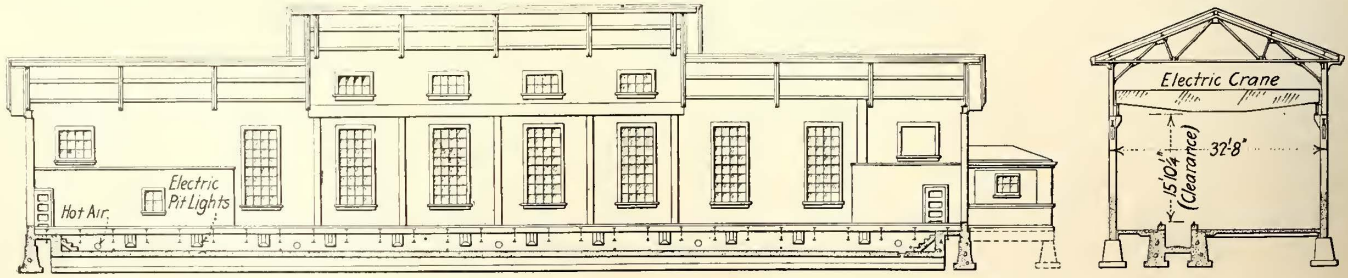
At the overhaulings, which, as before mentioned, are given to the engine whenever it becomes necessary to turn or change its tires, the cab frame is lifted off the trucks and the latter are stripped. All mechanical wear about the running gear is taken up and the motors and control are thoroughly overhauled, the engine being turned out in a condition that is as good as new. As no facilities are provided at Detroit for turning driving wheel tires, the tires, after they are removed from the wheel centers, are sent to the nearest steam locomotive repair shop.

The changing of a set of tires, exclusive of any other overhauling work, holds an engine for about four days, the procedure being somewhat slow on account of the fact that only a single overhead crane is provided. For tire work one end of the cab frame is blocked and the other end is raised while the trucks are run out from underneath. The raised end is then lowered onto blocks and the crane is released for the work of dismantling the trucks, the wheels being removed and set up on the floor so that the tires can be taken off the centers and replaced with new ones.

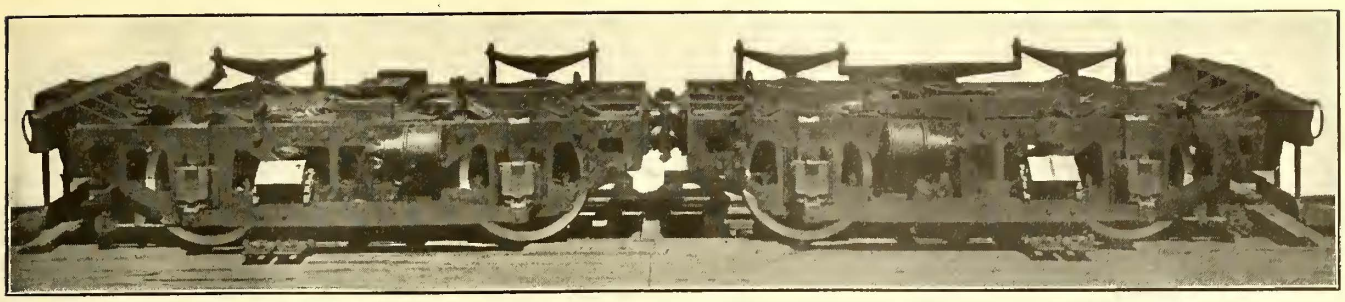
Electrical Repairs

The regular attention that has been devoted to the locomotives has resulted in keeping the details of the equipment in astonishingly good shape, this being especially applicable in the case of the motors, which are taken off the trucks at each overhauling, stripped of their armatures, blown out and thoroughly examined. Before being replaced in service the armatures and fields are painted all over with Sterling black varnish.

At the present time the commutators are in perfect condition and none of them has yet required turning or slotting, the mica having been cut down when the motors were built. Self-lubricating General Electric brushes are used and the life averages about eighteen months, some lasting for two years. They are almost invariably renewed only on account of wear, such break-



DETROIT TUNNEL MAINTENANCE—ELEVATION AND CROSS-SECTION OF INSPECTION SHED



DETROIT TUNNEL MAINTENANCE—SIDE VIEW OF ASSEMBLED TRUCKS AND MOTORS FOR LOCOMOTIVE

age as occurs happening only in cold weather. Only two armatures have given out during the five years that the engines have been in service. One of these got an interior short-circuit which burned out three coils and a pair of core bands. On the other, two armature coils were burnt out and had to be replaced.

Aside from these failures, practically nothing has had to be done on the armatures since they were placed in service. At the end opposite to the commutator the canvas hoods have frayed off in some cases, and where this has occurred the frayed canvas has been trimmed off and bound down by means of heavy cotton cord, six or eight turns being wound on between the edge of the first band and the edge of the bell. On this winding there are applied three coats of Sterling varnish, and this seems to hold the cover permanently in place, as no troubles have developed from such repair jobs.

The field windings also have given excellent satisfaction, only one field coil having had to be renewed because of an actual failure in the windings. In addition, one compensating field lead broke down at such a point as to require the renewal of the field coil. A negligible number of flash-overs have been experienced. These have taken place between the commutator and the end-bell, and in most cases the arc has carried over to the motor frame. But in every instance the results of the flash have been easily repaired by the local force at Detroit by filing up the burnt spots and painting over the creepage space.

However, for the sake of protecting the locomotives against the effect of emergencies, two complete spare motors and two extra armatures are kept in storage in the inspection building at all times. One spare controller is also kept on hand, but this has never been used, and it should be said that the control equipment appears to be in a remarkable state of preservation.

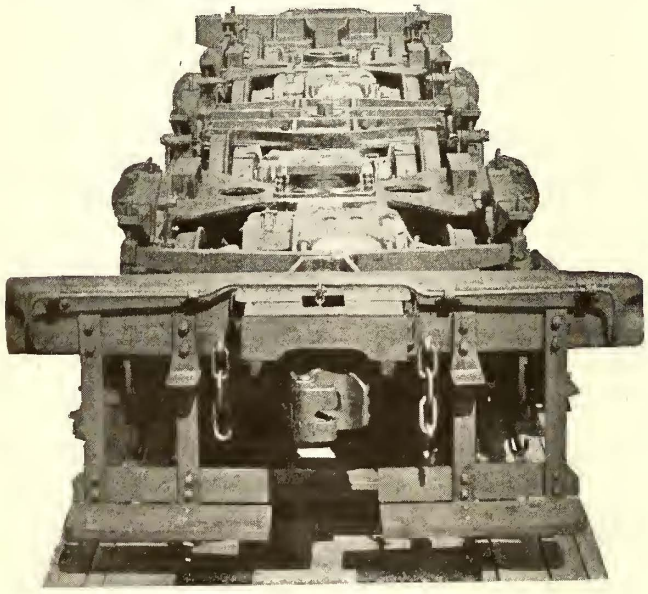
Only six arc-chutes have been replaced, and only six pairs of contact tips renewed, during the five years' service of time on the six older locomotives. On the original engines the contactors were of the GE-166 type, and these have given exceptional service. On the newer engines No. 266 contactors were installed, and these have not shown quite perfect results, although under ordinary circumstances their action would be considered thoroughly satisfactory. Drafts of current of the order of 500 amp. per motor are frequent on the tunnel approach grades and the engines are run on sand with the idea of getting the train up the grade regardless of the load on the motors. Consequently, when trains beyond the locomotive rating are inadvertently delivered at the tunnel the above-mentioned amperage is greatly exceeded, and cases have been encountered where the contactors have been unable to break the heavy current, the consequent arc burning them out. No circuit-breakers are installed on the engines, the motors being protected by 600-amp. fuses.

It is the practice to paint the inside of the arc chutes with shellac at each overhauling, as this is considered to be an aid in reducing the burning caused by the arcs that are thrown from the contactors. Whenever this

DETROIT TUNNEL MAINTENANCE—ONE-HUNDRED-TON LOCOMOTIVE

painting is undertaken the burnt composition on the sides of the chute and on the contactors themselves is first scraped off with an old hacksaw blade so as to leave a smooth surface for the paint. On the master controller the segments are wiped off with oil once every ten days, removing only just what the oil takes off. The results have been thoroughly satisfactory, because the only wear apparent at present is at full running position, where the vibration has produced a shallow notch but not enough to be noticeable. No burning is in evidence anywhere about the master controller.

With regard to the motor bearings, it may be said that axle bearings are renewed when they are ⅛ in. large. They are only just now beginning to require changing, having lasted about five years. Quite a little side play, however, has been found to develop in all of these bearings, and at intervals liners have had to be riveted onto the collar at the end of the brass to take this up. During the period of about a year this side play increases up to approximately ½ in., and it is then reduced by attaching a soft brass liner with countersunk brass rivets, the thickness being sufficient to reduce the side play to about 1/16 in. The axle-cap studs gave a certain amount of trouble in the beginning,



DETROIT TUNNEL MAINTENANCE—FRONT VIEW OF LOCOMOTIVE CHASSIS

as they were made of steel and had a strong tendency to become brittle and break. Later on wrought-iron studs were substituted for the original ones, and this has obviated the difficulty. Armature-bearing brasses are renewed after they get 1/32 in. large, or during the course of about three years' service. Some trouble has been experienced with these, three or four of them running hot in the course of every year.

Mechanical Repairs

Practically no trouble has been experienced with the mechanical features of the locomotive. Repairs, aside from normal wear, have been confined to small details, such as that the equalizer pins at the centers and ends of some of the equalizers have shown a tendency to roll and shear off the keys. This is ascribed to extreme hardness of the metal of which the pins were made, which permitted them to work out of place and cut off the keys, since soft-metal pins installed on some of the engines do not display the tendency. Occasionally, also, equalizer hangers have broken, but in the newer engines these were made considerably heavier than on the older machines, the thickness having been increased to the depth of the boss throughout the whole length of the hanger.

At only one end of the cab frame is there the usual center casting and kingpin, the other end having a sliding support to permit the swivelling of the articulated truck frames, and this center casting is fastened to the cab frame with eight 1-in. bolts. These bolts have been found to shear off when one engine hits another a moderately hard blow, the primary cause being the extreme rigidity of the heavy engine frame, which prevents any "give" to reduce the force of the impact.

Very little difficulty has been experienced with the third-rail shoes. Normally these run for three or four months, and have to be replaced then only because of mechanical damage and not because of excessive burning or wear. However, when the engines are operated on the grades in the tunnel against the normal direction of the traffic (a practice sometimes necessitated by congestion of freight at one side of the river) the shoes burn off very rapidly. It has been the case, in fact, that shoes have lasted only for twelve hours' service under such conditions. This appears to be caused by corrosion on surface of rail from brine dripping from refrigerator cars. A high-resistance scale is formed, often 1/16 in. thick.

Side play for the driving wheels does not appear to be a serious matter on these locomotives. Engines are turned out after an overhauling with about ⅛-in. side play in the driving boxes, and they stay in service until the movement reaches as much as 1 in. Normally, of course, the speed is low, but occasionally the locomotives are reported to reach a speed of 50 m.p.h. for short distances. Even with the maximum side play, however, no especially hard-riding qualities are developed nor is any damage done to the track. The side play at the driving wheels is taken up with hub collars, which were originally made of cast iron but later were changed to soft brass, as this metal was found to run better against the cast-steel boxes. The hub collars run loose in the recess at the inside of the driving wheel hub, and it is stated that they never cut the surface of the hub because of grit getting in between the two surfaces.

As before mentioned, double pinions and gears are used for each motor. These were originally applied with great care at the manufacturers' plant, and they were checked for alignment of the teeth on opposite ends of the shaft with a surface gage reading to 0.003 in. During the five years of service the wear has been small, the material in both gears and pinions being heat-treated, General Electric grade D, and for this reason the problem of applying new pinions and maintaining the original alignment of teeth has not yet arisen. However, during the life of the locomotives, the circumstance has been brought up whereby one of the motors originally installed upon a locomotive has been replaced with another, and in this case the pinions on the new armature shaft have always meshed perfectly with the old gears. Pinions are also removed from the armature shaft quite frequently owing to the fact that the motors are of the box-frame type, and at overhaulings it is necessary to remove one pinion before the motor can be dismantled. In this case the pinion is replaced upon the old key, being warmed in boiling water and tapped into place with a light sledge hammer, while being forced home by screwing up the pinion nut. The gear center on each side is in one piece with the driving wheel, the gear teeth being cut on a rim that is shrunk onto the gear center and keyed in place. None of these rims has ever been taken off, owing to the small amount of wear on the gear teeth.

A noticeable feature of the engines in operation is

the spotless condition of the cabs, the brass work, even to the Pyrene fire extinguishers, being polished to a looking-glass finish, and the miscellaneous equipment neatly stowed away. Among the latter is a droplight on a long flexible cord, which when not in use is kept in a specially arranged sheet-iron receptacle. For the cleanly cabs the assistant motormen who are assigned to each engine are responsible. The motormen are charged with the duty of seeing that the engines are in good operating condition while they are in service, bearings that run hot or controllers that act badly having to be promptly reported to the maintenance force. In this connection it may be noted that three men ride with each engine: a motorman, an assistant motorman and a conductor, who handles train orders, makes couplings and is generally responsible for the movements of the locomotive, especially in the case of its running light.

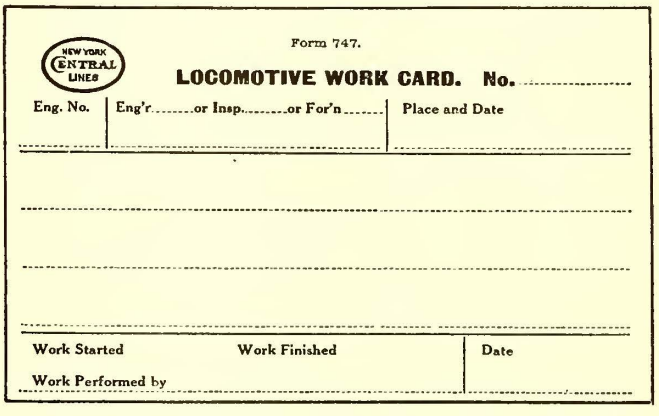
THIRD-RAIL MAINTENANCE

The electrical department of the Michigan Central Railroad, which is under J. C. Mack, signal-electrical engineer, and C. G. Winslow, assistant electrical engineer, and which has charge of the electric locomotive maintenance as above outlined, also is responsible for the upkeep of the third-rail contact system that is installed in the electric zone. The latter division of the electrical work is handled by a force of repair men separate from that employed on the locomotives. This force is headed by an electrical supervisor and a general foreman, and reporting to them, are three men classed especially as third-rail maintainers. However, because of the fact that all electrical work involved in the supply of electric power, the operation of telephones, signals and interlocking plants, the lighting and industrial power in the Detroit passenger station and the like is also handled by this department, there are a number of other employees who help out on third-rail maintenance in cases of emergency. In the same manner the third-rail maintainers devote a part of their time to outside work, no rigid line being drawn between the duties of the different classes of workmen. For the past two years a considerable amount of construction work has been done, so that the actual cost of third-rail maintenance cannot be definitely determined during this period. However, in the year 1913, the cost was $135 per mile, on the 19 miles of third-rail then existing, and this will give an idea of the cost under normal conditions. For the year 1915 the recorded cost of power distribution was $210 per mile of third-rail, this figure including, however, maintenance of power-distributing underground cables of all voltages.

Generally speaking, the most prolific causes of expenditure in the maintenance of the third-rail are derailments and the salt-water drip from refrigerator cars, of which a great number are handled over the electric zone. This drip falls upon the third rail and causes creepage across the insulators from the third-rail to the brackets that support it, setting up carbonization that eventually provides a sufficiently free path for current to burn out the insulator. The drip from the refrigerator cars also displays a tendency to run to the under side of the third-rail, and, as before mentioned, the consequent rusting, together with the salt deposit, forms an insulating medium on the contact surface that causes a certain amount of burning and also produces cracks in the contact shoes of the locomotives.

During dry weather it is very unusual for any insulators to break down. However, whenever fog or rain comes creepage is accelerated, and frequently as many as twenty-five or thirty insulators have been lost within a short time after damp weather sets in. There are 1000 insulators for each mile of third-rail, the insulators being installed in pairs, two to each supporting bracket. Under normal conditions many more insulators are lost by burning than by breaking, an example of which may be seen in the record for 1913, when 1200 insulators were burnt out and only 360 broken. Of these burned insulators, it may be said, 375 were on the tunnel tracks, and all but five of these were lost on the east-bound track, which serves the majority of loaded cars, as the west-bound traffic is composed largely of empties. From June, 1912, to June, 1913, approximately 700 insulators out of a total of 19,000 installed were lost by burning and approximately 200 by breaking, but between June, 1913, and June, 1914, when a large amount of construction work began, the number of burned insulators was increased to 1336 and the broken ones to 1017. This increase in insulator failures was largely traceable to the construction of the new passenger station at Detroit and the lack of adjustment of new and untried construction.

A certain amount of work has to be regularly done in adjusting the position of the third-rail to provide for wear in the running rail and ties. Recently brackets have been supplied that are 1 in. shorter than the standard, so that as the running rail cuts into the ties, the third-rail can be lowered correspondingly by using the short brackets with the proper number of shims under the base to bring the third-rail to the correct height above the top of the running rail. Previous to the introduction of the short brackets it was necessary to remove the brackets and cut away the extended ties on which they rested whenever it was desired to lower the third-rail.


Form 747.

NEW YORK CENTRAL LINES

LOCOMOTIVE WORK CARD. No. .....

Eng. No.	Eng'r.....or Insp.....or For'n.....	Place and Date

Work Started	Work Finished	Date
Work Performed by		

DETROIT TUNNEL MAINTENANCE—WORK-REPORT CARD

The wear on the third-rail to date has been very small, and there is nothing about the construction that regularly requires repairs or replacement, except the insulators. However, on account of occasional derailments that take place, with a consequent breaking down of the third-rail, the department keeps at hand in storage half a mile of material for third-rail construction, in addition to the supply of extra insulators required to replace those which are lost by burning or mechanical breakage. At the present time the third-rail mileage approximates 23, the increase from the previously mentioned figure of nineteen being due to additional construction in connection with the large new passenger station at Detroit.

The West Penn Railways Company of Pittsburgh, Pa., has substituted 1¼-in. x 4-in. grooved maple flooring for the yellow pine flooring formerly used for its car bodies and vestibules. Experience has demonstrated that the maple flooring lasts twice as long as the yellow pine, which was also purchased with ½-in. grooves at 2½-in. centers.

Overhead Construction—Tools, Specifications and Tests

The Relative Merits of Tower Cars and Automobile Emergency Wagons Are Discussed—Valuable Hints Are Also Given on Reel Cars, Pole-Setting Equipment, Small Tools, etc., and the Precautions to Be Taken to Secure Satisfactory Overhead Material

By CHARLES R. HARTE
Construction Engineer The Connecticut Company, New Haven, Conn.

THE really fundamental piece of apparatus of overhead construction and maintenance is the tower, which has been changed very little from its earliest form. This apparently is due to two quite unrelated causes: first, an appreciation and fulfillment at the outset of the real requirements, and, second, failure on the part of overhead men to realize the cost of the line gangs' effective time. Whether it shall be mounted on a car or on a wagon depends on the service. For lines on private right-of-way the car is a necessity, and its ability to carry a full equipment of tools and material makes it exceedingly valuable whenever it can be brought to the point involved and kept there. For city work, however, the mutual interference between tower and trolley and street traffic restricts its use to other than rush hours, compelling the use in addition of a wagon which can short cut to the work, dodging interference, and make quick temporary repairs.

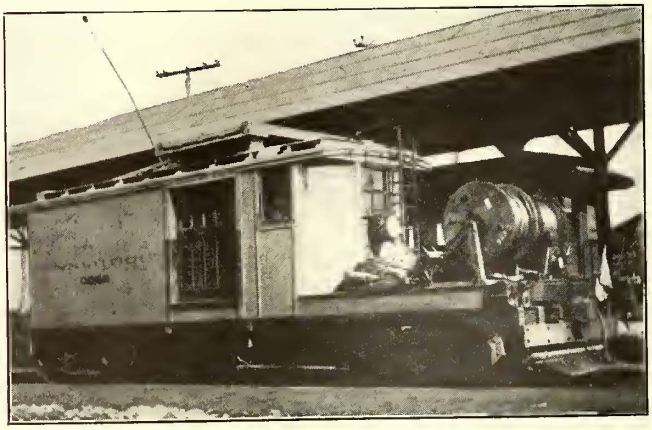
At least one large company employs almost no towers at all, practically all work being done from extension ladders used in pairs to form "A's." To pass a car the men come down and stand the ladders in a vertical position. This brings them just outside the clearance. When the car has passed, the "A" is again formed and the men go back, all in less time than it takes to describe the procedure.

Time being the main essence of the situation, particularly if the trouble arises from a fire, many of the urban companies maintain an emergency service which, in addition to regular repair work, goes out on fire alarms. In many instances by the use of drop harnesses and horses the apparatus is rushed to the ground with the first apparatus. However, in spite of the marked advantages of the automobile chassis—instant readiness, high speed, unlimited operating radius, and ability to carry a heavy equipment, often obviating the necessity for a car—there are surprisingly few used, and practically none of these makes use of the engine for anything but propulsion.

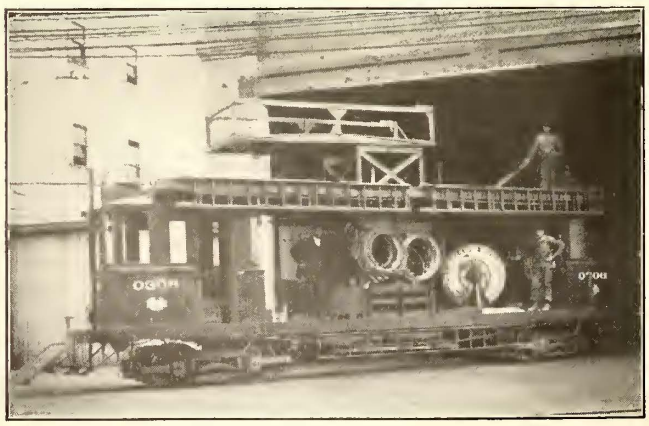
Raising and Lowering the Towers

The lighter towers can be raised by hand with comparatively little loss of time, although the engine could do it far better; but although the big car towers require far too much costly time and effort, and that when it is most needed for other purposes, the large majority depend upon hand winches and human muscle. The simplest power application connects the hand winch with an electric motor, but this, as well as the more compact and efficient motor winch, is high in first cost. Air devices are less costly. In one instance an air motor has been connected through the worm gearing to the winch.

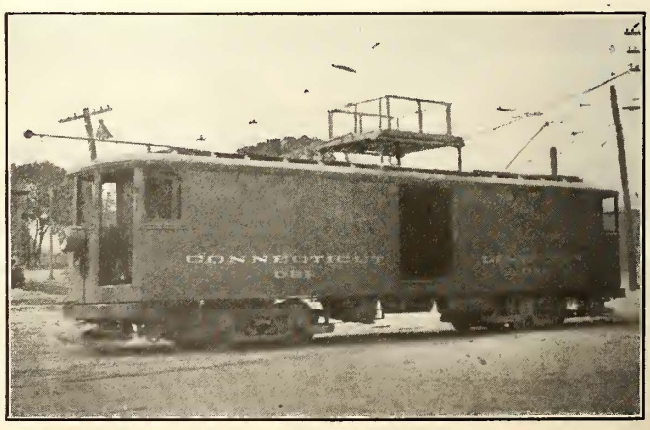
A less expensive but more complicated installation consists of an air hoist with, if necessary, a system of sheaves for multiplying the stroke to give the required lift. This, as well as the plan of carrying the platform on the plungers of vertical air cylinders, is objectionable on account of the elasticity



OVERHEAD CONSTRUCTION—COMBINED TOWER AND REEL CAR; PLATFORM SLIDES INTO EXTENSION POSITION

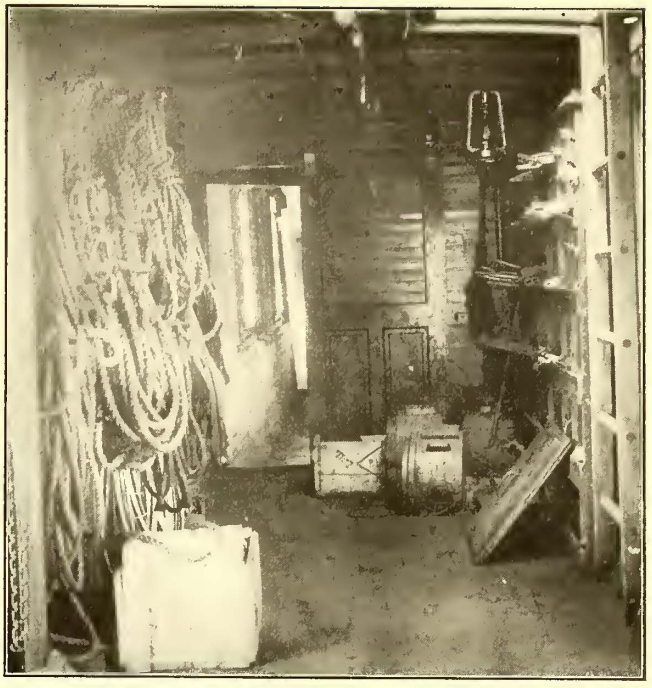


OVERHEAD CONSTRUCTION—UNITED RAILROADS OF SAN FRANCISCO TOWER AND RUNNING OUT CAR



OVERHEAD CONSTRUCTION—CONNECTICUT COMPANY TOWER CAR; PLATFORM RAISED ABOUT 1 FT.

OVERHEAD CONSTRUCTION—INTERIOR OF CONNECTICUT COMPANY TOWER CAR; BENCH END



OVERHEAD CONSTRUCTION—INTERIOR OF CONNECTICUT COMPANY TOWER CAR; OPPOSITE END TO BENCH

of the air, which causes the platform to dance. On the other hand, a liquid system requires a special pump as contrasted with the well standardized compressors used with the air lift, and leakage is not readily compensated for.

A scheme devised by Mr. Thomas, master mechanic in the Waterbury shops of The Connecticut Company, and now standard on the system, cleverly utilizes the good points of both air and liquid. In this a supply pipe is taken from the air-brake tank through an engineer's valve to the top of a pressure tank which is partly filled with oil. From the bottom of this tank an oil pipe passes, through a control valve, to the bottoms of four ram cylinders, which are simply sections of 3½-in. brass pipe. With the control valve open, applying pressure on the oil lifts the platform, which is carried on the plungers. Releasing the air lowers it, and it can be locked in any position by simply closing the control valve. It was found that while the maintenance of perfectly tight plungers was very costly they could be kept reasonably tight with little trouble, the leakage oil being led to an overflow tank from which it is returned to the pressure tank. The first installation lacked proper insulation between plungers and platforms, and in wet weather the latter were too "hot" for comfort, while the heavy oil employed stiffened up so in cold weather that it literally "gummed the game." These troubles were easily remedied, however, and the cars have been exceedingly satisfactory ever since.

Equipment of the Tower Car or Wagon

Whether or not the platform shall be of the overhang type depends upon the nature of the service. An overhung platform allows work to be done with wagon or car clear of the track involved, and causes the least disturbance to traffic, particularly if rotated by power. It adds greatly to the weight, however, for it must have far more rigid and substantial support. For work in large cities the best combination is usually found to be a square-platform emergency wagon working directly beneath "the trouble," and an overhung platform car, which, however, also works under the trouble if practicable.

Tower equipment ranges from a light extension ladder, a pair of heavy bolt cutters for strand and trolley wire, a few small coils of strand and trolley, and a chest carrying some hand tools, ears, hangers and insulators, this being pretty close to the irreducible minimum of a light emergency wagon, up to a car installation that is a cross between a general store and a machine shop—and for the high-pressure repair and renewal work of the larger cities there is none too much. For example a recent medium-sized car has the following normal equipment:

Pole-framing tools: Axes, draw-knives, plane, chisels, saws, braces and bits, etc.
Pole-setting tools: Picks, shovels, bars, pike-poles, chains, blocks and falls, etc.
Overhead tools: Sampson grips, monkey and Stilson wrenches, heavy bolt-cutters, hammers, soldering pot, etc.
Overhead material: Ears, hangers, pull-overs, strain insulators, splices, anchor sets, section insulator runs, brackets, trolley wire, strand, clamps, bolts, washers, tape, S-hooks, cross-arm braces, lag screws, etc., sufficient for about 1 mile of single track, with extra supplies of parts most subject to wear.
Telephone and signal material: Cross-arms, insulators, insulator pins, choke coils, ½ mile of No. 10 wire, side brackets, signal lamps, keyless sockets, etc., for about ½ mile of line, with extra parts.
Telephone test set; telephone set with pole connector.
Signal lamps, signal lanterns, fusees, flags, "stop" and "slow" signals.
Fire extinguishers, metal pails, brooms, etc.
Work bench with 10-in. bench vise.
30-ft. extension ladder.

Apparatus for Running Out Wire

For running out feeder or trolley wire a reel car is often used as a tender, a common form being a flat car with triangular frames a little more than reel width apart with reel bearings on long screws on the inclines. Still simpler, for use in connection with a wagon, is the reel gig, a reel-carrying frame which is an extension of the tongue projecting enough behind the axle, to which it is pivoted, to hold the reel clear of the ground when the tongue is level, while by raising the latter the bearings are lowered and the reel rests on its rims. This same device with slight modifications can also be used as a pole gig, such as was described by S. L. Foster of the

United Railroads of San Francisco in a recent number of the JOURNAL. Mr. Foster, by the way, has the best reel gig the writer has seen.

Often, however, the reel is carried on the tower car. If mounted to feed out on the center line, as it should be, the reel requires some handling device, such as a small crane or trolley hoist, and on one car the standards can be rotated 90 deg. and the reel rolled into place. Commonly, plain cheek plates are bolted to the reel sides, an arbor a trifle smaller than the holes is slipped through them and the bearings of the adjustable supports, and the desired tension is maintained by means of a piece of scantling—or pretty much anything else that is handy—used as a brake against the rim, or not infrequently against the wire itself. In a much better plan a band brake forms part of the standards, lugs or similar devices on the cheek plate, engaging with the brake drum. This is always on the job, gives perfect control, and the empty reel can be returned for credit without causing a riot when it reaches the maker.

Although the writer knows of no case where the reel stand is also fitted for power drive, such an arrangement would seem very desirable when picking up wire if a special motor was not necessary. At least one of the larger companies, the United Railways of San Francisco, has found an independent wagon with motor-driven reel and winch head a profitable investment.

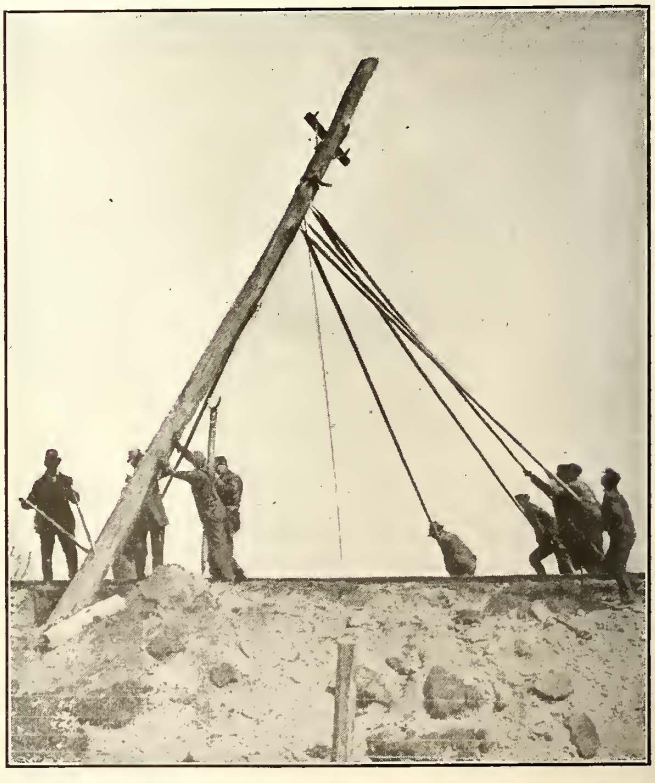
Small Tools for Overhead Work

The overhead smaller tools were largely standardized by the telegraph and lighting industries before the electric railway entered the field. The requirements of the latter have differed in the main only in requiring strength to handle the heavier material. In a few cases changes in type were required, the cam and similar short-grip come-alongs, for example, when enlarged to handle the heavy copper wire developing a tendency to deform as well as to securely grip it. The tools, of whatever kind, should be of the best, for cheap tools are costly wherever used, and nowhere more so than in overhead work, where a failure at a critical moment may have most serious consequences.

Pliers and cutters of the smaller sizes are usually worn as personal armament in the belt, often in company with a peen hammer, screw driver, and small monkey wrench, but the tower should carry extra ones for emergencies. A very useful tool for installing round-top hangers is the "wrench" which holds the hanger so that one lug can be hooked on the span and the round top can then be twisted until the other lug can be adjusted. Special local devices often require special tools for their best installation. For example, S. L. Foster, previously referred to, uses on turns a feeder clamp consisting of two lugs which grip the feeder and hold it to the insulator when the single bolt is tightened. The feeder is bent to the proper angle by a "jim-crow" similar to a diminutive rail bender.

Tools for Pole Setting

Spoons, digging-bars, pikes, cant-hooks, jenneys and the rest of the pole-setting equipment are in the main no different from that of pre-trolley times. A device long in use, but only recently on the market in a form designed to meet the heavy eccentric load, is the pole jack. It is indispensable in city work, and nearly so in the open, its use being economical because it is a time saver, and, with wood supports, a pole saver. Another "once-used-never-without" device, which has been very slowly developed, is the pole setter, almost an absolute necessity in modern city work, and a money saver even on small lines, particularly if wisely combined with the tower or tool wagon. In its simplest form it is a gin pole, but it may be found in varying degrees of complexity and efficiency. In the open, where guys can be run out, a gin pole, shears or wagon derrick, if fitted with a good winch, is usually quite satisfactory. In some cases a snap rig permits easy use of the team, in which case, of course, provision must be made to prevent pulling the setter out of place. For city work, however, where heavy poles must be handled among a



OVERHEAD CONSTRUCTION—HOME-MADE YET VERY EFFICIENT POLE SETTER; NOTE ANCHOR GRIP ON RAIL OPPOSITE POLE BETWEEN WHEELS. POLE ERECTION BY HAND

maximum of light, power and communication wires with a minimum of clearance, and traffic conditions restrict if they do not entirely prevent guying, the device must be very carefully worked out or the results will be disastrous.

A pole-setting device of comparatively recent development, which is very effective in its limited field, that is where many poles are to be set on low grades and in soil free from large stones, is the power auger. On the transcontinental telephone lines this machine proved exceedingly satisfactory. In the South and West, particularly if built as an attachment to other apparatus and not as an independent unit, it might well prove economical on extensive work.

Other Devices for Overhead Work

Speaking of attachments, a mounted, "able-bodied" motor or gasoline engine can often be used to great advantage on a small system if arranged to serve a number of devices hooked up to it as needed, and requiring little space or interest allowance when idle. Many of the field devices find good use in the store yard. The cable-puller winch is worth several men if heavy material is to be handled, while if it is equipped with a rereeling device, as it should be, with its aid usable old wire can readily be put in shape for re-employment. It is well to use a uniform diameter for such coils, or possibly two diameters, so that one size can be hung inside the larger. If strand is kept tied up in coils of a size easily handled, and of a length lending itself to the requirements of the system, the cars can be restocked in a few minutes and there is not the waste of wire or time which results when a full reel is kept "on tap" and the men help themselves.

Requiring little power work, but sometimes helped out thereby if it is available, is the overhead work which can be done in advance in the yard. How much can be so treated is always a local question which requires a balancing of the gain in time against the loss in material. Anchor logs can be prepared, brackets made up, and similar work done in advance without waste. Spans can also be made up if for uniform distance between poles, otherwise the margin allowed in length for safety eats up an astonishing amount of strand. Goose-egg and other open-groove porcelain strains, now used to a considerable extent, do not lend themselves to advance make up, the desire on the part of workmen to close the strand so tightly that the "egg" cannot drop out resulting in much injury and breakage, particularly with high-grade strand. In San Francisco wrought-iron loops are used, these being so shaped that the eggs can be slipped in at one end and slid down to a snug fit at the other.

As stated earlier, however, the whole question of tools and practice is tied up with local conditions, and each property has to determine for itself whether the saving at one point warrants the probable added cost at another.

Specifications

Although telegraph construction, long standardized, has furnished the groundwork for trolley overhead practice, until recently there were almost no specifications for the latter. The few which had been written were far from complete, and differed widely in what they prescribed. This was doubtless due to the fact that by far the greater part of our trolley mileage has been built in independent units, too small or too uncertain in outcome to warrant the expense of special research work. The absence of any standard specification resulted in each constructor becoming a law to himself.

Sometimes service or other requirements were set forth, sometimes not. In at least one instance "—— miles of overhead put up" covered the field broadly if not specifically, and at least as sensibly as a recent specification which prescribed a minimum weight for certain devices under bending stress only, without the slightest restriction as to the section to be used. In the same class was another specification, which fixed a minimum weight for a hanger, where every unnecessary ounce is an economic crime of high degree, not merely wasting material, but accelerating wear on car and trolley. This minimum being greater than the standard weight of a well-known make, the manufacturer had the patterns vigorously rattled in preparing the molds, giving a much thicker and heavier shell, which was accepted as entirely satisfactory.

In 1906 R. E. Wade and the writer, with the generous assistance of many "overhead men," engineers, constructors and operators, to whom drafts were sent for criticism and suggestion, prepared quite a complete specification for material and construction for the New York, New Haven & Hartford Railroad trolley lines. Recognizing the importance of the production side of the situation, this specification was also submitted to the leading manufacturers with the request that they, too, freely criticise and suggest from their point of view, and advise just what stock material would most nearly meet the requirements as written, and also as they would modify them. Many of the suggestions were most helpful, and were embodied in the text, and from the material submitted limits were established which would admit all the commercial designs meeting the requirements of the final draft. Drawings were then made up showing only the important dimensions, leaving as much as possible unrestricted except by the requirement that every article comply with good commercial practice. It is interesting to note that with one exception every device specified was standard with at least one manufacturer, by no means always the same maker, however. The feed-in yoke, of which no marked type had fingers of desired length, was readily modified.

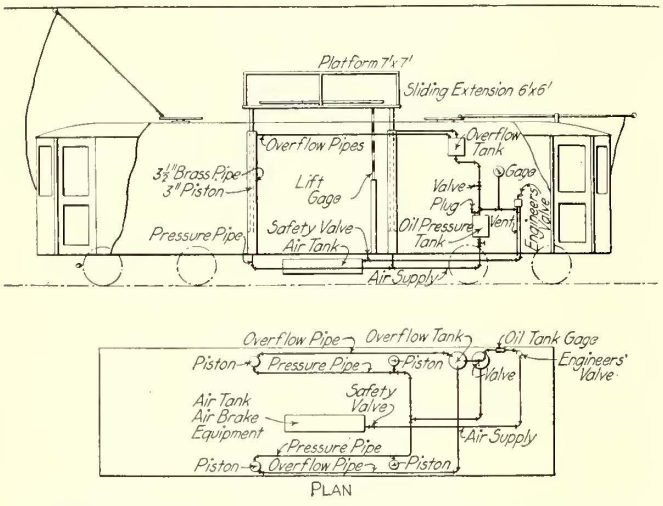
The importance of adjusting technical demands to commercial conditions is too often overlooked. A special design, considered by itself, is often more efficient than the market types, but this is only part of the story. The higher cost, and the difficulties and delays involved in securing deliveries, not infrequently give a net result decidedly in favor of the stock article. It is doubtful if there has been more flagrant disregard of this fact, however, than in "overhead," and the shelves of the makers are full of patterns differing just enough from each other to be different, and each acceptable only to its special advocate. That such special designs are more expensive is pretty well understood. That the extra cost of development, care of patterns, loss of room, etc., is paid for by just and unjust alike, as an "overhead" prorated over the output, is not always realized by the purchaser of the usual devices. Obviously the imposition of such charges is the only way in which the maker can protect himself, while the money locked up in stock of this character means just so much less standard material, and consequent greater likelihood of delay in filling orders. In the developing A. E. R. E. A. specifications, recognition of these facts, and acceptance of material already standard with other overhead interests wherever it is applicable, should materially improve market conditions.

Tests and Testing

Whether or not the material obtained complies with the requirements is, of course, best determined in a well-equipped testing laboratory. Many of the larger companies either have such facilities, or employ the

services of one of the private laboratories, of which there are a number. Where financial conditions do not seem to warrant the expenditure necessary under either of these plans, much can be done with home methods if used with that breed of sense called "common" because of its rarity.

The sole purpose of any test should be the determination of the fitness, or otherwise, of the device under observation for the service to which it is to be subjected. In some cases it becomes desirable, in order to produce a breakdown and to observe just what happens, to employ loads or conditions unlikely of realization in service. However, as a rule, service loads multiplied by a factor of safety ranging from two, for wire and similar specialized and dependable products, up to six for rough wood, to cover manufacturing and material contingencies, are entirely sufficient and proper. Armed with chemicals and testing machines a laboratory enthusiast can produce all sorts of results and, if a company can afford it, some good can often be had from investigations apparently quite afield from ordinary



OVERHEAD CONSTRUCTION—PIPING SYSTEM FOR COMBINED AIR AND OIL TOWER PLATFORM LIFT

use. For the less fortunate property, however, this is neither necessary nor desirable.

For almost every material the general appearance is a good index, especially if the inspector is reasonably familiar with the processes of production.

Testing Wood Cross-Arms and Strains

Wood requires some little acquaintance and experience. High-grade or very poor stock is unmistakable, but there are intermediate grades in almost all varieties that keep the young inspector continually in hot water. Cross-arms are particularly subject to doubtful appearances. By holding one end of a cross-arm in a vise and subjecting it to a twisting stress by means of a bar slipped through the opposite end pinhole, it can usually be readily determined if the "defect" is an open crack of some kind or merely a scratch or a mark. This test must be made with discretion, however, for a perfectly good cross-arm can be split with surprising ease if the twist is sharply applied. Loose knots can often be "jumped" by a sharp blow on the adjacent wood, while cracks and shells can often be detected by the sound on tapping the suspected stick sharply. Poles do not show defects as clearly as finished material, but many troubles are obvious. A scoring tool is convenient to determine if the wood under the surface is "live," and a miniature pick will usually reveal soft but undisturbed knots, usually a sign of inside rot.

Wood "strains" usually fail either from defective ends or cross-grain. A crude but effective testing machine can be made from a heavy beam with a water tank for the weight. Knowing the relative positions of fulcrum, test point and tank, the weight of the beam and the cross-section of the tank, the latter can be marked for the desired loads which can be applied uniformly and as rapidly as desired up to the delivery capacity of the filling hose. While perhaps not as good as an Emery, an Olsen or a Riehlé, such a testing machine can, with a few fittings easily made by a good mechanic, be of great use. Cross-grain is usually quite apparent with the modern natural-finish strains. For the older black-painted ones, and in testing for dead wood in the natural finish, the strain, held by one end, is struck smartly across the edge of an anvil or the head of a rail, letting the free end extend beyond the object struck.

Testing Metal Pieces

On inspection protective coats on metal usually show blisters if there is lack of adhesion. If the object will permit bending, a few bends furnish an admirable test for the attachment of the coat. As to its thickness, the well-known Preece test, with its modification for sherardizing, is easily made and is the standard. As many know, sherardizing often "blooms" with a fine red coat, apparently a heavy rust, which presently disappears with no appreciable ill effect. Apparent service failures of this treatment are usually of this class. There has, however, been some irresponsible and wretched sherardizing, the "bloom" of which was real corrosion.

The chief shortcoming of malleable and forged material is brittleness, due to burning or crystallization, and one test is the same as for cross-grain in wood, a smart blow across a sharp edge. Eyebolts, anchor rods and the like can also be treated for protection, adherence and brittleness at the same time by gripping one end in a well-anchored bench vise, and bending sharply a few times. Such a bending test, continued to destruction, is a good rough-and-ready check on the toughness of ears, strand, wire and the like, particularly in connection with the appearance of the fracture. Strand and wire from the better makers, however, runs very uniformly, and tests other than behavior in making up are hardly needed.

Mechanical Insulation Tests

Hangers rarely give trouble by the softness of the insulation, but there have been instances where they have done so. There should be no observable softening or loss of strength at a continued temperature of 150 deg. Fahr. The chief weakness is at the junction of lugs and body, readily detected by a smart blow on an anvil. The general strength can be checked by hanging by the lugs and loading the stud, through a bar screwed to it, with 600 lb. It has been gravely required that the stud should support 8000 lb., but how senseless such a requirement really is appears from a consideration of the corresponding consistent test for the span. With the standard inclination of 1 ft. in 10 of half spans, 1-lb. load at the car gives 10-lb. pull at the pole. To correspond, then, to the 8000-lb. hanger test, the span strand should be tested at 40 tons.

Whether the company must use these rough tests or whether it can support a full-fledged testing department, and the net cost of the latter if wisely administered is by no means high, it is most important that the inspectors have a reasonably clear knowledge of the manufacturing details of the materials to be tested. Such knowledge, on the one hand, prevents the ridiculous mistakes often made by sincere but ignorant inspectors, and, on the other, permits prompt and effective "nailing of the fairy tales" with which ingenious supply men sometimes endeavor to meet unexpected contingencies.

Planning and Efficiency System in Portland (Ore.) Shops

An Adaptation of the Taylor System to Electric Railway Repair Shops Has Been in Use in Portland for Two Years with Satisfactory Results—By Centralizing the Planning and Other Clerical Work the Effectiveness of the Shop Force Has Been Increased

By F. P. MAIZE
Master Mechanic Portland Railway, Light & Power Company

SOME time ago when the management of this company, after having been impressed with the workings of the Taylor efficiency methods in some of the Eastern manufacturing plants, decided to introduce the system in the electric railway repair shops in Portland, we endeavored without success to obtain printed matter describing the application of the system to electric railway shops. Investigations showed that planning and efficiency systems, sometimes misnamed "scientific management," were being tried out by several roads, but only in a small way and in only parts of their shops. Now that the system has been successfully started in Portland, it may be of assistance to other companies to have the benefit of our experience in order that they may avoid at least some of our mistakes and have something of a foundation to work upon. The following statements have, therefore, been set down, giving the facts just as they occurred.

The master mechanic who adopts the planning system will find that he has undertaken a difficult task, but a study of our experience may encourage him in accomplishing it. He is advised, however, not to attempt it unless he starts with the determination to stick to it and push it through, no matter what occurs. There will be plenty of hard work, and many ups and downs before success is achieved.

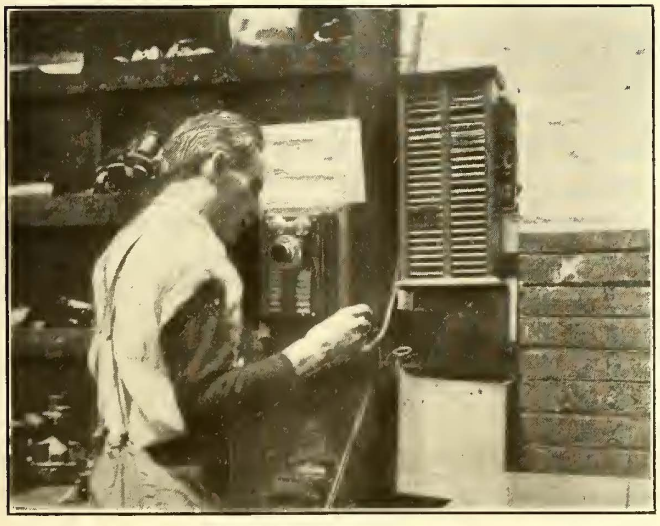
The planning and efficiency system now in operation in the shops of the Portland Railway, Light & Power Company is founded entirely upon the principles and methods made famous by the late Frederick W. Taylor. With all due respect to the "experts in scientific management," we are satisfied that the chances for successful adoption of planning and efficiency systems are greater when the methods are developed and introduced by the local organizations without the aid of so-called experts.

Enthusiasm in the possibilities of the Taylor method is the first requisite. The writer confesses to the possession at first of the usual prejudices against such methods, believing that they meant only additional red tape and that the savings which might be secured in the shops would be offset by correspondingly increased expenses in the office. However, in his apprenticeship and workman days he had had the customary unsatisfactory experiences with piecework methods, and later, when entrusted with the handling of workmen and direction of work, had learned to appreciate the importance and desirability of good pay for the workmen and stability in the schedules of wages. This experience made it relatively easy for him to become interested in, and to take up the principles of scientific planning and efficiency and to apply them to the local electric railway repair-shop conditions.

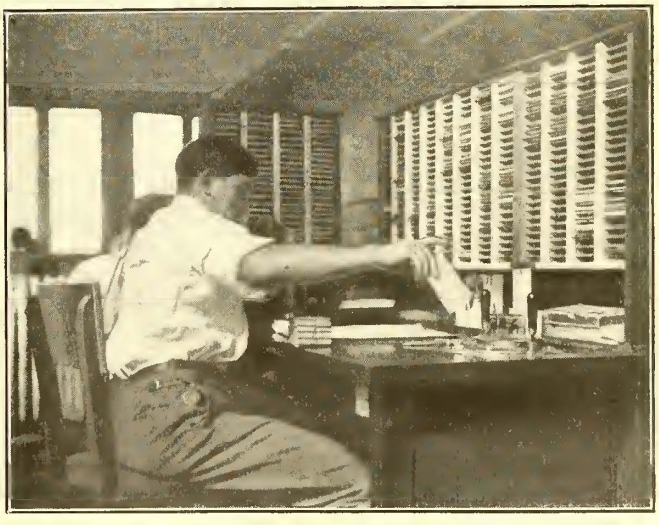
EARLIER REPAIR-SHOP PRACTICE OF THE COMPANY

The conditions on the property at the time of the introduction of the planning system were as follows:

The railway operated from 400 to 500 cars, making a mileage of about 14,000,000 per year. Due to the large area covered by the city, the railway had one large shop and four carhouses well scattered. As the carhouses were some distance from the shop, and it would cost more to transfer the cars to and from the shop than to do the light work on the spot, each carhouse was



PLANNING SYSTEM—FIG. 1, WORKMAN CALLING IN TO START JOB. TIME SLIP CABINET AT RIGHT, BOX FOR TIME AND INSTRUCTION CARDS BELOW



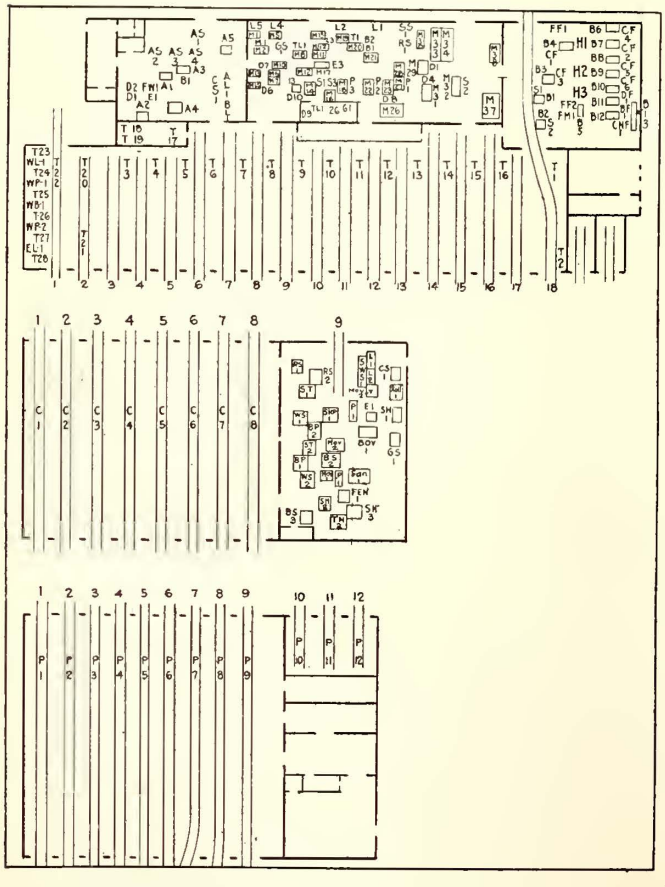
PLANNING SYSTEM—FIG. 2, TIME CLERK ANSWERING TELEPHONE AND STAMPING AND FILING TIME CARD

CAR HOUSE 1				CAR HOUSE 3				CAR HOUSE 4			
CAR	CAUSE	IN	OUT	CAR	CAUSE	IN	OUT	CAR	CAUSE	IN	OUT
534	Yard	10/16	10/23	406	OHP	10/9	10/9	1100	Contactors	10/16	10/18
346	OH	10/6	10/20	407	OHP	10/10	10/20	1063	OHP	10/9	10/20
341	OHP	10/12	10/24	575	BP	10/15	10/16	1055	OH.	10/15	10/21
174	OH	10/2	10/16	343	OH	10/14	10/19	707	OHP.	10/13	10/24
								1002	Roof	10/12	10/16
CAR HOUSE 2											
451	Heaters	10/14	10/17					701	Collision	10/15	10/24
556	OHP	10/8	10/18					704	"	10/15	10/24
MISCELLANEOUS											
1827	Trunk Latch	10/15	10/15								
1883	"	10/16	10/17								
1852	Shutters	10/15	10/16								
1839	Bell	10/15	10/19								

PLANNING SYSTEM—FIG. 3, BLACKBOARD CHART, CARS IN AND OUT

equipped with wheel grinder, car hoist, crane, drill press, emery wheel, grindstone and small forge. The carhouse forces were allowed to grind wheels on the cars, change wheels, change armatures on the split-type motors, and replace complete motors of the box type, but they were not allowed to do any general overhauling or heavy repairing.

All parts, such as controllers, armatures, motors, air compressors, circuit breakers, etc., were sent to the carhouses ready to be put on the cars, and if any parts



PLANNING SYSTEM—FIG. 4, CHART OF SHOP LAYOUT

were defective these were replaced and the defective parts were sent to the shop for repairs. A delivery car visited each carhouse every other day to deliver and pick up material. By this plan equipment was kept in good shape, and the patchwork which is liable to be done at carhouses because of lack of facilities and time to do good work was avoided.

The cars received general overhauling at the shop on a mileage basis. This consisted in taking the motors and trucks apart, repairing all worn pieces, cleaning and painting the motors, overhauling the wiring, electric parts, air valves, etc., as well as the car body. All parts had been standardized, making them interchangeable in the different equipments where possible in order to minimize the variety of parts. All individual parts were made exactly alike, so that if any gave out they could be replaced at the carhouse without fitting.

THE PLANNING AND EFFICIENCY SYSTEM AS ADAPTED TO PORTLAND SHOP CONDITIONS

The Taylor system as applied in industrial plants is so well known that it will suffice here to state that for our purposes the elements consisted in the following elements: (1) The organization and instruction of an office force for planning and routeing work, following its progress and keeping all necessary records; (2) the transferring of all clerical work to this office; (3) the securing of data as to the capabilities of men and machines, and (4) the fixing of such time allowances for jobs as would conduce to economy in production. How this was done will develop as the story progresses.

MAKING A START

After deciding to adopt a planning and efficiency system the first question was how to start. It was decided that the best way would be to adopt a small part of the system all over the plant at one time rather than to try it in a part of the plant only. The latter procedure might have resulted in interference between the two systems. The chief clerk was first set to planning the office part, and the general foreman to systematizing the work in the shops so there would be no hitch when we were ready to begin. Previously cars had been ordered in by the chief clerk under instructions of the general foreman, but now this was entirely turned over to the chief clerk whose duty it would be to keep the shop supplied with work.

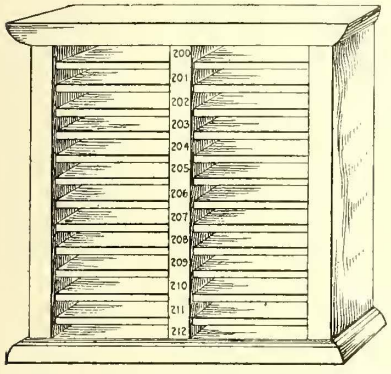
The foremen were first approached on the subject, and as nearly all of them took kindly to the plan we next discussed it with the workmen. Rumors had circulated in the shops to the effect that scientific management was to be introduced, and that it would make the men work harder. For this reason the name "Planning System" was adopted, appropriately, as we had decided to take up the planning part first. The attention of the men was directed to the fact that they would not be required to make out time cards, and that material would be delivered to them, thus saving them the trouble of going for it. They soon began to take an interest in the system, some of the good men asking how soon it was to be inaugurated, as they thought it a good thing.

We had in the shop office a large blackboard on which was a chart for keeping track of cars in the shop. This chart is shown in Fig. 3. We decided to continue the use of this board, and made also a large route board of the complete shops as shown in Fig. 4. This was laid out to scale, and numbers were used to indicate spaces for material with letters for the respective shops. For example, "*A*1" designated space No. 1 in the armature room, "*B*" designated the blacksmith shop, etc. On the board rectangles representing the machines were num-

bered and lettered also. Thus, "*E*1" was used for emery wheel No. 1, "*BM*2" for boring mill No. 2, etc. Corresponding with the lettering on the route board, signs were hung over each machine and space on square boards painted white and lettered in black. These sign boards were not fastened tight, but were attached in such a way that they could be moved in case a rearrangement of the space was found more convenient.

GETTING THE OFFICE WORK STARTED

As each department had a telephone, we decided to put one calculagraph in the office, to keep the time cards in the office, giving the workmen paper duplicates, and to have the workmen telephone to the office for orders, the time clerk stamping their cards in the office. Small cabinets were made to hold these time cards near the telephone in each department. The design of the cabinets is shown in Fig. 5. The cabinets were made with left-hand and right-hand sections, the left-hand one for the slips representing jobs on which the men were working, and the right-hand one containing the slips showing the jobs next to be started upon. A large cabinet for the use of the time clerk was placed in the office, divided into main sections to correspond with the shop cabinets.



PLANNING SYSTEM—FIG. 5, CABINET FOR TIME CARDS

When a workman had finished a job, he telephoned in to the time clerk, who stamped his card out on the calculagraph. The workman would then take up the next time card, which stated that he was starting on a new job, and the time clerk would correspondingly stamp the starting time on the card in the office.

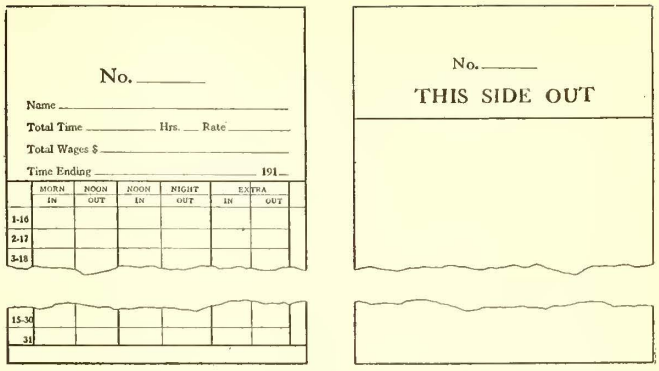
Previous to starting the planning system, the office force consisted of seven men: a chief clerk, a statistical clerk, a mileage clerk, a record clerk, a cost clerk, a time clerk and a stenographer. There was also one clerk in the overhauling department to make out requisitions, and one in the carpenter shop, making a total clerical force of nine. In introducing the new system we found it necessary to move the outside clerks into the office, and to increase the office force by one clerk and one office boy, making a total of eleven. In order to systematize the work of these clerks, the schedules of duties shown in Table I on page 542 were prepared.

SHOP PREPARATION FOR THE TRANSITION

In putting the new plan into operation, no changes were to be made in the shop foremanships but each foreman was instructed on the following points:

A "moving gang" was to be provided, and these men were to move all material. No work was to be done without an order from the office, and if the men had nothing to do they were to wait until they got orders from that source. When work came in that required the taking apart of equipment, an order for such work would be secured, after a list of what was to be done had been made out and reported to the office on an instruction sheet.

When all the plans for keeping records had been completed and the necessary forms printed, it was decided to inaugurate the new plan on the date of the beginning of the next ensuing payroll. On the previous day all



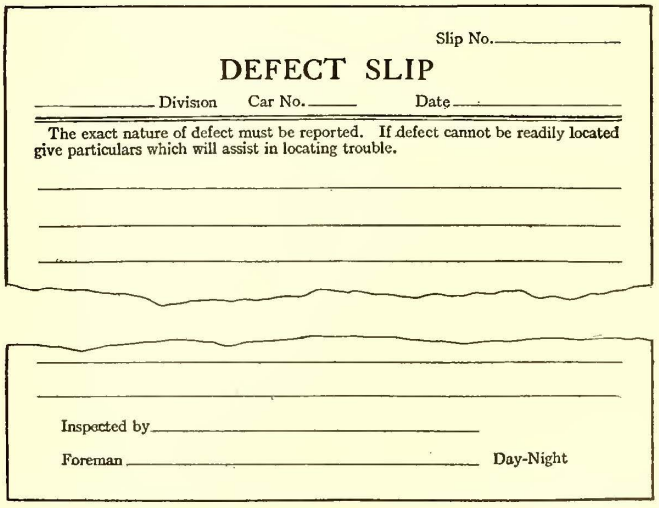
PLANNING SYSTEM—FIG. 6, SEMI-MONTHLY TIME CARD

of the foremen were instructed to close up all of the jobs on which work was being done, and to send to the office a list of the unfinished jobs and a list of the names of men who would work on these jobs. Each workman had been given a number, and the foremen had furnished the chief clerk with a statement of the various classes of work which the respective men could do properly and the machines which they were competent to operate.

The night before the new plan was inaugurated, the daily time cards were taken out of the clock racks, and semi-monthly cards like those shown in Fig. 6 were put in for each man. This was done as the men were to be paid twice a month. The office force made out the individual time cards for all of the jobs left over, and for any new ones which were on hand. The jobs were assigned to the men, and the cards were distributed to the several cabinets ready for the men when they arrived in the morning. The foremen were instructed to be near the telephones in the morning, and to instruct the men if necessary. Everything started out with but little delay, such delay as did occur being caused by the necessity for assigning a job to each workman on the first morning.

THE FIRST DIFFICULTY AND HOW IT WAS OVERCOME

The first trouble started because the workmen ran out of work and had nothing signed up for them to do. As the office force was not acquainted with the work, the foremen turned in to assist them and, although they had to work nearly every night for a while, little time was lost by the men. It was soon found that work was being done so much more rapidly under the new system that the men were running out of work.



PLANNING SYSTEM—FIG. 7, DEFECT SLIP

Table I—Duties of Office Clerks

Duties of Chief Clerk—Production Clerk

1. Receive all approved orders. Assign shop order numbers. Make out instruction sheet and cost record.
2. Designate order of work and sequence of operations. Approve material lists. Give instruction sheet to route clerk and material lists to material clerk.
3. Receive reports of variation from schedule. Investigate and notify proper departments of delays.
4. Issue tracer for material not received promptly.
5. Receive instruction sheet and cost record from cost clerk when completed. Make record of operations. Index and file.
6. Supervise all office work.
7. Receive and open mail, and send to proper desks.
8. Order in disabled cars. Keep record of cars in shop.
9. Keep record of all cars overhauled and painted, with dates next due. Order cars to shop when due.
10. Keep record of all work performed in department.
11. Make up all work orders and estimates.
12. Make out requisitions for all material to be purchased.
13. Make receipts for all material received on purchase orders.
14. Check all orders and invoices.
15. Check and approve all requisitions for material drawn from storeroom.
16. Keep record of cars owned.
17. Keep record of all changes affecting cars.
18. Make up monthly statement of cars owned.
19. Make up monthly report of work performed in department.
20. Keep record of free transportation of all forms used in department.
21. Keep list of all employees in department, with addresses, etc.
22. Make up office payroll.
23. Check and approve shop and carhouse payrolls.
24. Check report of distribution of shop labor and material. Add percentages and send to auditor.
25. Keep record of locker keys in possession of employees.
26. Check and approve monthly estimate for stationery.
27. Make out credit memoranda for all scrap material shipped.
28. Make up monthly statement of oil and grease consumed.
29. Keep ledger account of manufacturing, work-order and shop expense.
30. Keep record of number of men employed at different rates in each department and keep total of the monthly payrolls.
31. Keep efficiency record of office employees and inspectors.
32. Keep record of all company tools.
33. File catalogs and periodicals.
34. Supervise fire drill organizations at shops and carhouses.
35. Attend and report on all fires occurring on or near company property, excepting buildings under supervision of light and power department.
36. Inspect fire alarm system at shops daily.

Duties of Route Clerk

1. Receive instruction sheet and cost record.
2. Fill in operations and estimated time.
3. Enter work on route sheet.
4. Put tag on planning board.
5. Make out order of work sheet.
6. Make out instruction cards.
7. Give instruction sheet to cost clerk.
8. Receive duplicate time cards and instruction cards for work completed.
9. Check completed jobs on route sheet and plan board.
10. Notify cost clerk when jobs are completed.
11. Report variations from schedule to production clerk.
12. Take shift on time desk.
13. Take production clerk's place when he is absent.

Duties of Assistant Route Clerk

1. Receive instruction card from route clerk.
2. Make out time cards in duplicate for each operation. Send duplicate with instruction card to department foreman. Give original to time clerk.
3. Receive duplicate time cards for completed jobs. Sort by shop-order number and give to route clerk.
4. Receive time cards and work reports from rip track. Put charges on time cards and give to assistant time clerk. Keep record of work.
5. Assist cost clerk in making out cost cards on cars overhauled and painted.
6. Take material clerk's place when he is absent.

Duties of Time Clerk

1. Receive original time cards from assistant route clerk. Distribute in right-hand pigeonholes.
2. At 7 a. m. stamp all cards in left-hand pigeonholes with calculagraph.
3. When workman telephones giving his number and the number of the job he has just completed, take corresponding card from left-hand pigeonhole, stamp in calculagraph, verify number of job the workman is about to take up, take corresponding card from right-hand pigeonhole and stamp in calculagraph, replacing in left-hand pigeonhole.
4. At 4.45 p. m. stamp all cards in left-hand pigeonhole in calculagraph. Copy these cards for the next day's work.
5. At 8.30 a. m. send the office boy to collect "ring-in" cards.
6. Check calculagraph cards for previous day, extend hours and amounts, check total with payroll. Give cards to cost clerk.
7. On the 13th and 28th of each month, close payrolls, extend time and amounts, balance and copy for new payroll. Give to chief clerk.
8. Make out time certificates for all employees leaving service.

Duties of Material Clerk

1. Receive material lists from production clerk. Write all requisitions in triplicate. Forward original and duplicate to storeroom. Send triplicate with move order to moving gang.
2. Receive triplicate requisitions from moving gang when material has been delayed and give them to cost clerk.
3. Take shift on time desk.
4. Assist cost clerk in preparing monthly statement.

Duties of Cost Clerk

1. Receive instruction sheet and cost record from route clerk and file in current file.
2. Receive calculagraph cards from time clerk. Enter on proper cost record sheets.
3. Receive duplicate requisitions from auditing department, sort and check with triplicates. Enter on proper cost record sheets.
4. When notified by route clerk that a job is completed, close shop order. Total up labor and material. Enter on recapitulation sheet.
5. Enter totals for manufacturing shop orders on special cost record.
6. Enter totals for overhauling and painting on special cost record.
7. Submit special cost records to master mechanic.
8. Report cost of manufactured articles to auditor.
9. On the 28th of each month, total up all charges for labor and material, and enter on recapitulation sheet under proper distribution. Total up recapitulation sheet and give to chief clerk.
10. Take shift on time desk.

Duties of Office Boy

1. Every half hour make rounds of shop, taking out time cards and instruction cards, and collecting completed cards.
2. Sort time cards.
3. Perform other duties as designated by chief clerk.

Duties of Statistical Clerk

1. Arrive at 7 a. m.
2. Receive telephone reports of crippled cars, etc., from carhouse foreman. Tabulate and give copies to master mechanic, chief clerk, general foreman, general manager, and file.
3. Receive written pull-in reports from carhouse foreman, and tabulate on morning report.
4. Tabulate weekly pull-in record.
5. Tabulate monthly pull-in record.
6. Keep record of all changes in equipment and report to general manager, superintendent of transportation and claim department, and file.
7. Keep record of car assignments.
8. Keep record of principal items drawn from storerooms.
9. Keep record of cars inspected.
10. Keep record of armatures, fields, wheels, etc., changed.
11. Keep record of cost of changing armatures, wheels, etc., and grinding wheels.
12. Tabulate monthly report of operating expenses.

Duties of Car Record Clerk

1. Receive reports from carhouse and shop foremen of all work performed and equipment changed.
2. Record all data on car record cards.
3. Receive Sellwood carhouse time cards. Put on charges and give to assistant time clerk.
4. Receive daily mileage report from auditor and record on mileage cards.
5. Number all parts of equipment.
6. Make special reports of changes of test equipment, broken axles, etc.

Duties of Mileage Clerk

1. Receive reports from carhouse foremen of all renewals of equipment ordered.
2. Enter on record sheets. Obtain mileage from mileage cards and enter on record sheets.
3. Make up monthly statement of mileage made by equipment.
4. Ship all scrapped wheels. Make special report of wheel mileage.
5. Make up graphic charts showing mileage made by parts.
6. Put tabs on mileage cards of cars due for overhauling.

Duties of Stenographer and Assistant Time Clerk

1. Change dial in recorder daily.
2. Take dictation. Type correspondence.
3. File correspondence.
4. Extend and code carhouse time cards.
5. Enter on payrolls.
6. On the 12th and 28th of each thirty-one-day month, and the 12th and 27th of each thirty-day month, close carhouse and rip-track payrolls, extend time and amounts, balance and give to chief clerk. Copy payrolls for next month.
7. Check up stationery stock and make up monthly estimate.

At this time, several men resigned on account of getting better positions elsewhere or leaving town, and we did not hold their places. In fact, we were pleased not to be required to find work for them, as we were getting out more work than was scheduled for each day.

There was no dissatisfaction among the men, but we found that some of the foremen were becoming dissatisfied because the office force, through lack of familiarity with the system, was putting some of the office work on the foremen. The foremen, also, were trying to keep up the old system. To overcome this difficulty, we gave the foreman in each department one workman to work on the old system, and any little odd jobs that had to be done were turned over to this workman. This expedient saved the foremen the work of getting orders for the small jobs that were overlooked by the office, which had all it could do to handle the large jobs. It also showed the foremen that they did not need to keep up the old system, and we instructed them how they could simplify the making out of the sheets by having the workmen give them the lists of items. We also explained that after the sheets had been made out for the work already in the shops, it would not be so difficult to maintain the system.

Form 568 MECH. DEPT.

Move Order

Date

MOVE

From

To

Wanted by O'clock M. 191

Shop Order No.

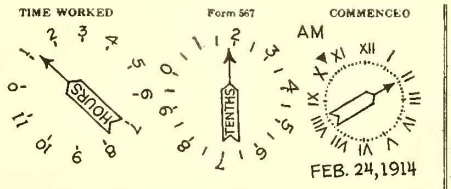
PLANNING SYSTEM—FIG. 8, MOVE ORDER FORM

After working on the new scheme for two weeks the office force had a good line on the work, and was able to keep up with its end without working overtime. The work of the foremen had also slackened, so that they were satisfied. To show how the system was working, the following detailed illustration has been selected.

ROUTINE FOR OVERHAULING AND VARNISHING A CAR

A good illustration of the operation of the system is furnished by the procedure in the case of overhauling and varnishing a car. The car is first called in by the chief clerk for overhauling and varnishing. It is sent, some time during the night, from one of the carhouses to the shop with a slip like that shown in Fig. 7. The car is left in the yard and the slip is put into the mail box for the foreman of the "moving gang." In the morning this man notifies the route clerk, who makes the appropriate entry on the blackboard shown in Fig. 1, and also fills in a move order on the blank shown in Fig. 8. The car is then put upon the assigned track in the motor shop. Two time cards, like the one shown in Fig. 9 are made out, one with instructions to raise the car and take out the trucks, and the other

TIME WORKED Form 567 COMMENCED



P.R.L. & P. Co. Mech. Dept.
TIME CARD

Employee No. 200
Dept. No. 3
Shop Order No. 1914
Date Feb. 24, 1914
Work Code
Distribution 485

Car No. 600 Operation 1

Jack up car & remove trucks.

Estimated Time	Hours	Rate	Amount

PLANNING SYSTEM—FIG. 9, TIME CARD

with instructions to dismantle the equipment. One card goes to the time clerk, and the other to the cabinet in the motor shop. A sheet like that shown in Fig. 10 is furnished to the foreman, and is filled out when the trucks are dismantled. For example, the items might be as follows:

Quantity	Article
2	Radius bars, straightened, plugged and drilled.
4	Radius bar brackets, straightened, plugged and drilled.
8	Live levers, plugged and drilled.
8	Dead levers, plugged and drilled.
4	Turnbuckles to be repaired.
8	Brake connecting levers, plugged and drilled.
5	Pedestal gibs, straightened, plugged and drilled.
4	Release springs repaired.
4	Brakeheads spot-welded and ground.
2	Motor suspension bracket spot-welded and ground.
4	Brake-hanger castings refitted.
4	Brakeheads refitted.

The instruction sheet, for which the form is shown in Fig. 11, is sent in to the route clerk who routes the material to the first shop that has work to do on the car, issuing a time card for the work and also an order for material if any is needed. In the meantime, all

Mechanical Department

MATERIAL TO BE REPAIRED

For

Sheet No.

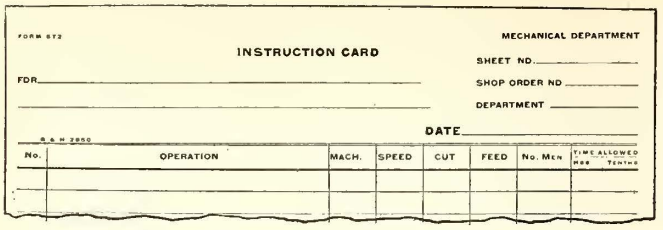
Shop Order No.

Distribution

QUANTITY	ARTICLES

Foreman

PLANNING SYSTEM—FIG. 10, FORM FOR MATERIAL TO BE REPAIRED


FORM 572

INSTRUCTION CARD

MECHANICAL DEPARTMENT

SHEET NO.

FOR

SHOP ORDER NO

DEPARTMENT

DATE

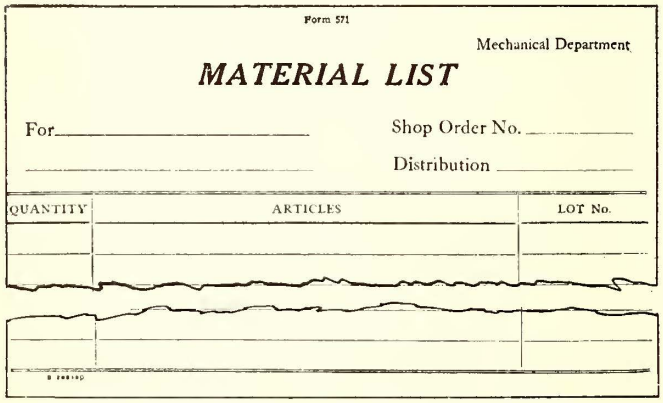
No.	OPERATION	MACH.	SPEED	CUT	FEED	No. MEN	TIME ALLOWED HRS / TENTHS

PLANNING SYSTEM—FIG. 11, INSTRUCTION SHEET FORM

parts have been left on the shop floor under the signboard designating the assigned track. When the piece is finished in one department, the route clerk orders it to the next shop and so on until it is finished, when he orders it returned to the assigned track.

A material list, on a form like that shown in Fig. 12, is also given to the foreman, who fills in entries for new material needed and turns the list over to the production clerk. The latter has with him a material clerk who makes out a requisition on the stores department on the form shown in Fig. 13. This material is moved by the moving gang to the assigned track. After all new material is delivered, and all parts repaired and returned, time cards are made out for assembly. A requisition for each article is made out on a separate form, and if one of the articles is not received, a tracer, see Fig 14, is sent for it.

When the work on the trucks has been completed, instruction sheets are made out for the overhauling of the electrical equipment, motor equipment and air equipment, and when the car is finished in the motor shop, a move order is given to transfer it to the carpenter shop, and time cards are made out for each operation


Form 571

Mechanical Department

MATERIAL LIST

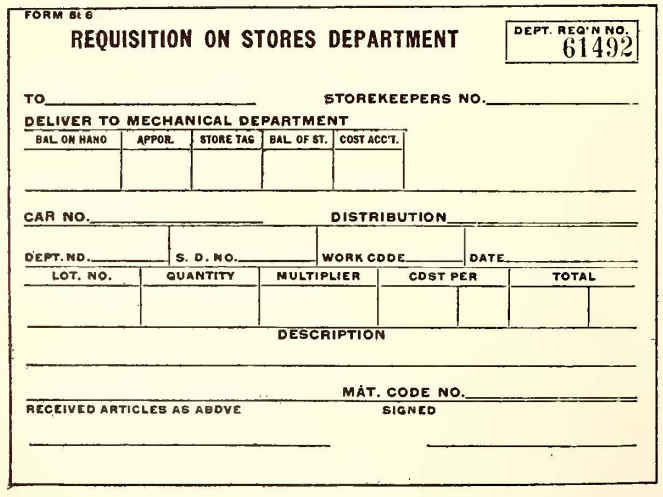
For

Shop Order No.

Distribution

QUANTITY	ARTICLES	LOT No.

PLANNING SYSTEM—FIG. 12, FORM FOR MATERIAL LIST


FORM 81 6

REQUISITION ON STORES DEPARTMENT

DEPT. REQ'N NO. 61492

TO

STOREKEEPERS NO.

DELIVER TO MECHANICAL DEPARTMENT

BAL. ON HAND	APPOR.	STORE TAG	BAL. OF ST.	COST ACC'T.

CAR NO.

DISTRIBUTION

DEPT. NO.

S. O. NO.

WORK CODE

DATE

LOT. NO.	QUANTITY	MULTIPLIER	COST PER	TOTAL

DESCRIPTION

MAT. CODE NO.

RECEIVED ARTICLES AS ABOVE

SIGNED

PLANNING SYSTEM—FIG. 13, FORM FOR REQUISITION ON STORES DEPARTMENT

as before. When these operations are all finished, the work being assigned by the office and time kept on the time cards as when the car was in the motor shop, the car is ordered moved to the paint shop, where a similar instruction card is prepared. When the car is finished it is moved out into the yard, and the chief clerk notifies the carhouse foreman to have it taken away and to bring in another car.

It may be of interest to note the items which might appear on the six instruction sheets, to which reference has just been made. Such a list is given below.

Instruction Sheet No. 1.—Overhaul Car No. 600—Trucks.

1. Jack up car and remove trucks.
2. Remove motors.
3. Dismantle trucks.
4. Repair truck irons — Weld brakehead.
5. Assemble trucks.
6. Replace motors.
7. Replace trucks and let car down.

Instruction Sheet No. 2.—Overhaul Car No. 600—Electrical Equipment.

1. Inspect cables, leads, circuit-breakers, fuse boxes, contactors and reverse, and resistance.
2. Clean and oil controllers.
3. Inspect light and bell circuits.

Instruction Sheet No. 3.—Overhaul Car No. 600—Motors

1. Clean outside.
2. Remove armatures and fields.
3. Repair armatures and fields.
4. Clean and paint inside.
5. Assemble.
6. Test.
7. Clean and repair gear and motor cases.

Instruction Sheet No. 4.—Overhaul Car No. 600—Air Equipment

1. Remove compressor, governor gages, valves, brake levers and rods.
2. Repair levers and rods.
3. Replace equipment.
4. Repair hand brakes.
5. Overhaul compressors.
6. Clean and repair valves.
7. Repair air fenders.

Instruction Sheet No. 5.—Overhaul Car No. 600—Body

1. Adjust sash curtains and doors.
2. Repair steps and put on safety treads.
3. Repair roof.
4. Repair overhead signs.
5. Tighten up under car body.
6. Repair seats.
7. General body repairs.
8. Repair body irons.

Instruction Sheet No. 6.—Varnish Car No. 600

1. Wash.
2. Strip.
3. Body repairs.
4. Sand body and prime.
5. Remove varnish from sash and doors.
6. Putty body, sand, touch up first coat.
7. Sand, stain, varnish inside.
8. Paint and varnish sash doors and trimmings.
9. Sand sash and doors.
10. Touch up second coat, stripe and letter.
11. Varnish, first coat.
12. Varnish, second coat.
13. Trim.
14. Paint roof and deck.
15. Paint floor.
16. Clean and paint trucks and fenders.
17. Stripe trucks.
18. Varnish.
19. Clean glass.

It will be noticed from the instruction sheets that we were obliged to bunch the work considerably, which was necessary on account of having to teach all the office and shop force the new system. In four months we were able to make most of the instruction sheets in the office, as all types of cars had nearly the same work. At this time, we also had sheets of nearly all material manufactured in the shops. While the system at this time was crude, it was working very nicely, and we came to the conclusion that it was time to take the next stop.

The Efficiency Foreman

The foreman of the machine shop was a bright young man who had taken a great interest in the new system. It was decided to give him the title "efficiency foreman" in addition to his title as foreman of the machine shop. He was also given an assistant whose function was gradually to relieve him of the machine-shop work. The efficiency foreman was furnished with a stop watch, and he started to make time studies in the machine shop as well as to make instruction cards for each job in that shop. The first instruction cards which had been turned in were not satisfactory; as the time seemed too long. Although we had what we considered then a model shop with all conveniences, we believed that conditions in the shop would have to be bettered in order to shorten the time. The difficulty was that we had not studied the small details, and

when we did so we found that there were many which could be improved.

The efficiency foreman was started in to watch each job, following up one at a time. He made a test and determined the proper tools to be used and the best way in which the job could be done. At the end of his study, he made out an instruction sheet. He also made a study, with the help of reference books, of the best shapes of tools and cutting speeds, determining experimentally which gave the best results. He found that it was necessary to change the speeds of most of the machines, and in some cases to put on larger belts.

Form 569 MECH. DEPT.

Tracer

Date

To

Material ordered on Req'n. No.

Dated Calling for

has not been received, and work on

Shop Order No. for the

Dept. is thereby delayed. Kindly advise when this material was ordered and when we may expect to receive it.

PLANNING SYSTEM—FIG. 14, TRACER FORM

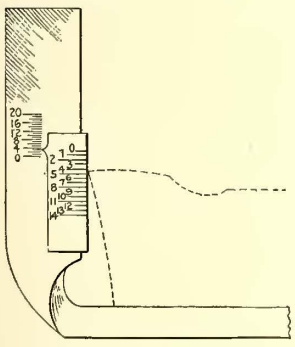
The efficiency foreman, after making a close study of the men, reported that too much time was lost when they were obliged to think about what they should do next. He was, therefore, instructed to get out instruction cards, on the forms like that shown in Fig. 11, of which the following is a sample.

INSTRUCTION CARDS FOR STANDARD PONY AXLES, C. R. STEEL, 3¾ IN.

1. Adjust lathe, machine L-2.
2. Put on dog No. 18.
3. Put in lathe.
4. Set tool No. 6
5. Cut to 3½ in., 13¾ in. long, speed 74, cut ⅛ in., feed 16¼.
6. Cut to 2-29/32 in., 8½ in. long, speed 60, cut 19/64 in., feed 16¼.
7. Set tool No. 1.
8. Cut to 3-15/32 in., 5⅝ in. long, speed 370, cut 1/64 in., feed 65.
9. Cut to 2⅞ in., 8⅛ in. long, speed 370, cut 1/64, feed 65.
10. Set roller No. 4.
11. Roll finish on journal, speed 300, feed 40.
12. Set tool No. 7.
13. Cut slot for check plate, speed 300, cut ¼, hand feed.
14. Change ends and repeat operations Nos. 4 to 13.
15. Take out of lathe.

Tools required: One tool No. 1, one tool No. 6, one tool No. 7, one roller No. 4, one lathe-dog No. 18.

The efficiency foreman was to get out these cards, paying no attention to the time, with the idea of making time studies later. He found it necessary at first to make tables of speed and feed for different machines, as is shown in Tables II and III, and a gage for setting tools, like that illustrated in Fig. 15. This necessitated that all tools be ground at a certain angle, and for this purpose we took one of our whet tool grinders and put on an angle plate. The table was provided with two indicators so as to show the correct angle for various types of tools and diameters of wheels. The foreman also found that different tensions in belts produced different results, so that we purchased a wire-belt-lacing machine, and made a pair of clamps with spring balances in order to keep the proper tensions.



PLANNING SYSTEM—FIG. 15, GAGE FOR SETTING TOOLS

All of the above was taking a great deal of time, and the efficiency foreman had opportunity to watch the men and note the small mistakes which they were making. He became discouraged in that he thought he was not getting along fast enough. We explained to him that it took time to study everything thoroughly, that haste would necessitate repetition, and that now, being relieved of the machine-shop work, he had an opportunity to note the details of all operations that were being performed incorrectly. He then started to straighten things out by getting out the instruction cards and having the men use them. The result was surprising, and our force was reduced so much in this department that if one man stayed away a day, it threw the work back for the other departments.

TABLE II—SPEED AND FEED FOR BELT-DRIVEN LATHE NO. L.3

Cone No's	1	2	3	4	5
Open belt	80	115	170	260	400
Back gear	8	12	18	28	42

FEEDS

Cone 1	Cone 2	Cone 3
40	60	80

EFFICIENCY STUDIES IN THE PAINT SHOP

As the foreman of the paint shop was to be off for several months, we next determined that we would have the efficiency foreman lay out the work in that shop. He decided to take one of the standard series of cars going through the shop at that time, and get out the appropriate instruction cards. As the cars were washed before being given a general repairing, he arranged to follow them through the carpenter and paint shops.

We first made out two general instruction cards, one for the carpenter shop, and one for the paint shop, dividing the work in the two departments into twenty-four general items. These are given below.

INSTRUCTION CARDS FOR VARNISHING CLASS NO. 500 P. A. Y. E. CAR

1. Strip car, one man.
2. Wash car, three men.
3. General body repairs, four men.
4. Scrape and repair roof, two men.
5. Repair steps, one man.
6. Sand body and prime, two men.
7. Scrape sash and doors, two men.
8. Putty body, two men.
9. Sand and touch up first coat, two men.
10. Sand, stain and varnish inside, two men.
11. Sand sash and doors, one man.
12. Paint and varnish sash and doors, one man.
13. Touch up body, second coat, two men.
14. Stripe and letter, two men.
15. Varnish outside, first coat, two men.
16. Varnish outside, second coat, two men.
17. Trim car, one man.
18. Paint roof and deck, two men.
19. Paint floor, two men.
20. Clean trucks, one man.
21. Paint trucks, one man.
22. Stripe trucks, one man.
23. Varnish trucks, one man.
24. Clean glass, three men.

We next made out detail instruction cards for each general item, classifying the operation of each item as *A*, *B*, *C*, etc. The following is a list of the items covered by the general instruction sheets.

DETAIL INSTRUCTION CARD FOR STRIPPING NO. 500 CLASS P. A. Y. E. CAR FOR VARNISHING

1A. Remove all sash, entrance doors and two exit doors, one man.
1B. Remove door curtains, one man.
1C. Number window stops, one man.
1D. Mark curtains, one man.

TABLE III—HIGH-SPEED DRILL PRESS NO. D4 FOR DRILLING MILD STEEL

Cone No.	95 Feed	135 Feed
1		0 to $\frac{1}{2}$
2	$\frac{17}{32}$ to $\frac{3}{8}$	$\frac{11}{16}$ " $\frac{3}{4}$
3	$\frac{25}{32}$ " 1	$1\frac{1}{64}$ " $1\frac{1}{4}$
4	$1\frac{17}{64}$ " $1\frac{5}{8}$	$1\frac{41}{64}$ " 2

FORM 488

LOT NO._____

MANUFACTURING DATA

FOR DEPT. MATERIAL

COST DATA_____SHOPS

SHOP ORDER	DATE ISSUED	DATE COMPLETED	NO. PIECES	TOTAL LABOR COST	TOTAL MATERIAL COST	TOTAL COST	LABOR COST PER PIECE	MATERIAL COST PER PIECE	TOTAL COST PER PIECE	REMARKS

PLANNING SYSTEM—FIG. 16, COST CLERK'S SHEET

DETAIL INSTRUCTION CARD FOR WASHING CLASS NO. 500 P. A. Y. E. CAR FOR VARNISHING

(Three men assigned to wash car and clean glass.)
2A. Remove seats.
2B. Remove signs.
2C. Clean under seats.
2D. Clean sand boxes.
2E. Wash roof.
2F. Wash inside of car.
2G. Wash outside of car.
2H. Clean glass.

DETAIL INSTRUCTION CARD FOR BODY REPAIRS NO. 500 CLASS P. A. Y. E. CAR FOR VARNISHING

3. General body repairs, four men.
4. Scrape and repair roof, two men.
5. Repair steps, one man.
7. Scrape and repair sash and doors, two men.
17. Trim car, one man.

DETAIL INSTRUCTION CARD FOR FINISHING SASH AND DOORS NO. 500 CLASS P. A. Y. E. CAR FOR VARNISHING

11. Sand sash and doors, one man.
12. Paint and varnish sash and doors, one man.
12A. Prime.
12B. Putty.
12C. Paint first coat.
12D Paint second coat.
12E. Stipple.
12F. Varnish first coat.
12G. Varnish second coat.

DETAIL INSTRUCTION CARD FOR VARNISHING OUTSIDE NO. 500 CLASS P. A. Y. E. CAR

6. Sand body and prime, two men.
8. Putty body, two men.
9. Sand and touch up, first coat, two men.
13. Touch up, second coat, two men.
14. Stripe and letter, two men.
15. Varnish body, first coat, two men.
16. Varnish body, second coat, two men.

DETAIL INSTRUCTION CARD FOR VARNISHING INSIDE NO. 500 CLASS P. A. Y. E. CAR

10. Sand, stain and varnish inside, two men.
10A. Sand inside.
10B. Stain inside.
10C. Paint brake-staff, pipes, etc.
10D. Varnish inside.

DETAIL INSTRUCTION CARD FOR PAINTING ROOF AND FLOOR OF NO. 500 CLASS P. A. Y. E. CAR

18. Paint roof and deck, two men.
19. Paint floor, two men.

DETAIL INSTRUCTION CARD FOR PAINTING TRUCKS NO. 500 CLASS P. A. Y. E. CAR

20. Clean trucks, one man.
21. Paint trucks, one man.
22. Scrape trucks, one man.
23. Varnish trucks, one man.

The above set of instruction-card items shows that we were now going into more detail, but not giving any time allowance, and we decided that we would not make any time studies until we had all of our instruction sheets made out in full, and then we could devote the necessary time to them.

The savings which we were able to make by the new system are illustrated by reference to the savings on one article. GE-57 axle brasses cost $6.86 in 1912, $6.40 of which was for material. In 1914 the cost was $5.006, of which $4.60 was for material. The weight of each pair of brasses was 32 lb. in 1912 and 23 lb. in 1914.

The costs are recorded on the cost clerk's sheet shown in Fig. 16. A sheet like this was made out for every article manufactured, and the costs were compared with manufacturers' prices, in order to show if it was costing us too much. After eight months' trial, although we had not had time to go into small details of time studies, nor to take up the bonus system, we had been able to stop a lot of leaks and to reduce the cost of maintenance of equipment, at the same time keeping the equipment in better shape. The monthly pull-in report reproduced in Fig. 17 shows a smaller percentage of pull-ins than we had ever had before, and the following four months showed a gradual decrease from this.

HANDLING MATERIALS

On account of the adoption of the planning and efficiency system at the shop we had been having some trouble in the handling of materials at the car houses. We had a delivery every other day, and materials sent in to be repaired were tagged and repaired, and then sent back.

MECHANICAL DEPARTMENT

Monthly Pull-in Report — Month ending Oct 31 1914

	CAR HOUSE 1	CAR HOUSE 2	CAR HOUSE 3	CAR HOUSE 4 CITY	CAR HOUSE 4 INT.	TOTAL
Motors—Armatures	9	1	3	3	4	20
Fields						1
Brushholders	8	4	1	1		14
Arm. Bearings		1				1
Terminal Wires		4	1	1		6
Gears	1					1
Pinions		1				1
Controllers	3	1				4
Resistance	3	6	1	1		11
Contactors		1	4	1		6
Switches and Fuse Boxes	2	1		1		4
Car Cables	1	1		1		3
Car Lights and Light Wiring	1					1
Magnetic Brakes		2				2
Air-Compressors						
Compressor Motors	4				1	5
Governors	1		1			2
Triple Valves			1		1	2
Motorman's Valves				1		1
Pipes and Hoses			1			1
Trucks—Wheels			4			4
Journals			1	3	2	6
Miscellaneous	1	2		1	1	5
Brakes—On Trucks	1					1
Rods, Hangers, Etc.	2	1				3
Slack or Tight	3	1	5			9
Car Bodies—Windows		1	2			3
Doors	1	1		1		3
Steps		2	4			6
Grabhandles		1		2		3
Registers		1				1
Fenders	2	2	6	5		15
Sanders						
Gongs	5					5
Draweheads, Etc.						
Coupler Sockets and Jumpers						
Trolleys	1		1		1	3
Collisions	3	1		2		6
Miscellaneous	1	2	1			4
Found O. K.	3	7	1	2		13
Total	57	45	38	26	10	176
Total Cars Operated	3916	2579	2563	2610	1016	12624
% Pull-ins to Cars Run	1.5	1.8	1.5	1.0	1.0	1.4
Pull-ins, Due to Mech. Defects	47	31	22	14	10	124
Pull-ins, Due to Other Causes	10	14	16	12	0	52
% Due to Mech. Defects	82	69	58	54	100	70
% Due to Other Causes	18	31	42	46	0	30
Total Mileage	408168	221131	258883	286594	158467	1333243
Pull-ins Per 1000 Miles	0.14	0.20	0.15	0.09	0.06	0.13
Miles Between Pull-ins	7160	4914	6812	11023	15846	7575

PLANNING SYSTEM—FIG. 17, MONTHLY PULL-IN REPORT

FORM 587 — Mechanical Department

Used for Departmental Accounting; For Material not in General Supplies.

MATERIAL RETURNED
FOR REPAIRS OR RENEWAL

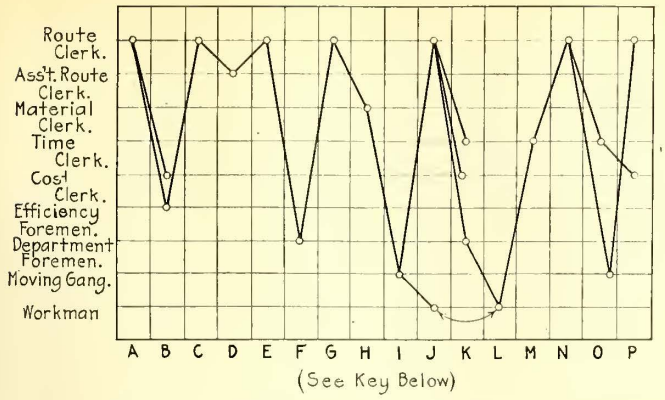
From_____Barn — Year | Month | Day

NO.	ARTICLE	CHECK REC.	CHECK RET.	REPLACEMENT ACKNOWLEDGED

INSTRUCTIONS

BARN FOREMAN will list hereon, all material returned to shops, to be scrapped or repaired, retaining duplicate for record.
DELIVERY CREW will check material when loaded on car at the barn. List will be turned in to Shop Office and orders written to repair such parts as can be repaired, and requisition written to replace such articles as are scrapped. List will be returned to delivery crew in time to load material for next trip. Delivery crew will check each item when loaded in car for replacement, and will obtain foreman's signature after each item delivered to barn. List must be returned to shop office after each delivery, and will be filed in office after all items are checked and signed for as replaced.
NO MATERIAL will be delivered to barn except as shown on this list.

PLANNING SYSTEM—FIG. 18, FORM FOR RETURNED MATERIAL



PLANNING SYSTEM—FIG. 19, ROUTEING CHART

A. Route clerk makes out instruction sheet in duplicate, giving original to cost clerk and retaining duplicate.

B. Efficiency foreman and route clerk in conference assign workmen and estimate time allowance for each operation, this to be obtained from previous records when possible. Cost clerk files original sheet in cost ledger.

C. Route clerk computes time when each operation will begin makes out routeing cards and files under proper date and hour in route case. He gives duplicate instruction sheet to assistant route clerk.

D. Assistant route clerk makes out instruction cards with duplicate time cards for each operation and returns same to route clerk.

E. Route clerk files instruction sheets numerically, files time cards numerically, files instruction cards in the order in which the work is to be done. He twice daily removes instruction cards for work to be done during the next period, and sends them to the department foreman with order-of-work sheets.

F. Department foreman makes out list of material required for each job, notifies route clerk of any absentees affecting assignments to work, and sends material list to route clerk.

G. Route clerk notes on instruction sheet that material has been ordered and gives material list to material clerk.

H. Material clerk writes requisitions for material in triplicate, and sends original and duplicate to store keeper, and triplicate to moving gang to be used as a move order.

I. Moving gang receives material from storekeeper, delivers material to the designated place and returns move order to route clerk.

J. One hour before work is scheduled to begin, route clerk ascertains if material has been delivered, or if there is any other reason for delay. If not, he sends the duplicate time card to department foreman, and the original to time clerk, and gives triplicate requisition to cost clerk.

K. Department foreman puts time card in workman's pigeonhole in card rack in the sequence occupied by order-of-work sheet and gives instruction card to workman just before he finishes preceding job. Time clerk puts time card in rack, cost clerk files trip.

L. Workman notifies timekeeper when he is starting the job, performs operation and notifies timekeeper when finished.

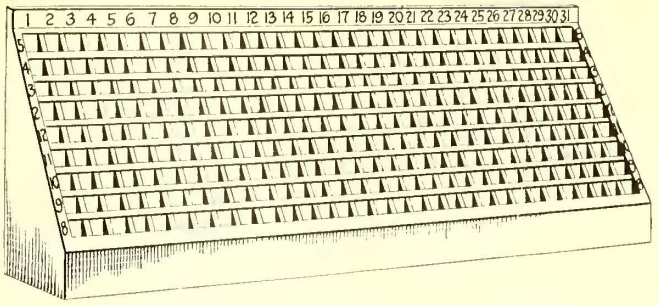
M. Time clerk stamps both old and new cards in calculagraph, gives both to route clerk and notifies route clerk if there are no more cards in the rack for that particular workman.

N. Route clerk checks time cards with route cards, issues a move order to moving gang to move completed material to its next destination. If the work is not started or finished on schedule he ascertains reasons, rearranges schedule, notifies all concerned of delay and gives card back to time clerk.

O. Time clerk puts new cards in time rack, extends old cards, and gives them to cost clerk. Moving gang returns move orders to route clerk.

With the new system, the office was not always promptly notified regarding material sent in for repairs, and it would not be repaired until the foreman complained of not getting it back, thus making a delay. To overcome this difficulty an inventory was made of all the material at the carhouses, and also a list of what each carhouse was allowed to carry in stock. When the carhouses were short their stocks were filled, and when they were overstocked the surplus was returned. As we delivered every other day to the carhouses, the list was cut very close so that they would run short if they did not watch their materials closely.

The foremen were notified that they would have to return piece for piece, as nothing would be sent out on the old orders, but must be entered on a "material returned" slip like that illustrated in Fig. 18. A list of materials on which there were no returns was furnished them; for example, tape, nails, screws, etc. These they were to write on the bottom of the list. In case pieces were lost from the car, the foremen were to write notes to the master mechanic, giving the car



PLANNING SYSTEM—FIG. 20, CABINET FOR SLIPS FOR FOLLOWING JOBS

number and the items of material lost and these pieces would be replaced. This kept the office in close touch with everything that was lost from the car, and if the foremen were becoming careless, which would be indicated by their letters. We had very little difficulty in starting this return system and it has worked out nicely. Besides overcoming the difficulty at the shop, we were able to save in material, as all material was watched closely and all that could be repaired was repaired, cutting down the leak in that direction.

ROUTEING CHART

After some time we noticed that the office was beginning to put out the time cards ahead of time, some of the men having a number of cards in their box. The foremen would then tell them what jobs to do next. As this was going backward a routeing chart like that shown in Fig. 19 was made out, and the men were instructed to follow it. On the first day that this order went into effect, we had several men out of a job in ten minutes, but it showed the office force where they were "falling down" in routeing the work. While the office force was perfecting the routeing, the efficiency foreman made some time studies on the work in the machine shop.

The first job was 330 Brill-22 special truck spring-post bushings, and the shortest time taken for one piece by stop watch was one minute, eleven seconds. The total time was seven and one-half hours, making the time taken for one piece average one minute, twenty-two seconds. This was considered a good record as no time was lost for the workman to get a drink, move materials, etc. The record was that of a very good man. We then took the time of a young man on the turret lathe, a man with whom he had had trouble because of his habit of leaving his work and running around. The result of the record was as follows:

Operation, turning trolley wheels. Shortest time taken by stop watch, one minute, five seconds. Average time taken on five hundred wheels, two minutes, twenty-nine seconds.

Operation, making radius-bar roller bolts. Stop watch time, turning and threading, four minutes, forty-nine seconds. Average time taken on fifty pieces, ten minutes, forty-one seconds.

This test, as well as an incident that occurred in the blacksmith shop, brought very forcibly to our attention the fact that the time studies were very essential. The incident was this: Some time before the hour for quitting, the blacksmith at work on the forging machine had to stop work because he was tired out. He was making a very difficult forging, which necessitated using the hammer as well as the forging machine, and required a lot of walking. He had always had two pieces of iron in the fire at a time, and the largest number made in one day was ninety pieces. On this day, he

TABLE IV—TIME TAKEN FOR TRUCK AND MOTOR REPAIRS

	Truck Operations								Motor Operations					
Date	1	2	3	5	6	7	Total	Emp.	1	2	4	5	Total	Emp.
2 25-15	1.2	1.6	9.2	16.8	7.2	1.4	37.4	78-83	3.1	3.6	4.3	6.9	17.3	85
2-27-15	1	1.2	8.2	18.2	6.2	1.4	36.2	81-84	2.5	3.8	6	7.1	19.4	85
3-15-15	1	1.2	9.3	18	5.6	1.8	36.9	81-84	2.2	3.4	3.8	4.5	13.9	85
3-20-15	1.2	1.6	10	19.4	6	1	39.2	81-84 78-83	3	3.2	2.8	3.1	12.1	85

TABLE V—TIME TAKEN FOR REWINDING ARMATURES

Date	1	2	3	4	5	6	Total	Emp.
3-12-15	.4	1.1	1.8	.5	4.2	1.5	9.5	9
3-12-15	.3	1.1	1.5	2	5.9	.4	11.2	2
3-24-15	.7	1.6	1.3	2.7	3.8	1.4	11.5	9
3-27-15	.6	1.3	1.4	1.4	5.8	1.3	11.8	9
5-23-15	.7	1.3	1	3.2	7.5	1.5	15.2	7
5-28-15	.6	1.1	1.4	2.5	8.5	.4	14.5	7

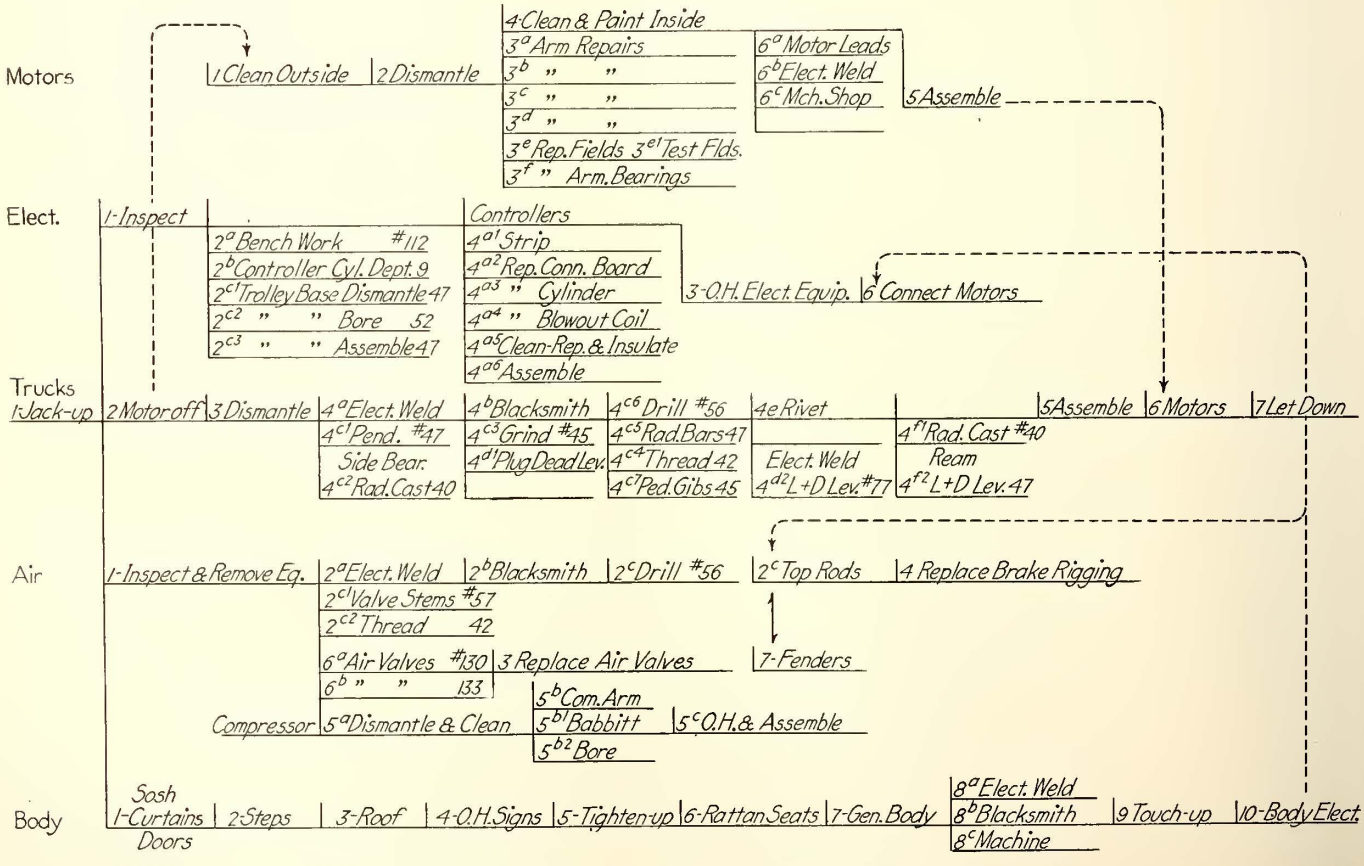
had three pieces in at one time, which made him work harder than he could stand, to keep them from burning. This raised his output to 110 pieces for that day. He was told not to repeat this procedure, but he said that he could do more than the two pieces. He was, therefore, instructed to put in three pieces for a while, and then to put in two until he rested up. He was thus able to get as many out and not be overtired by the end of the day.

The System After a Year's Experience

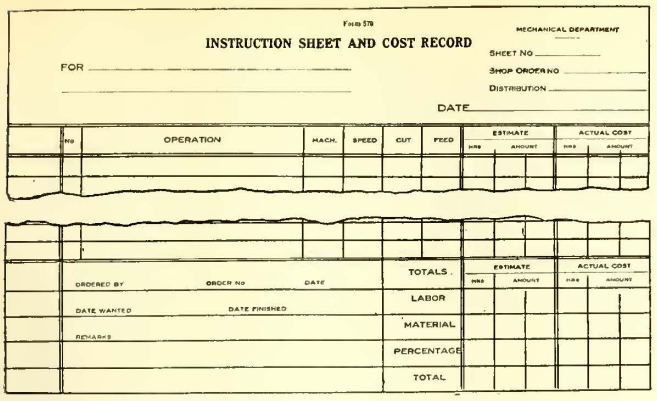
After the planning and efficiency system had been running for a little more than a year, we had been able to dispense with men in each department, and had been able to go farther and farther into details. This put more work on the office, but as the increase was not enough to require an additional clerk, the work was cut down by having two instruction cards made out for all of the regular work, one for the office, and one for the shop. The shop copy was shellacked and varnished so that the dirt would wipe off. Files were also prepared for these cards, and instead of making out an instruction sheet for each job, the number of the sheet was put on the time card, and the standard instruction card was used. As there were very few jobs that were not regular, this procedure greatly reduced the amount of work.

The route clerk was having trouble in keeping track of the material routed through the shop, so that work was not signed up in one shop before it was finished in another. He also had difficulty in keeping the work moving when finished, and a delay tied up the work all along the route. The source of this difficulty lay in the fact that we had no time limits on the different jobs. A cabinet, like that shown in Fig. 20, was therefore prepared, to permit the following up of the work. By estimating the time required, which by means of old records could be done very closely, putting this on the slip with the job number, and following the slip in the cabinet, some improvement was made. The clerk was not accustomed to the work, however, and found it difficult to look after so many slips. The main trouble was to watch the general overhauling, because there was so much material to route through the shop, and if this was delayed there would be nothing for the pitmen to do, while if they started on the job before all the material was returned, they would waste time.

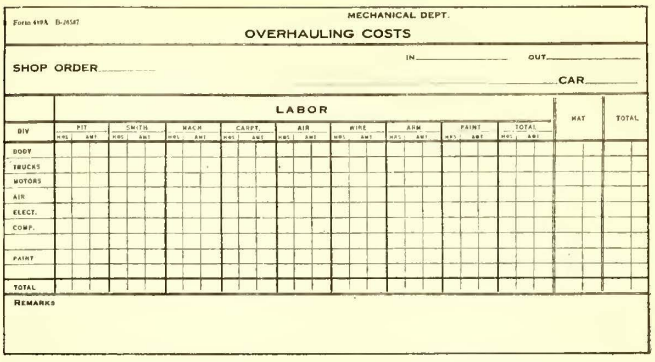
To simplify this work, route sheets like that shown in Fig. 21 were made. One of these was used for each car that was in for general overhauling, and the time when it should be finished was put on the sheet at the end of the line covering each operation. As each job was signed out, the route clerk would indicate this by means of a red line at the proper place on the chart. When the operation was finished he would add another red line, and when the card was returned to the car he would put a red circle at the end. These sheets he kept before him, so that he could see at a glance what work should be followed up. This overcame the trouble, but it was introduced merely for the purpose of train-



PLANNING SYSTEM—FIG. 21, GENERAL REPAIR CHART



PLANNING SYSTEM—FIG. 22, FACE OF FORM FOR ASSEMBLING INSTRUCTIONS AND COSTS, DETAIL OF LABOR AND MATERIAL ON BACK



PLANNING SYSTEM—FIG. 23, CARD FOR ASSEMBLING DATA ON OVERHAULING COSTS

ing the route clerk as we consider the use of the slip box shown in Fig. 20 to be much better.

SOME RESULTS OF THE PLANNING AND EFFICIENCY SYSTEM

Some idea of the saving secured from this system can be obtained from the following examples. Before starting the system, the average time taken to overhaul motors and trucks on one of our standard prepayment cars, equipped with Brill maximum traction trucks, with two motors, was eighty-two hours. After starting in a crude way, this was reduced to fifty-nine and one-half hours, and after going farther into detail, and making a study of each operation, we were able to reduce the average to fifty-three and one-quarter hours.

Table IV shows a record and comparison of different operations on trucks. In this table, operation No. 4 is omitted, this operation being the repair of parts in the blacksmith and machine shops, which is subdivided and kept track of according to the number of parts to be repaired. Also in motors, operation No. 3 is omitted, this being for necessary repairs to armatures and fields, also subdivided according to the work to be done.

In winding a standard armature, the time taken ran from twelve to eighteen and one-fifth hours, the average being fourteen hours. This was divided into operations as follows:

INSTRUCTION CARD FOR WINDING ARMATURES

1. Inspect.
2. Strip.
3. Clean core.
4. Clean commutator.
5. Wind, connect, put on heads, and test.
6. Band and paint.

After the work was divided up, as above, we were able to get records like those shown in Table V. Some variation in time will occur in operation No. 3 in case the armature has been damaged by rubbing. This will also be true of operation No. 4 because commutators may be grounded, and may have to be taken off. In cases of this kind, to be fair to the workman, a reasonable time must be allowed.

Where more than one employee works on a job, different colored ink is used for each, the same colors being used in writing a man's number which is used in reporting the operation that he has done. In the truck gang two men work together—one pitman and one helper; in the motor gang, each man works alone.

OPERATION OF THE STANDARD INSTRUCTION SHEET

The standard instruction sheets are working out nicely for all regular work, relieving the foremen as well as the office force of the task of preparing any instruction sheets except those for irregular work. The following is an example of the way in which such work is taken care of.

We had a car damaged very badly by collision with an automobile truck. This car was ordered to the shop by the chief clerk, and was sent out in the regular way. Each foreman was given an instruction sheet to fill out, and these were turned over to the chief clerk who made out the various instruction sheets and turned them over to the route clerk.

The sheets made out by the several foremen contained the following items:

Electric and Pit Shops: Remove truck No. 1 end, circuit breakers, main switch, air switch, two light switches and controller, disconnect wires and turn back clear of vestibule. Repair one controller and spring posts. New parts: Two Brill 22 spring post bushings, and one pair of wheels. Estimated cost: Labor, $5.58; material, $30.68.

Carpenter Shop: Remove all damaged parts, and take off dash irons, bumper irons, platform floor, vestibule sash, two center posts, two corner posts, upper vestibule rim, end platform timbers, vestibule framework, draw head and slide. Repair bumper irons, straighten dash vestibule panels, two inside panels, one entrance door, entrance step and straighten angle-iron knees.

New parts: Two side and two center timbers, one corner post, two center posts, vestibule framework and new platform. Estimated cost: Labor, $97; material, $15.

Air Shop: Remove all damaged parts. Remove fender, brackets, cylinder and connection, motorman's valve and piping. Repair two fender screens, one fender trip shaft, one fender bracket, two trip levers, two adjusting rods, and one trip rod connecting with valve. New parts: One chain to air cylinder on fender. Estimated cost: Labor, $5; material, $3.

Paint Shop: Paint all new work as standard instruction. Vestibule floor, two coats of floor paint after new work is finished, vestibule to receive one coat of varnish. Estimated cost: Labor, $5; material, $2.

When receiving the instruction sheet from the chief clerk, the route clerk had time cards made out, and routed them through in the regular way. The chief clerk also made out an estimate of the cost of repairs.

We have recently started to make time studies of each operation, filling in the time on the instruction cards that we have in the office. We shall thus have an idea of how long it will take to perform each operation, and by comparing the men's time with the instruction cards, we shall be able to note the efficiency of each man. This will take care of the production part of the shop, but not of the wages. At present, the rate of pay of the men is being advanced according to the percentage of efficiency, although this is a very crude method. We expect to work out a bonus system, but this will take some time as we wish to have all of the time allowances filled out on the instruction cards before starting the system.

In closing, it should be urged that care be taken not to push the planning and efficiency system too fast, as it must be worked out very thoroughly and systematically to be successful.

Repair-Shop Applications of Oxy-Acetylene

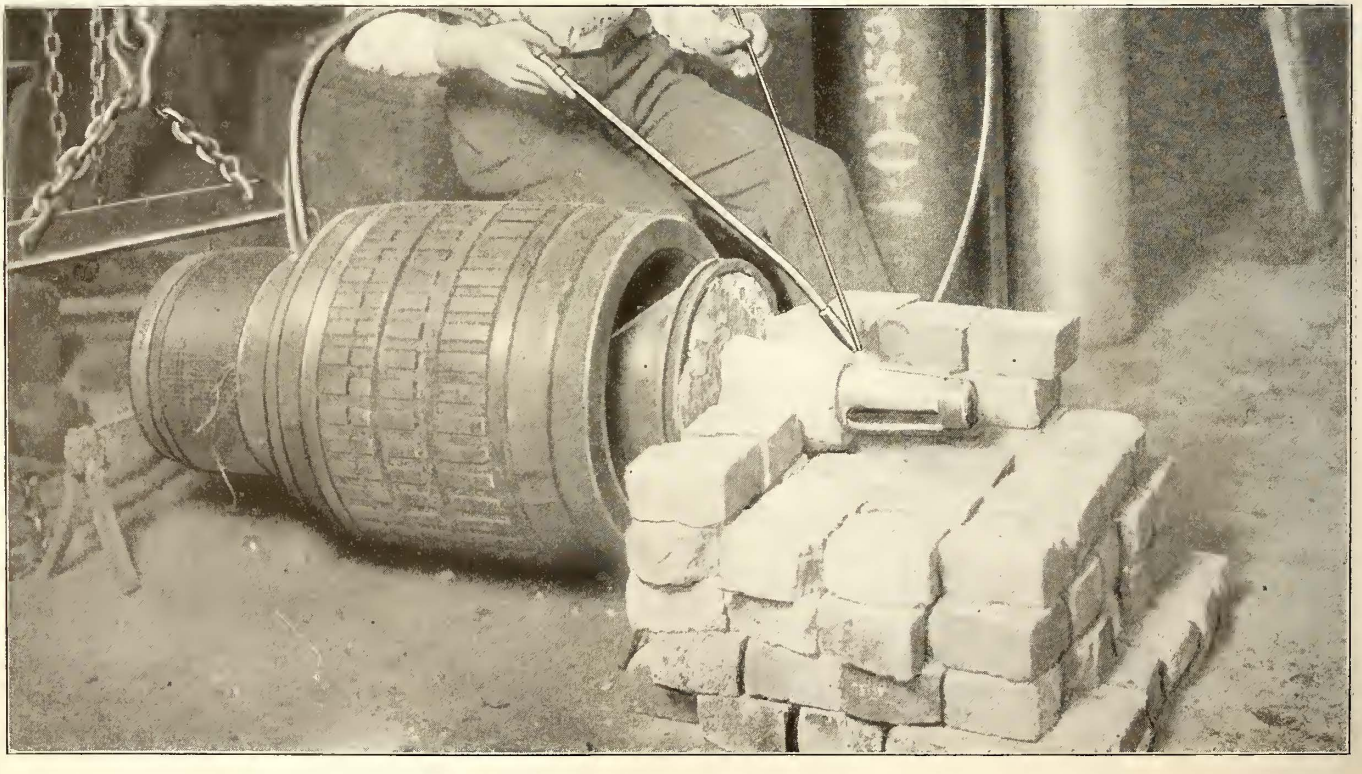
An Extraordinary Variety of Repairs by This Form of Autogenous Welding Is Now Made in Shops of Every Size, the Process Being Especially Convenient in Heavy Truck Repairs, Even Permitting Broken Parts to Be Restored without Removal from the Car

A PANACEA for innumerable ills of electric railway equipment has been supplied by the oxy-acetylene welder and cutter. Perhaps no other tool introduced into electric railway repair shops during recent years has made possible greater economies, since its ability to reclaim worn or broken parts has effected large savings in material without increase in the payroll and has made it unnecessary to purchase and carry in stock many of the most expensive of repair parts. In fact, in many instances, storerooms have even been replenished from the scrap heap. Descriptions of the more common of these methods have appeared in various issues of the Electric Railway Journal for the past three years, but owing to the constantly increasing scope of the work that may be accomplished by this process many novel applications have recently been developed, and outlines of a number of these are presented in the following paragraphs.

Armature and Axle Bearing Housings Reclaimed

It has been the experience on the Terre Haute, Indianapolis & Eastern Traction Company, of which M. F. Flatley is master mechanic, that armature bearing housings and frame heads can be successfully welded, and that in many cases even more satisfactory results can be obtained than if new parts are purchased. The reason for this is that the repaired casting can be overbuilt to compensate for the wear in the frame head, thus insuring a close fit when the parts are assembled. Since the wear is caused by movement between the frame and the housing, if a new housing is installed the difficulty is only partially remedied, because the new housing cannot be held tightly in place in the worn frame. In this case the bearing housings have their worn surfaces restored by building on new metal, after which the housings are turned in the lathe to about 0.01 in. larger than a new housing to fit the old frame. A cast-steel rod is used in the welding operation so that cast steel is built on cast steel, hence no difficulty is experienced in turning the housing in the lathe. The average cost of thus welding and machining a housing is $2.82,, whereas the cost new is $8.60.

Reference has been made in previous issues to the building up of worn axle seats for motors, but the Terre Haute, Indianapolis & Eastern Railway is going one step further by reclaiming worn axle caps from the scrap pile. This has been accomplished in many instances by filling up the dowel-pin holes and redrilling them at a relatively small cost. Previously some of these axle caps had been reclaimed by bushing the worn holes and providing new dowel pins, but the bushings frequently worked loose and wore into the axle cap in the same way as the dowel did before the bushing was inserted. The dowel-pin hole would finally become so badly worn that it would be impossible to insert a bushing large enough to fill the hole completely and thus prevent movement. When this occurred the service life of the axle cap was ended, and in cases of this kind, autogenous welding was the only possible means of reclamation.



OXY-ACETYLENE REPAIRS—RESTORING PINION SEAT ON OLD ARMATURE SHAFT

The average cost of renewing the two dowel-pin holes with the oxy-acetylene welder is 70 cents as compared with a cost of $10.03 for a new axle cap. This represents a saving of $9.33, neglecting scrap value, and the finished job should increase the life 100 per cent, because the welded metal is cast steel of the same quality as that in the axle cap. As a precaution against the dowel-pin wear in reclaimed axle caps, the caps are bolted in place, the caps and motor housings numbered in pairs, and each bearing is calipered for size. The cap is then planed off to reduce the bore so that when the bolts are drawn up the bearing will be clamped tightly in the housing, and thus the dowels are relieved of the work of holding the bearing secure. In one of the accompanying illustrations an axle cap is shown ready for welding and another is shown fully restored and ready for service.

Old armature bearings are also repaired very successfully by welding. If the collar is worn down it is built up with Tobin bronze and turned in a lathe to the standard size. If the bearing is cracked, a V-shaped groove is cut along the crack, and this is filled with bronze by the welder. Experience has demonstrated that bearings repaired and reclaimed in this manner are as good as new, and the average cost of repairing them, for both the pinion and the commutator ends of an armature, is $1.20. A new commutator-end bearing costs $4.19 and a new pinion-end bearing costs $7.78. The total average saving made by reclaiming a bearing of the type used by this company is thus $10.57 and the wear life is increased practically 100 per cent.

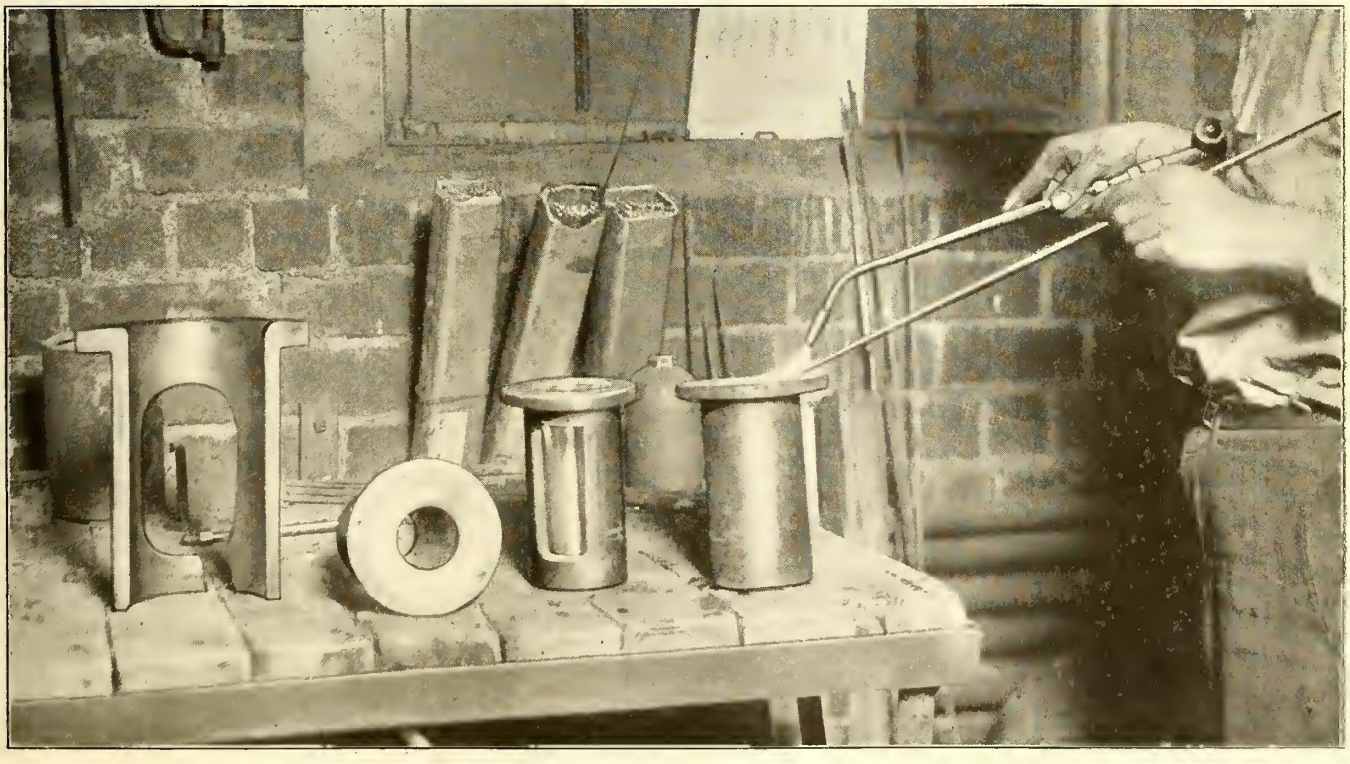
Pinion Seats and Keyways Restored

The restoration of worn pinion seats and keyways by welding is probably quite commonly known, but such success has been attained by this company in this practice that a description of its methods should be of interest, especially to those companies having many of the older types of motor involving the dismantling of the armature and its reassembly when a new shaft has to be installed. To obviate this difficulty and reduce the cost, the oxy-acetylene welder is employed.

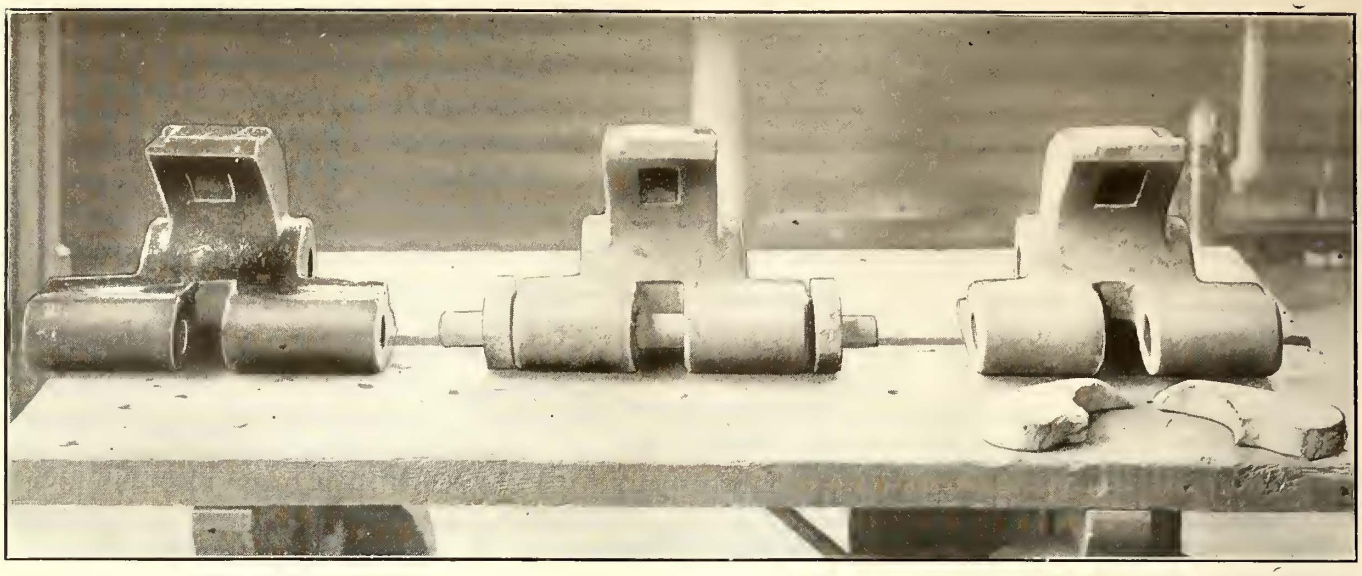
Preparatory to welding, the pinion end of the armature shaft is first thoroughly cleaned to remove all grease and dirt. Fire clay is then packed into the core head to prevent unnecessary heating of the armature core, which might affect the winding. The bearing seat of the shaft is also incased in fire clay and wrapped with asbestos paper to protect the surface from the intense heat which must be applied to the pinion seat during the welding operation. As a protection for the operator a fire-brick oven is built around the end of the shaft. After these preparations have been completed the shaft is brought to a white heat with a kerosene torch, in which condition the entire surface that forms the pinion and nut seats is built up by welding on vanadium steel and the old keyways are filled in. When the welded shaft has cooled, the armature is placed in a lathe where the pinion seat is turned to the standard size. After a new keyway has been cut the operation is complete. The total cost of the operation is approximately $7.60, while the cost of a new shaft for the particular armature shown in the illustration on page 550 would have been $58. The time devoted to this entire operation was approximately twenty-four hours, and it may be said here that the promptness with which a repair of this nature can be made also reduces to a minimum the number of extra armatures necessary to meet emergencies.

Coupler Knuckles Lengthened

A very unusual application of welding that has been made by this company is found in its plan of lengthening coupler knuckles. Abnormal track surface conditions, truck-spring deflections and wheel wear had caused cars to uncouple, in a number of instances, indicating that the 11-in. face of the knuckles in the M. C. B. radial car couplers was too short. The difficulty became especially noticeable with interurban cars in train service at sharp changes in grades, particularly at approaches to bridges and in the city streets. Although the couplers and car heights were carefully examined and corrected to eliminate coupler failures, the mechanical department was unable entirely to overcome the



OXY-ACETYLENE REPAIRS—RESTORING FLANGES ON THE WORN BEARINGS



OXY-ACETYLENE REPAIRS—THREE STAGES OF LENGTHENING COUPLER KNUCKLE

trouble. After trying various remedies to no avail, it was decided to increase the length of the knuckle face from 11 in. to 13 in., and to safeguard the service it was considered desirable to make the change promptly. An investigation of the time required to obtain new knuckles indicated that about the only way to do so would be to make new patterns and have the knuckles cast at a local foundry. Such a move, however, entailed scrapping the old knuckles in addition to paying for the special knuckles. As an experiment one of the standard 11-in. knuckles was lengthened by welding on pieces with oxy-acetylene, and this proved so successful that it was decided to lengthen all the knuckles with the welder, the work being done at an average cost of $2.26 per knuckle.

The following procedure was adopted: A templet was first cut from a piece of sheet steel to the exact shape of the top of one of the standard knuckles, and from this templet pieces were cut from 1-in. x 3-in. steel bars with the oxy-acetylene cutting torch. These pieces were afterwards forged to fit the ends of the knuckle, to insure perfect contact, about 1 in. of the small end of the forging being beveled as shown in one of the accompanying illustrations, simply to improve the appearance of the finished knuckle. Auxiliary knuckle-pin holes were then drilled through both of the forgings, and they were pinned to the casting as shown in the view of the assembled knuckle and forgings. As an extra precaution against any chance of failure and to reinforce the weld, an additional hole ½ in. in diameter was drilled through each forging and into the knuckle for about 1¼ in., a small pin being driven tightly into the hole. This held the piece firmly in position during the welding operation, and assisted in strengthening the weld.

After the knuckle and forgings had been assembled, the entire casting was placed in a blacksmith's forge, and one end was brought to a white heat. In this condition the forging on that end was rapidly welded to the casting, the cast-steel rod being melted as far down in the joint as possible, and the metal being gradually carried up to the working face of the knuckle. When the weld was completed on one end the knuckle was again placed in the forge where the other end was heated and subsequently welded in a like manner. This preheating of the knuckles is considered to be a very important part of the operation, because when it is properly done the amount of gas necessary to make the weld is reduced about 50 per cent.

After the welded casting became cooled, all metal projections were chipped off with a chisel and hammer, and the face of the knuckle was finished with a file or portable emery wheel. The need for finishing, however, could be practically eliminated by the skillful use of the torch during the welding operation. An examination of a number of knuckles lengthened in this manner showed little or no evidence of how the work was done, as there was no line of demarcation indicating where the weld had been made. The distribution of the cost of the work follows:

Blacksmith labor	$0.28
Helper's labor	.18
Machinist's labor	.20
Welder's labor	.60
10 lb. of 1-in. x 3-in. steel	.18
1 lb. of filling rod	.10
18 cu. ft. of acetylene gas	.36
24 cu. ft. of oxygen	.36
Total	$2.26

The original cost of the 11-in. knuckle was $4.50, and if the mechanical department had decided to buy special knuckles the cost would have been considerably more than this. In addition there would have been the delay necessary to prepare the special pattern and to obtain the steel castings which are scarce and high-priced owing to the present conditions in the steel industry.

Steel-Car Repairs on Michigan Railway

In the shops of the Michigan Railway at Albion, Mich., of which R. C. Taylor is master mechanic, the oxy-acetylene welding and cutting outfit has become indispensable in connection with steel-car repairs, the cutting torch being particularly useful in both construction and repairs to the all-steel car bodies. While the welding torch is used occasionally in this work it has been found more useful in reclaiming and repairing equipment and truck parts. In the oxy-acetylene welding and cutting department there is provided a complete stock of rods of all the different kinds of metal used in equipment parts which may become damaged or broken. While cutting is done by several of the workmen engaged in repairing steel car bodies, welding has been found to require the services of an expert, and accordingly it is done by one man. When the welding outfit was purchased this man received instruction in the various kinds of welding operations, and after about a year's experience he has become very skillful.

Innumerable repair jobs which, under ordinary conditions, would have been difficult, have become quite

easy when the oxy-acetylene cutting and welding torches were brought into play. When this outfit was purchased, there were included several tips for cutting different thicknesses of metal and a special rivet-cutting torch. The latter has been found especially useful in removing and renewing damaged members in the steel cars, as rivet heads may be cut at the rate of three per minute.

In one instance a 7-in., 13½-lb., channel intermediate sill in an all-steel express car was badly twisted in a wreck. This channel was bent at right angles and the needle beam that was framed into it was also badly distorted. Under ordinary conditions it would have required two or three days to cut out this bent sill and needle beam with a hack-saw and chisel. Moreover, two sets of splice plates would have been necessary to replace the damaged section of the intermediate sill in the car-body underframe. With the oxy-acetylene cutting torch, however, the damaged section of the channel was quickly cut at two places and removed. The bent sill and needle beam were taken to the forge shop and straightened, and in a very short time they were ready to be replaced in the underframe. Instead of using splice plates where the bent section of the intermediate sill joined the sections from which it had been cut, an oxy-acetylene weld was made in twenty minutes, about 50 cents' worth of gas being used in the operation. Only about ten minutes were required to cut off the rivets and to cut through this channel in two places when it was removed from the underframe. Experience has shown that it costs about $1 an hour for the gas used in various welding operations, the quantity depending upon the size of the tip employed.

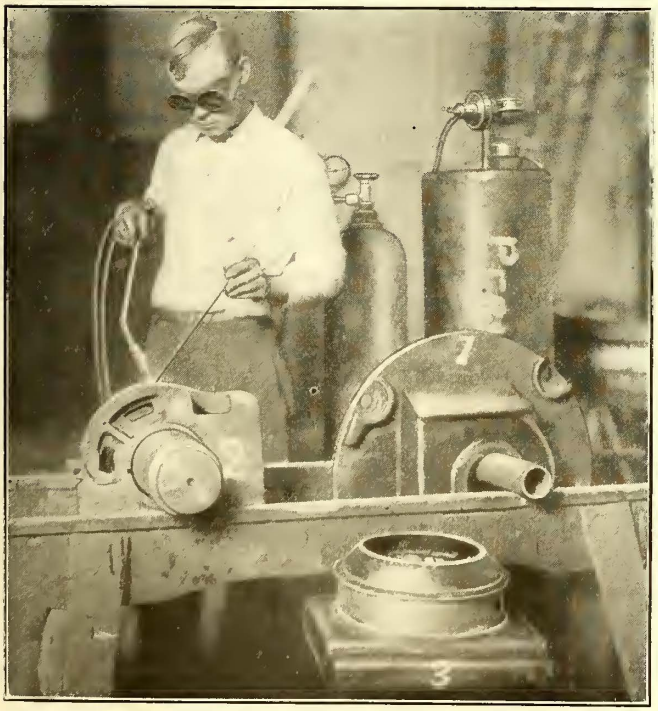
Innumerable other small cutting operations are necessary in steel cars in both construction and repair work. For instance, instead of suspending the conduits beneath the cross-bearers in the underframe, slots are cut through the webs of these members and the conduits passed through them. Damaged side plates are quickly removed by using the rivet cutter, which cuts the head of a rivet without damaging the plate. After the plates have been straightened in the blacksmith shop they are restored to their original position and welded in place. Similarly, many forging operations have been superseded merely by cutting out the parts from metal of the required thickness. For instance, body brake-levers, which were formerly made from 1¼-in. steel bars by forging them to the proper dimensions, are now cut from 1¼-in. plates. By this method the cost of manufacturing the levers is greatly reduced, since all that is required after the levers have been cut to a templet is to drill the necessary holes.

Worn Journal Boxes Reclaimed

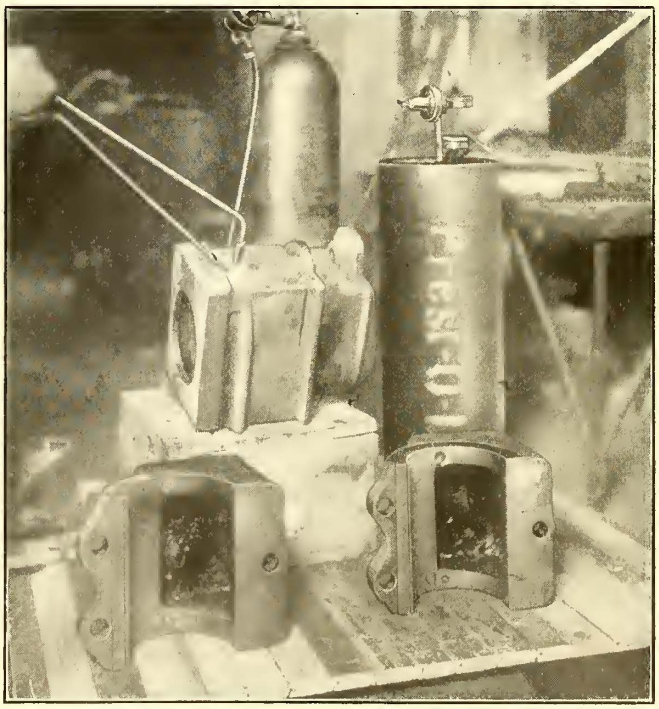
Prior to the advent of the oxy-acetylene welder worn journal boxes had to be scrapped and replaced with new ones. This waste of high-priced metal has been obviated by the Michigan Railway by providing new ⅛-in. sheet-steel chafing plates and welding them in the pedestal ways. In one of the accompanying illustrations are shown two 6-in. x 11-in. malleable-iron journal boxes, one of them being worn and the other having been repaired with the oxy-acetylene welder. As it has been found very difficult to weld malleable iron with malleable iron, Tobin bronze is employed to cheapen this operation, and the metal produces satisfactory results. The first cost of one of the journal boxes shown in the accompanying illustration is $6.25, while the cost of welding on new chafing plates is only 50 cents. Although the chafing plates have been riveted on successfully in some instances it has been found very difficult to make them oiltight, whereas when the plate is welded in place this requirement is readily met.

Miscellaneous Applications

The heaviest weld that has been successfully made in the shop of the Michigan Railway has been on the cracked shanks of old Sharon type and Tomlinson radial type M.C.B. couplers. The approximate first cost of one of these coupler shanks is $12.50, and the cost to weld it is $2. Welds in simpler form are frequently made to obviate delays in the receipt of material, thus making it unnecessary to carry a large stock of spare parts in the storeroom. For instance, GE-239, 2400-volt, brush-holder receptacles that have been burnt in service are readily put in condition for operation. In

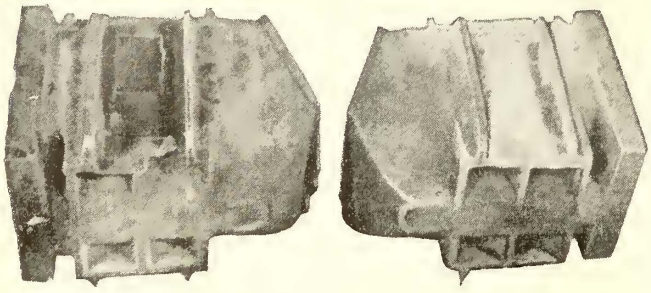


OXY-ACETYLENE REPAIRS—BUILDING UP MOTOR END-HOUSING WITH CAST STEEL



OXY-ACETYLENE REPAIRS—WORN AND RECLAIMED AXLE CAPS AND JOURNAL BOX

one of the accompanying illustrations, one of these brush-holder receptacles in need of repairs is illustrated, together with one that has been restored. For this work a scrap brush is fastened to the receptacle during the welding operation to serve as a mold for the inner surface of the brush-holder receptacle. The cost new of one of these holders is $2.50, and the welding cost, including labor, material and gas, is about 25 cents. A similar case occurred in connection with a broken base on one of the Michigan Railway's pneumatic trolley bases. As shown in one of the accompanying illustrations, the base, which is made of cast iron, was cracked across one side, and to weld it cast-iron metal was poured into the crack. The cost new of one of these bases is approximately $25, but the cost of material, labor and gas for welding was about $1. In addition to the saving made by reclaiming the casting, it was important that the base be restored to service in a short time, and the welder readily met this condition.

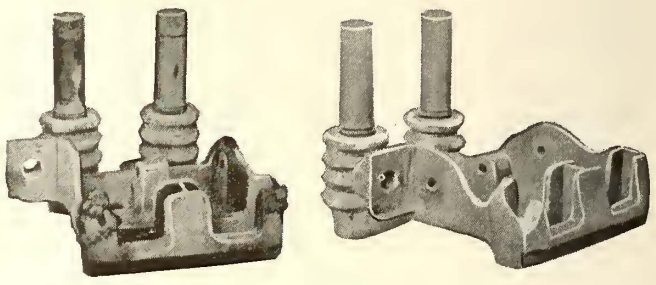


OXY-ACETYLENE REPAIRS—WORN JOURNAL BOX REPAIRED WITH TOBIN BRONZE PEDESTAL WAYS

Again, a casting which was used in connection with the third-rail shoe mechanism, and which was broken in service, was practically impossible to replace promptly because of slow deliveries on steel castings. To restore the casting to service three welds were required, two across the end of the yoke formed by the casting and one where this yoke connects with the main casting. In the instance cited the piece broken out of the end of the yoke was lost along the roadway. It was necessary to prepare a short section of cast steel to take its place and weld it to the two sides of the yoke. The labor, materials and gas used in completing this job cost 50 cents. On another occasion a coil from a Peter Smith hot-water heater had burned out or burst by freezing and the oxy-acetylene welder was employed to restore it to service. At the time the repair was made the possibility of saving was not as important as the prompt provision of heat for the car. Still, the cost new of one of these coils was approximately $75, and the cost of welding was only $3. This work was very successfully accomplished, and the welded coil has been in service for several months. The saving made in this case was $72, and it was unnecessary to deduct anything from this figure for scrap value because the old tube was practically worthless as scrap.

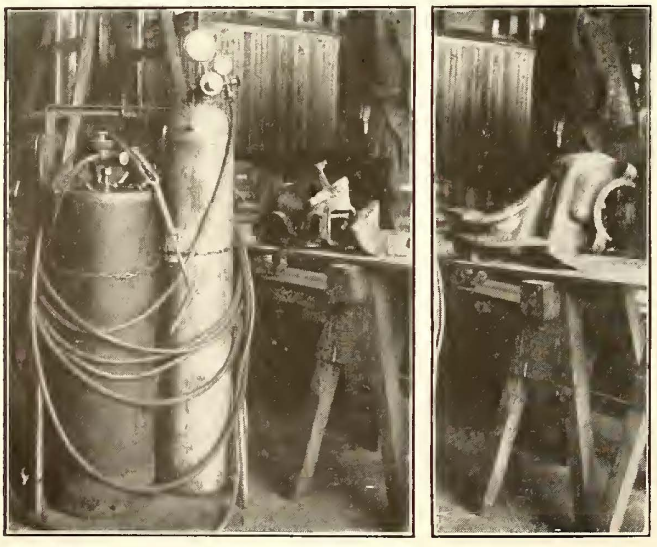
Quick Repairs in Chattanooga

An example of quick repair work done in the shop of the Chattanooga Railway & Light Company is shown in one of the accompanying illustrations. In this case the repairs were made to a sandbox which had been broken near the bottom at the spout. As sandboxes rarely break, and extra ones are not kept on hand, the broken spout, under old conditions, would have meant either running the car without sand or else keeping it out of service for four or five weeks, because at present it is difficult to obtain electric railway material promptly after it is ordered and the cost of patching the break would have been all out of proportion to the value of the casting. With the oxy-acetylene welder, however, these difficulties disappeared. One of the illustrations shows the broken sandbox and another shows a shop man repairing it. Still another shows the finished job fifteen minutes after the work was begun, the total cost of labor and material for the work amounting to only 75 cents. In this case the car was ready for service about twenty minutes after the work was begun.



OXY-ACETYLENE REPAIRS—VIEWS OF DAMAGED AND RESTORED 2400-VOLT BRUSH-HOLDER

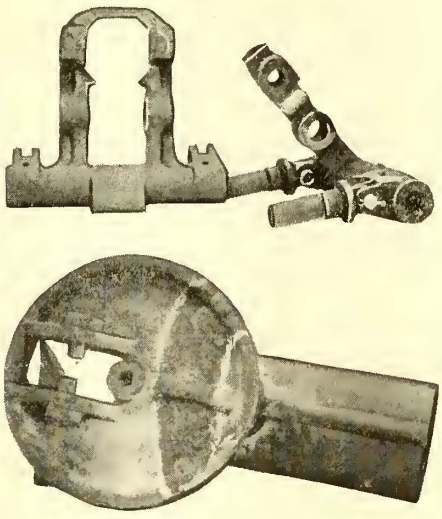
The acetylene welding outfit is used very generally



OXY-ACETYLENE REPAIRS—VIEWS OF BROKEN AND RESTORED AXLE CAP

OXY-ACETYLENE REPAIRS—BROKEN TRUCK FRAME WELDED IN PLACE

by this company for repairing heavy broken parts, such as truck frames, drawheads, brake hangers and body bolsters, and it is frequently used even for such odd jobs as repairing broken stoker castings. Recently one of the company's cars had a broken brake hanger carrier of 7/8-in. x 4-in. steel which was restored without taking the truck from under the car and even without taking the brake hanger off the truck. Its removal and welding in the blacksmith shop would have cost approximately $3, whereas the actual expenditure was 50 cents. Several broken truck frames have been repaired at a cost that averages between $1.50 and $3, the replacement of such pieces under ordinary methods involving a cost that ranged between $40 and $50.



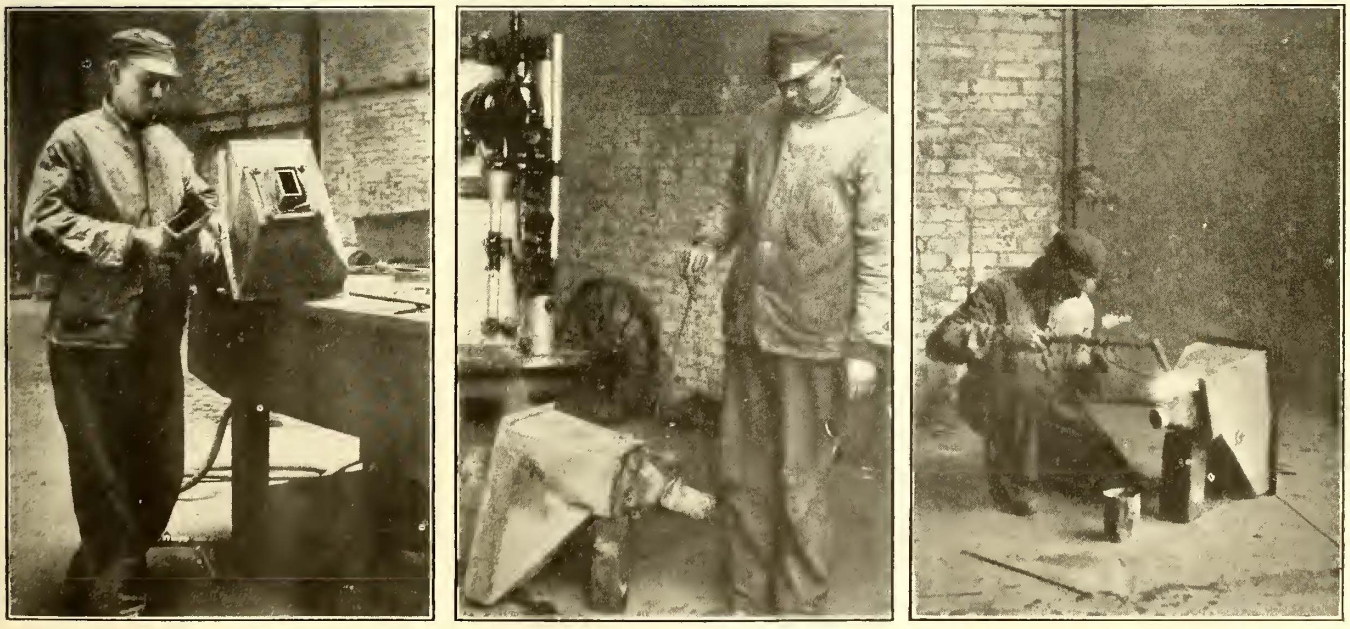
OXY-ACETYLENE REPAIRS — BROKEN AND RECLAIMED THIRD-RAIL SHOE-CASTING AND WELDED TROLLEY BASE

The heaviest work that is done at Chattanooga with the oxy-acetylene welding apparatus consists in repairs to body bolsters which are constructed of 7/8-in. steel plate 9 in. wide. These plates are bent at right angles at each end to form the support for the side sills, and it has been found that they display a tendency to break at the inside of the bends. To repair them originally cost $10, but with the oxy-acetylene flame the operation of repairing the break costs approximately $2.50.

W. S. Henry, master mechanic Chattanooga Railway & Light Company, states that the best way to train an operator appears to be merely to turn him loose with the machine after he has learned to regulate the flame. At Chattanooga originally a point was made of having the operator make one or more practice welds each day for some weeks so that his experience would be regularly developed without waiting for the occurrence of emergency jobs which form the greater part of the work that is done with the apparatus.

In The Milwaukee Electric Railway & Light Company's shops a novel application of the oxy-acetylene flame has been developed in the burning of lead to make lining material for storage-battery boxes. In connection with this work, as well as the regular welding operations that are carried on with the apparatus it has been found that the cost of work depends largely upon the element of time. H. A. Mullett, superintendent of rolling stock, states that the operating cost per hour ranges from 40 cents, when a No. 2 tip is used, up to $1.17 when a No. 7 tip is used.

On the Chicago Elevated Railways, H. A. Johnson, master mechanic, states that the uses to which it can be put to advantage have been continually extending, and in cases of emergency the value of the apparatus is considered to be not measurable in dollars and cents. Some of the work which is being done is as follows: Building up worn pinion fits, keyways, stripped threads on armature shafts and worn motor housings, welding broken motor shells, building up worn brush-holders, worn nose suspensions and many other jobs of a similar nature. The company has tried also the filling up of flat spots on steel wheels when the flat spots did not come close to the flange. Out of several operations of this kind one was found where the metal sloughed off, but as a whole the experience is considered to be satisfactory. It is considered that in many cases the actual cost of doing a welding job is not the most vital feature. In many cases time is the determining factor, especially in cases of broken machinery, where the replacement of a part would necessitate a long delay in the receipt of new castings. In Chicago the question of breaking in operators has not been a serious matter, as a shop employee may be sent to the establishment of one of the manufacturers of oxy-acetylene apparatus where repair work is handled, and he can work for three or four days beside an experienced operator, picking up in this way more knowledge than he could in the railway company's shops in a considerably longer time. For the welding operators, a knowledge of the welding and working of metals is considered to be a material help in the proper handling of the welding apparatus, and for this reason the company is using blacksmiths to do the gas welding.



OXY-ACETYLENE REPAIRS—WELDING BROKEN SAND BOX IN FIFTEEN MINUTES

New Type of One-Man Car

The Prominent Characteristic of the Latest Ultra Light-Weight Car, Recently Built for Stone & Webster in Accordance with the Birney Design, Is the Retention of Standard Forms of Construction, the Weight Complete Being 10,000 Lb., and the Seating Capacity Twenty-Nine

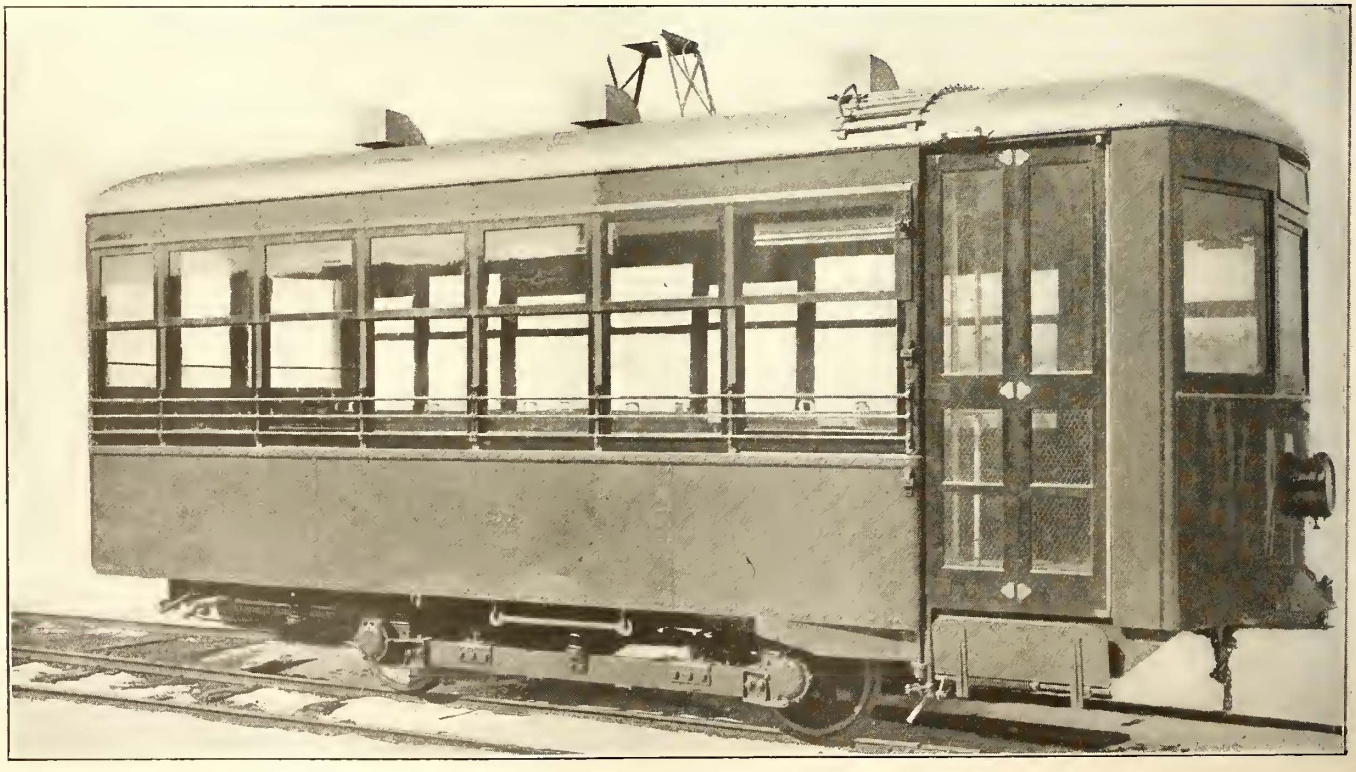
WITH the increase in popularity of one-man operation much attention has been devoted to the development of a design of car that would be best suited to this method of handling traffic, and a number of different types have been proposed. A few of them have been built and placed in service, and the latest addition to the list is the Birney one-man car which is about to be introduced on the Stone & Webster properties in the Puget Sound district. This car, which is described in the accompanying paragraphs, is the result of an extended study by its designer, C. O. Birney of Stone & Webster, Boston, Mass., of the factors governing the cost of handling traffic on systems of various sizes.

The study has included consideration of the increasing demands by the public for improvements in service and in conveniences, the increased cost of labor and material, the tendencies toward track extension and longer hauls, and the operation of automobiles, both private and jitney. Some of these elements have a tendency to reduce the purchasing power of the fare unit, and others incline toward reducing the earning power of the property. Yet recent analyses have indicated that the average load of a modern electric car for fifteen hours of each day ranges from seven to twenty passengers, the cars having capacity loads only in the rush-hour periods. In general, the present service is rendered by cars weighing from 24,000 lb. to 56,000 lb., with seating capacities ranging from thirty-two to sixty passengers. The cost of hauling such cars in addition to the wages of the platform men represents a direct loss to the company under the unfavorable loading conditions stated.

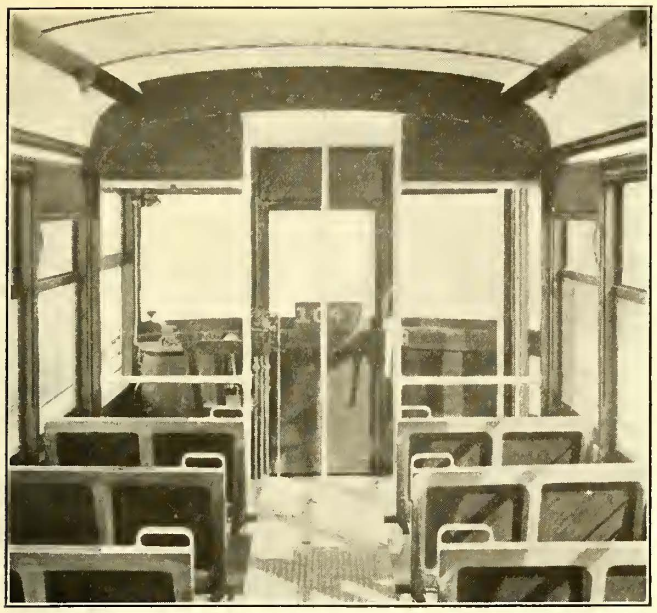
The provision of more satisfactory conditions with respect to the operation and net earning power of cars throughout the daily service involves a type of rolling stock that permits a considerable decrease in power demands as well as in platform expenses. Seeking these objects, Mr. Birney prepared designs for a single-truck car with a seating capacity of twenty-nine passengers, and a weight, equipped, of 10,000 lb. Two of these units have just been completed by the American Car Company, St. Louis, Mo., eight additional cars of the same type being on order. The design includes steel construction, with wood fillers, wood roof and wood interior finish, and the strength of the framing and associated parts is on an equal basis with the type of car construction generally employed on the Stone & Webster properties.

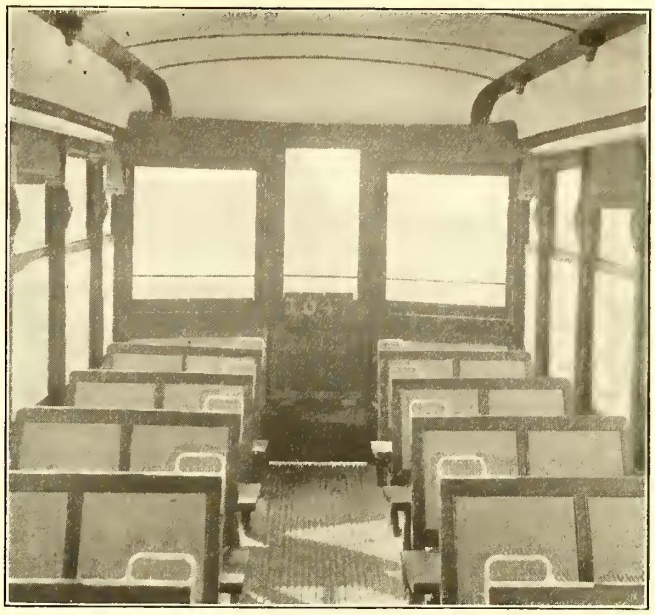
In consideration of the small passenger loads, the car has been designed and equipped so that it could be satisfactorily operated by one man under all conditions, and in addition to the savings thus derived, as well as because of the decrease in weight, it is expected that a considerable reduction in car and track maintenance will be effected.

The new cars are of the single-end, single-truck type, are provided with straight sides, round ends, arched roof, stationary top sash, lower sash arranged to raise, and have folding doors and steps, with the platform on



NEW ONE-MAN CAR—VIEW OF CAR COMPLETE EXCEPT FOR TROLLEY POLE AND HARP





NEW ONE-MAN CAR—INTERIOR VIEWS SHOWING FRONT PLATFORM AND REAR DOOR

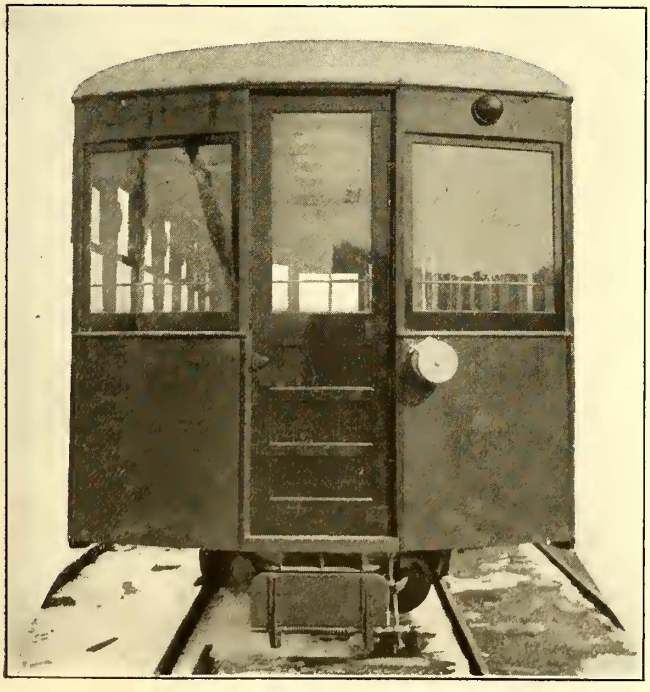
the same plane as the body floor. The principal dimensions and weights are given in the following table:

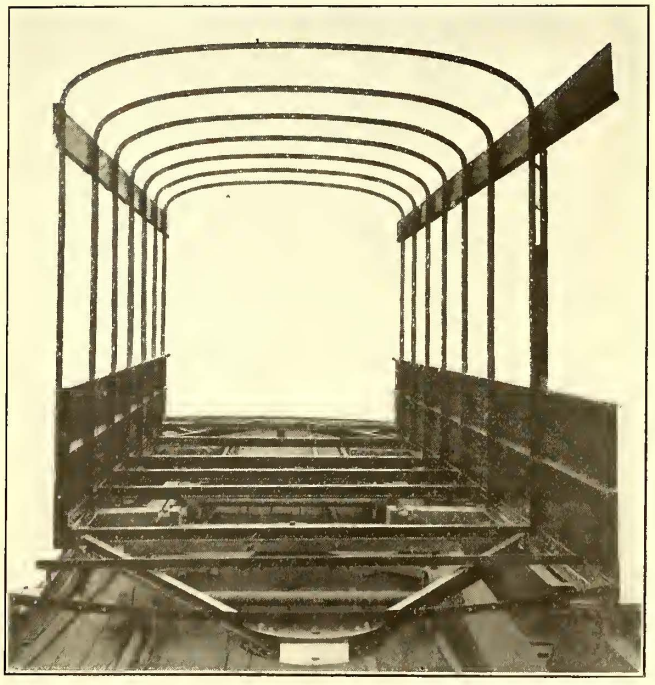
Length over all	22 ft. 10 in.
Length over dashers	22 ft. 4 in.
Length of platform over dasher	4 ft. 6 in.
Width over sheathing	7 ft. 6 in.
Width over all	7 ft. 10 in.
Height, rail to top of floor	2 ft. 3 in.
Height, rail to top of roof	9 ft. 9 in.
Seat and post spacing	2 ft. 4½ in.
Seating capacity	29
Height, floor to top of window rest	2 ft. 1 in.
Height, floor to bottom of top sash	4 ft. 2½ in.
Height, floor to point of arch	6 ft. 6 in.
Width of entrance and exit door, clear	2 ft. 6 in.
Width of emergency exit door in rear, clear	1 ft. 10 in.
Width of aisle	1 ft. 8 in.
Weight:	
Car body	4,050 lb.
Truck	3,000 lb.
Electrical equipment	2,333 lb.
Air brake equipment	617 lb.
Total	10,000 lb.

The cars are designed for near-side stops, with combined entrance and exit doors and a folding step. A rear emergency door of the swinging type operates in conjunction with a folding exit step. This door swings outwardly and is provided with manually and pneumatically operated locks, so that it cannot be opened except in emergency. At such times the pneumatically operated lock is automatically unlocked and the manually operated lock can be unlocked by persons attempting to leave the car from the rear. Special attention has been paid to ease of entrance and exit, and the 27-in. height from rail to floor requires the use of only one folding step, the riser being easily negotiated.

CAR-BODY ARRANGEMENT

The single-end arrangement was selected because it permits of the minimum weight per car unit, and while it was appreciated that double-end cars must be operated in some instances, the situation resolved itself into a comparison of the weight and cost of the single car, with necessary track facilities, versus the same elements in connection with double-end car construction. It was

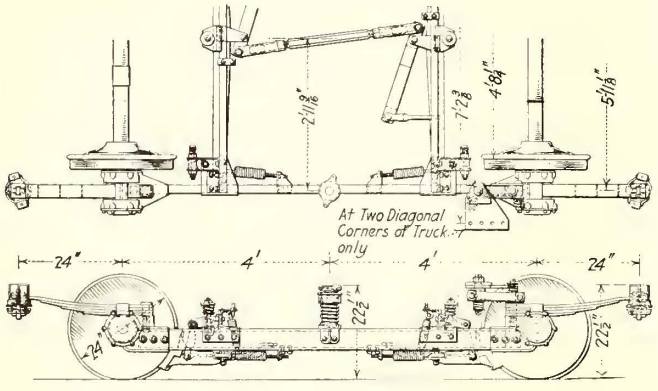




NEW ONE-MAN CAR—REAR DOOR AND STEP; CONSTRUCTION VIEW SHOWING FLOOR, SIDE AND ROOF FRAMING

estimated that a double-end car body having the same seating capacity would weigh 6000 lb. or that a double-end car of the same weight as the one actually adopted would provide a seating capacity of only twenty-four passengers. The weight of the single-end car body is but 4050 lb. and the greater weight of a double-end car would constitute a continuous tax against the operating company which would be in excess of the cost of driving the single-end equipment.

To gain the economies offered by one-man operation, it was considered necessary to equip the cars in such a manner that the degree of safety in service would be greater than that known heretofore, even under two-man operation. Because of the concentration of duties upon one man it was also considered necessary to provide all possible facilities, especially with respect to eliminating manually operated parts. Compressed air offered the desired flexibility, and the equipment has been arranged to that on emergency occasions the control of the power circuit, the operation of doors and steps, control of sand and application of brakes are automatically effected. The controller handle is so designed that in case the operator removes his hand from



NEW ONE-MAN CAR—ELEVATION AND HALF PLAN OF TRUCK

the handle in any position which permits current to flow to the motors, the current will be cut off by the circuit breaker. This causes the operation of a device which provides for the application of brakes, application of sand to the rails, the opening of the front exit door and the pneumatic unlocking of the rear emergency door.

It was considered also that any action required on the part of the operator in an emergency should be as simple as possible, and for this reason the control of the doors and steps, as well as of the brakes and sand, has been combined into one device operated by one handle. Aside from the great importance of this feature in emergencies, the combination of control is of great assistance in ordinary service operation, since it eliminates to the greatest possible extent the parts to be handled in running the car, thus permitting undivided attention for the important duties of the operator. The device, which is visible in one of the interior views of the car displaces the ordinary motorman's brake valve, though its operation and appearance are along similar lines. The positions of the handle are arranged so that the car is brought to a stop in the usual manner without involving the operation of doors and steps. After the stop is made, the door and step are opened by moving the handle to another position. After the exit and entrance of passengers the door is closed, following which the brake is released and the car is ready to start. The weight of the complete air-operated equipment, including piping, is only 617 lb., and it may be said that these features can be applied to any type of car in passenger service, thereby permitting the extension of the economies secured to existing rolling stock.

The underframe is composed of steel channels and angles, the side sills being 2½-in. x 3-in. x 3/16-in. angles and the cross-sills of 3-in., 4-lb. channel iron. The dasher angles are of 1½-in. x 1½-in. x ⅛-in. stock, the seat-rest angles being of 1¼-in. x 1¼-in. x ⅛-in. steel. The center sills are of the same size as the cross-sills; the side posts are of 1½-in. x 1½-in. x 3/16-in. T-iron, the corner posts being of 1¼-in. x ¾-in. x ⅛-in. angle iron reinforced with oak. No. 18 sheet steel is used to form the side plates, and the letterboards are of No. 20 sheet steel. The sashes, doors and finish are of mahogany. The roof is of 5/16-in. poplar covered with No. 8, 16-oz. canvas, and the flooring is 13/16 in. thick, yellow pine being used under the seats and hard maple, grooved to form floor mats, in the aisle.

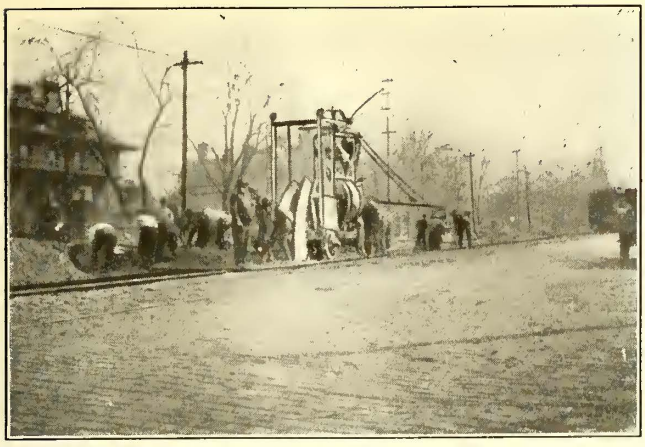
Truck Design and Equipment

On the truck are mounted two GE-258 motors, each rated at 18 hp. at 600 volts, mounted on a special Brill truck and wired to a K-10 controller. These motors are of the ventilated commutating-pole type. The armatures are mounted upon ball-bearings at both ends, lubrication being provided by a nipple through which grease is forced by means of a grease gun. The weight of the electrical equipment, including gears and gear cases, is 2333 lb.

The truck weighs 3000 lb., and has an 8-ft. wheelbase and 24-in. wheels. The journals are 3 in. x 6 in., the axle diameters being 3½ in. at the motor bearings and 4 in. at the gear seat. The height from the rail to the spring posts is 1 ft. 10 in., and from center to center of side frames is 5 ft. 9¼ in. The spring system consists of quarter-elliptic and spiral springs of the graduated type. A quarter-elliptic spring is mounted on each journal box, the band of the spring resting on the top of the journal box, and the inside end being bolted to the bracket or wing which forms a part of the box. The outside end of the quarter-elliptic spring is arranged with castings and pins to support the transverse swing links, which in turn support the graduated coil springs. These coil springs carry the light load of the car, which averages about two-thirds of the seated load. When this load is exceeded, the coil springs compress, causing the spring caps and seats to come into contact, and any additional load is borne on the quarter-elliptics.

Besides the above coil springs, an additional coil spring is provided at the center of each side frame, mounted on suitable seats. The top section is graduated and the spring acts similarly to those at the ends of the truck. The lower portion of this coil spring is of the same capacity as the quarter-elliptic springs and supports a portion of the maximum load. In order that the transverse swing of the car may not be excessive the truck is connected to the car body through the medium of links, which are attached to the truck at diagonal corners only, located on the journal boxes at a point about 12 in. within the wheelbase. The brakes are inside-hung, being supported by half-ball hangers, and the shoe heads are connected transversely by beams.

Other equipment on the car includes the Johnson fare box with transfer issuing device; Westinghouse air-brakes and safety features, Utility ventilators, Edwards sash locks, International cash register, Curtain Supply Company's pinch-handle curtains, transverse seats with hinged cushions and a folding seat on the inside of the rear emergency door, Esterline "Golden Glow" headlight, Feralun step treads, Keystone trolley catcher, Hunter signs, operator's seat, and Keystone pneumatic gong.



CLEVELAND TRACK COSTS—MIXING AND PLACING CONCRETE IN TRACK CONSTRUCTION

CLEVELAND TRACK COSTS—FINISHED TRACK WITH CONCRETE PAVEMENT IN DEVIL STRIP

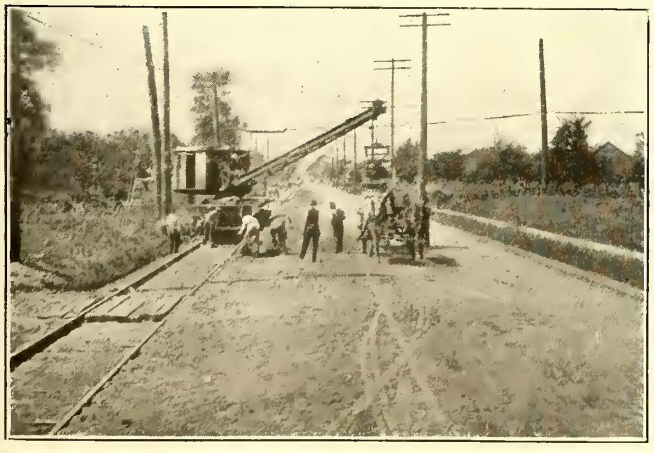
Unit Track Construction Costs for Thirty-One Jobs

This Detailed Cost Distribution Kept by the Way Department of the Cleveland Railway Should Be Especially Valuable as a Guide to Others for Track Construction in Preparing Estimates

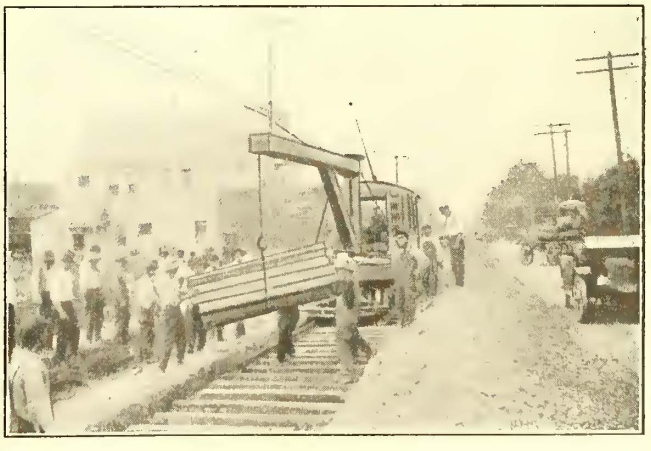
MORE than 25 miles of single track were constructed or rehabilitated by the way department of the Cleveland (Ohio) Railway Company during 1915, and in the accompanying table there are presented the costs per foot of track of the thirty-one different jobs which were included in this mileage. Very few companies have given as much attention to reducing construction costs in connection with their track work as the Cleveland Railway, and many forms of track labor-saving tools have been introduced in connection with this company's work. It is, therefore, of particular interest to have the unit results of a track department that has been a pioneer, in many instances, in the application of labor-saving tools.

All the track included in these jobs was of the Cleveland standard construction, and, unless otherwise stated, the data herein published apply to double-track line in paved streets. Cleveland standard track construction includes 95-lb., Section-400, high-carbon, T-rail with a chemical composition of 0.75 to 0.90 carbon and 0.10 metallic titanium. All the joint plates are 1⅛ in. thick, and they are made of the same steel as the rail. The joints are riveted with 1 1/16-in. rivets and the base is welded by the thermit process. This construction is known as the Clark joint, which has been previously described in these columns. International steel ties are used at the joints and Carnegie steel ties spaced at 4-ft. intervals are employed between the joints. The standard foundation construction is of the trough and beam type with 12 in. of 1:6 gravel concrete under the rail and 12 in. of concrete below the tops of the ties. Between the ties and the rails the concrete foundation is approximately 5 in. or 6 in. thick, and a 6-in. vitrified drain tile is laid beneath the devil strip. The track is paved with granite block, nosed to form the wheel flangeways, and the devil strip, unless otherwise stated, is paved with 1:1:2 granite concrete with 50 lb. of steel hardener to each barrel of cement used in the top 2½ in. of wearing surface.

Labor-saving equipment, which was an important factor in keeping down track construction costs, included the Clark pavement plow or rooter which was described



CLEVELAND TRACK COSTS—CLAMSHELL DERRICK CLEANING UP WORK



CLEVELAND TRACK COSTS—DERRICK CAR FOR HANDLING TIES AND RAILS

Cleveland Track Costs—1915 Cost Per Foot of Single Track,

TRACK MATERIAL

	1	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Bolts	.....	.....	.....	0.0038	0.0153	0.0040	.....	.....	.....	.....	0.0003	0.0053	0.0053	0.0095	.....	.....	0.0005	0.0001	.....	.....
Carbide	0.0006	.....	.....	.....	.....	0.0003	.....	.....	.....	0.0006	.....	.....	0.0001	0.0012	0.0008	0.0006	0.0007	0.0004	0.0007	0.0003
Cement	0.3195	0.2051	0.1685	0.1[illegible]0	0.3[illegible]81	0.3245	0.2394	0.3114	0.3204	0.3603	0.3138	0.2422	0.0418	0.1407	0.2540	0.3515	0.2571	0.2679	0.1948	0.1445
Cinders	0.0064	0.0021	0.0029	.....	0.0197	0.0022	0.0122	0.0005	0.0022	0.0017	0.0009	0.0009	0.0118	.....	0.0031	0.0030	0.0015	0.0010	.....	.....
Clips and bolts	0.0745	0.0755	0.0525	.....	.....	0.0437	.....	0.0491	0.0583	0.0388	0.0506	.....	.....	.....	0.0485	0.0501	0.0435	0.0492	0.0341	0.0460
Crushed stone	0.0115	0.0278	.....	0.3302	0.1816	.....	0.1741	0.0746	0.0055	0.0334	0.0335	0.3508	0.9327	0.2317	.....	0.0037	0.0435	0.0207	0.0971	.....
Drip boxes and covers	0.0089	0.0103	0.0895	.....	0.0249	0.0622	.....	0.0297	0.0223	0.0421	0.0304	0.0484	.....	.....	0.0325	0.0381	0.0318	0.0396	0.0237	.....
Gravel	0.3079	0.2636	0.1795	.....	0.1100	0.3328	0.0959	0.3137	0.2643	0.2978	0.2741	0.0507	0.0052	0.1761	0.3848	0.3025	0.2385	0.2518	0.1549	0.1374
Oxygen	0.0045	.....	.....	.....	.....	0.0027	.....	.....	.....	0.0037	.....	.....	0.0008	0.0089	0.0063	0.0042	0.0046	0.0039	0.0047	0.0021
Plank	.....	.....	.....	.....	.....	0.0018	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Plugging charges	0.0034	0.0024	0.0033	.....	.....	0.0021	.....	0.0032	0.0037	0.0032	0.0033	.....	0.0001	0.0015	0.0051	0.0032	0.0032	0.0031	0.0025	0.0021
Punchings	0.0003	0.0002	0.0003	.....	.....	0.0002	.....	0.0003	0.0003	0.0003	0.0003	.....	.....	0.0001	0.0004	0.0003	0.0003	0.0003	0.0002	0.0002
Rail, 95-400	1.1185	1.1181	1.1182	.....	.....	1.1182	.....	1.1182	1.1111	1.1180	1.1181	.....	0.0271	1.1182	1.1179	1.1183	1.1183	1.1182	1.1181	1.1185
Rail, 141-395	.....	.....	.....	.....	.....	0.0218	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0050	.....	.....
Rail, 80# tee	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.6971	.....	.....	.....	.....	.....	.....	.....
Rivets	0.0192	0.0018	0.0138	.....	.....	0.0181	.....	0.0188	0.0221	0.0179	0.0199	.....	.....	0.0167	0.0185	0.0201	0.0216	0.0162	0.0153	0.0072
Splices, 95-400	0.0686	0.0684	0.0598	.....	.....	0.0803	.....	0.0639	0.0676	0.0572	0.0688	.....	0.0013	0.0558	0.0650	0.0661	0.0684	0.0698	0.0618	0.0630
Splices, 141-395	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0036	.....	.....
Splices, 80# tee	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sand, lake	0.0037	.....	0.0020	0.0713	0.0505	.....	0.0500	0.0029	0.0007	0.0096	0.0220	0.0671	0.0001	.....	0.0041	0.0014	0.0006	.....	.....	.....
Sewer pipe	0.0440	0.0220	0.0440	.....	0.0324	0.0386	0.0327	0.0220	0.0230	0.0263	0.0244	0.0442	0.0645	0.0200	0.0220	0.0237	0.0220	0.0220	.....	.....
Slag	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0019	.....	.....	.....	.....	.....	.....	.....
Spikes	0.0031	0.0009	.....	0.0441	0.0194	.....	.....	0.0041	0.0019	0.0045	0.0006	0.0195	0.0219	0.0175	0.0007	0.0011	0.0043	0.0028	0.0123	.....
Thermit	0.0577	0.0454	0.0562	.....	.....	0.0356	.....	0.0546	0.0635	0.0540	0.0556	.....	.....	0.0268	0.0703	0.0543	0.0446	0.0519	0.0431	0.0368
Tie rods	0.0500	0.0500	0.0500	0.0318	0.0488	0.0500	0.0156	0.0490	0.0490	0.0500	0.0500	0.0332	0.0004	0.0509	0.0490	0.0490	0.0500	0.0490	0.0500	0.0410
Ties, Carnegie	0.2919	0.3128	0.2777	.....	.....	0.2958	.....	0.2833	0.3209	0.2236	0.2385	.....	.....	.....	0.2854	0.2881	0.2495	0.2844	0.1963	0.2400
Ties, international	0.1324	0.1393	0.1357	.....	.....	0.1192	.....	0.1260	0.1485	0.0756	0.1031	.....	.....	.....	0.1228	0.1314	0.1124	0.1241	0.0637	0.1054
Ties, oak	0.0307	0.0227	0.0139	0.2338	0.4228	.....	.....	0.0330	0.0097	0.1011	0.0360	0.4032	0.4319	0.3813	0.0147	0.0255	0.0708	0.0454	0.2219	0.0612
Combination splices	0.0110	0.0017	0.0091	0.0075	.....	0.0033	.....	0.0036	.....	0.0205	0.0011	.....	0.0017	0.0878	0.0109	0.0187	0.0067	0.0081	0.0233	.....
Bonzaño	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0896	.....	.....	.....	.....	.....	.....	.....
Total	2.6793	2.3701	2.2769	0.9055	1.3135	2.5574	0.6199	2.5619	2.4942	2.5402	2.4453	1.2655	2.3354	2.3447	2.5127	2.5576	2.3952	2.4391	2.3185	2.0117

TRACK LABOR

Bonding	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0022	0.0035	.....	.....
City of Cleveland	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleaning street	0.0312	0.0214	0.0321	0.0505	0.0413	0.0394	0.0437	0.0499	0.1063	0.0372	0.0437	0.0666	0.0097	0.1494	0.1143	0.0411	0.0431	0.1054	0.0368	0.0654
Concreting	0.1092	0.0619	0.0837	0.0633	0.1891	0.1192	0.0379	0.0901	0.1196	0.1575	0.0945	0.0658	0.0176	0.5125	0.0984	0.1273	0.0878	0.0863	0.0997	0.0509
Cutting rail	0.0055	.....	.....	.....	.....	0.0094	.....	0.0039	0.0009	0.0056	.....	.....	0.0020	0.0215	0.0094	0.0073	0.0044	0.0073	0.0165	0.0070
Drilling	.....	.....	.....	.....	.....	0.0052	.....	0.0006	.....	.....	0.0009	.....	0.0003	.....	.....	0.0005	0.0013	0.0025	0.0072	0.0070
Excavating	0.1845	0.3689	0.1385	0.2216	0.3389	0.1627	0.0897	0.1304	0.2226	0.2542	0.0949	0.2258	0.5926	0.3389	0.1973	0.1308	0.1757	0.1691	0.2271	0.1761
Grinding	.....	.....	.....	.....	.....	.....	.....	.....	0.0003	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Handling new material	0.1192	0.0509	0.0591	0.2051	0.0620	0.0805	0.0150	0.0871	0.0588	0.1182	0.0672	0.1552	0.0700	0.0431	0.0638	0.0626	0.0669	0.0515	0.0681	0.1240
Handling at store yard	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Laying drain tile	0.0512	0.0133	0.0568	.....	0.1061	0.0114	0.0268	0.0167	0.0248	0.0267	0.0258	0.0388	0.1014	0.0186	0.0235	0.0156	0.0178	0.0302	0.0141	.....
Laying plank	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Laying track	0.0600	0.0723	0.0222	0.0107	0.1890	0.0972	.....	0.1494	0.1049	0.1509	0.1306	0.0282	0.1546	0.1739	0.1358	0.0824	0.0703	0.0908	0.0883	0.0522
Loading	0.0340	.....	.....	0.0231	.....	0.0340	.....	.....	0.0019	0.0151	.....	0.0065	0.0146	.....	0.0385	0.0325	0.0191	0.0229	0.0055	.....
Plumbing	0.0461	0.0056	0.0828	.....	0.0198	0.0300	.....	0.0706	0.1002	0.0514	0.0456	0.0452	.....	0.0262	0.0455	0.0497	0.0701	0.0668	.....	.....
Reaming	0.0080	0.0031	0.0026	.....	.....	0.0087	.....	0.0112	0.0076	0.0132	0.0103	.....	0.0006	0.0279	.....	0.0076	0.0034	0.0054	.....	0.0237
Riveting	0.0074	0.0087	0.0056	.....	.....	0.0127	.....	0.0075	0.0071	0.0036	0.0066	.....	.....	0.0126	0.0105	0.0094	0.0103	0.0066	0.0077	0.0059
Sawing ties	0.0074	0.0013	0.0049	.....	.....	0.0099	.....	0.0071	0.0003	0.0061	0.0024	.....	.....	.....	0.0048	0.0063	0.0071	0.0058	0.0031	0.0077
Surfacing and aligning	0.2094	0.1219	0.1598	0.2262	0.3636	0.0852	0.0502	0.0569	0.1106	0.0995	0.0474	0.2316	0.3875	0.2913	0.0457	0.0659	0.1440	0.0957	0.0971	0.0703
Teaming	0.0558	0.0544	0.0375	0.0394	0.0401	0.0159	0.0400	0.0637	0.0516	0.0313	0.0356	0.0367	0.0741	0.1384	0.0078	0.0215	0.0232	0.0471	0.0734	0.0469
Temporary track	0.0276	0.0254	0.0081	0.0185	0.0219	0.0099	0.1707	0.0124	0.0055	0.0348	0.0051	0.0207	0.0020	0.1667	0.0237	0.0672	0.0836	0.0673	0.0519	0.0663
Tearing up	0.0436	0.0023	0.0141	0.0117	.....	0.0682	.....	0.0101	0.0034	0.0955	0.0059	0.0777	0.0003	0.1461	0.1085	0.0668	0.0456	0.0532	0.0871	0.1477
Watching	0.3595	0.1033	0.1142	0.2482	0.2190	0.0858	0.1577	0.1112	0.0546	0.1236	0.0436	0.2407	0.0464	0.0807	0.1362	0.1224	0.1362	0.0892	0.1271	0.2377
Welding	0.0128	0.0076	0.0094	.....	.....	0.0080	.....	0.0088	0.0083	0.0077	0.0073	.....	0.0003	0.0085	0.0108	0.0072	0.0098	0.0078	0.0097	0.0136
Work train operation	0.0170	0.0178	0.0160	0.0098	0.0590	0.0140	0.0010	0.1346	0.0676	0.0161	0.0382	0.0380	0.0964	0.0156	0.0814	0.0366	0.0562	0.0210	0.0260	0.0136
Resetting curb	.....	.....	.....	.....	.....	.....	.....	0.0104	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Puddling	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0164	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	1.3894	0.9401	0.8474	1.1281	1.6498	0.9073	0.6327	1.0326	1.0569	1.2482	0.7220	1.3775	1.5701	2.1719	1.1564	0.9607	1.0781	0.9459	1.0464	1.1160

PAVING MATERIAL

Block, dressed Medina	.....	.....	.....	.....	.....	.....	.....	0.0042	.....	0.0314	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Block, redressed Medina	0.7907	.....	.....	0.8090	.....	0.1319	.....	0.0499	0.0154	0.1639	.....	.....	0.0124	0.5784	.....	.....	0.1266	0.0186	.....	.....
Block, old Medina	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.9169	.....	.....	.....	.....	.....	.....	.....	.....
Brick, new	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0062	.....	.....	.....	.....	.....
Cement	0.1138	0.1871	0.1836	0.1373	0.6467	0.2223	0.0551	0.2242	0.2032	0.2148	0.1675	0.1462	0.0003	0.0988	0.0617	0.2237	0.1945	0.1784	0.1647	0.1510
Granite block	0.8590	1.5828	0.8600	.....	.....	0.8923	0.7997	1.0332	0.8402	0.9776	0.8958	.....	0.0091	0.8367	0.8673	0.9266	0.7775	0.8376	0.8543	0.8350
Granite, nosed	0.5818	0.5849	0.5754	.....	.....	0.5875	0.5701	0.6478	0.5731	0.5831	0.6118	.....	0.0035	0.5559	0.5862	0.5874	0.5824	0.5837	0.5845	0.5730
Granite, crushed	.....	0.1019	0.0052	.....	0.4476	0.1034	.....	0.0423	0.1500	0.1380	0.0650	0.1036	0.0189	.....	0.1521	0.1316	0.0916	0.0781	0.0111	.....
Gravel	.....	.....	0.0732	0.0605	.....	.....	.....	.....	.....	0.0243	0.0229	0.0557	.....	.....	.....	0.0313	0.0124	0.0118	0.0167	.....
Hardener for concrete	.....	0.0193	.....	.....	.....	.....	.....	0.0274	0.0206	.....	0.0216	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sand lake	0.0192	0.0095	0.0159	0.0029	0.0005	0.0098	0.0076	0.0111	0.0138	0.0102	0.0113	0.0015	.....	0.0233	0.0273	0.0073	0.0079	0.0105	0.0075	0.0096
Sand cushion	0.0708	0.0636	0.0903	0.1102	0.0591	0.0832	0.0186	0.0737	0.0388	0.0861	0.0505	0.1072	0.0041	0.0817	0.0224	0.0673	0.0742	0.0528	0.0445	0.0424
Tar	0.1486	0.0289	0.0926	0.1136	.....	0.0167	.....	0.1053	.....	.....	.....	0.1628	.....	0.3456	.....	.....	0.0129	.....	0.2375	0.0310
Asphalt	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	2.5839	2.5780	1.8962	1.2245	1.1539	2.0471	1.4511	2.2191	1.8551	2.2294	1.8464	1.4939	0.0483	2.5204	1.7232	1.9752	1.8800	1.7715	1.9208	1.6420

PAVING LABOR

Cleaning old material	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grouting	0.0667	0.0355	0.0691	0.0769	0.0063	0.0393	0.1084	0.0584	0.0553	0.0505	0.0585	0.0213	0.0023	0.1119	0.0316	0.0526	0.0331	0.0358	0.0920	0.0775
Handling new material	0.2229	0.0433	0.1624	0.0953	0.0931	0.0396	0.0284	0.0516	0.0571	0.0356	0.0299	0.1047	0.0028	0.0598	0.0359	0.0204	0.1293	0.0276	0.0332	7.0276
Laying	0.1782	0.1051	0.2460	0.2270	0.0907	0.1489	0.1168	0.1943	0.1934	0.2557	0.1002	0.1309	0.0095	0.1512	0.0765	0.2238	0.1157	0.1482	0.4015	0.2832
Loading	0.0643	0.0003	0.0429	.....	.....	0.0298	.....	0.0267	0.0072	0.0301	0.0614	0.0152	0.0012	.....	0.0109	0.0477	0.0295	0.0278	0.0050	.....
Plowing	0.0025	.....	.....	.....	.....	0.0031	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0041	0.0024	0.0036	0.0051	.....
Throwing on side	0.0531	0.0382	0.0544	0.0746	.....	0.0500	0.0374	0.0830	0.0538	0.0078	0.0435	0.1148	0.0035	0.1591	0.0048	0.0733	0.0781	0.0632	0.1885	0.1555
Work train operation	0.0091	0.0089	0.0018	0.0005	0.0295	0.0070	0.0015	0.0673	0.0337	0.0091	0.0191	0.0195	0.0482	0.0078	0.0407	0.0183	0.0281	0.0105	0.0015	0.0068
Total	0.5968	0.2313	0.5766	0.4743	0.2196	0.3177	0.2925	0.4813	0.4005	0.3888	0.3126	0.4064	0.0675	0.4898	0.2004	0.4402	0.4162	0.3167	0.7268	0.5506

REPAVING MATERIAL

Medina block, redressed	0.3813	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cement	.....	.....	.....	.....	0.0392	0.0015	.....	0.0139	0.0047	.....	0.0014	0.0140	.....	.....	.....	0.0290	.....	0.0159	.....	0.0588
Sand, lake	.....	.....	.....	.....	0.0123	0.0001	.....	0.0035	0.0004	.....	0 0001	0.0015	.....	.....	.....	0.0089	.....	0.0053	.....	0.0075
Sand, cushion	.....	.....	.....	.....	0.0109	.....	.....	0.0321	.....	.....	0.0056	0.0089	.....	.....	.....	.....	.....	0.0056	.....	.....
Asphalt	.....	.....	.....	.....	.....	0.3203	.....	.....	0.0373	.....	0.0993	.....	.....	.....	.....	.....	.....	.....	.....	.....
Granite block	.....	.....	.....	.....	.....	0.1172	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tar	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0421	0.0902	.....	.....	.....	.....	.....	.....	0.0246	.....	.....
Brick	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.1198	.....	0.0996	.....	0.1090
Total	0.3813	.....	.....	.....	0.0624	0.4391	.....	0.0495	0.0424	0.0421	0.1966	0.0244	.....	.....	.....	0.1567	.....	0.1510	.....	0.1753

REPAVING LABOR

Laying	.....	.....	0.1001	0.1749	0.1267	0.0267	.....	0.1466	0.0134	0.0102	0.0631	0.2485	.....	0.1261	.....	0.1024	0.0145	0.1230	.....	0.1685
Cleaning old material	.....	.....	.....	.....	0.0021	.....	.....	.....	0.0948	0.0024	0.0550	0.1109	0.0003	.....	.....	0.0049	.....	0.0017	.....	.....
Total	.....	.....	0.1001	0.1749	0.1288	0.0267	.....	0.1466	0.1082	0.0126	0.1181	0.3594	0.0003	0.1261	.....	0.1073	0.0145	0.1247	.....	0.1685
Grand Total	7.1307	6.1195	5.6972	3.9073	4.5280	6.2953	2.9962	6.4910	5.9573	6.4610	5.6410	4.9271	4.0216	7.6529	5.5927	6.1977	5.7840	5.7489	6.0125	5.6641
Feet of single track	995.1	6,314.8	1,502.7	1,459.3	1,795.1	3,237.1	658.6	5,996.6	12,699.1	3,209.1	9651.7	5,111.2	12,787.5	501.2	2,006.0	3,525.6	4,915.2	16,955.8	941.9	832.3
Work order numbers	1585	1599	1589	1618	1538	1534	1028	1572	1616	1566	1587	1533	1558	1607	1610	1531	1532	1528	1565	1541
	1	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Divided According to Jobs (Prices in Dollars)

TRACK MATERIAL

23	24	25	26	27	28	29	30	31	32	33
0.0259	0.0105	.....	.....	.....	0.0051	.....	.....	.....	.....	.....
.....	.....	0.0006	0.0001	.....	.....	0.0007	.....	.....	.....	.....
0.3047	0.0005	0.1716	0.3012	0.2295	0.3722	0.2555	0.3976	0.4700	0.2835	0.2827
.....	0.0216	.....	0.0013	0.0189	0.0054	0.0029	0.0032	0.0053	0.0055	0.0023
.....	.....	0.0483	0.0527	.....	0.0217	0.0497	0.0425	0.0550	0.0536	0.0403
0.1491	0.0418	.....	0.0039	0.2014	0.2413	0.0082	0.0491	.....	.....	0.0335
.....	.....	.....	0.0224	.....	0.0144	0.0365	0.0341	.....	0.0553	0.0380
0.1282	0.0006	0.1994	0.2927	0.1199	0.2628	0.2771	0.3326	0.5289	0.2721	0.3543
.....	.....	0.0041	0.0005	.....	.....	0.0048	.....	.....	.....	.....
.....	.....	.....	0.0001	.....	.....	.....	.....	.....	.....	.....
.....	.....	0.0027	0.0033	0.0028	0.0025	0.0032	0.0044	.....	0.0031	0.0035
.....	.....	0.0002	0.0003	0.0002	0.0003	0.0003	0.0004	.....	0.0003	0.0003
.....	.....	1.1196	1.1183	1.1191	1.1178	1.1180	1.1180	1.1181	1.1181	1.1180
1.6970	.....	.....	.....	.....	0.0369	.....	0.0368	.....	.....	.....
.....	0.7012	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	0.0163	0.0195	0.0168	0.0171	0.0205	0.0119	.....	0.0157	0.0194
.....	.....	0.0793	0.0677	0.0561	0.0511	0.0686	0.0684	0.0636	0.0663	0.0556
0.0756	.....	.....	.....	.....	.....	.....	0.0016	.....	.....	.....
.....	0.0729	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.0309	.....	0.0231	0.0004	0.0722	0.0091	0.0021	0.0109	.....	0.0005	0.0034
.....	.....	.....	0.0220	0.0220	0.0200	0.0247	0.0322	0.0320	0.0440	0.0205
.....	0.0383	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.0157	0.0204	.....	0.0006	0.0217	0.0151	0.0006	0.0022	.....	.....	0.0023
.....	.....	0.0461	0.0568	0.0473	0.0502	0.0542	0.0811	.....	0.0539	0.0579
0.0408	0.0001	0.0490	0.0490	0.0490	0.0500	0.0513	0.0500	0.0537	0.0490	0.0490
.....	.....	0.2782	0.3028	.....	0.1251	0.2871	0.2973	0.3174	0.3008	0.2249
.....	.....	0.1168	0.1347	.....	0.0555	0.1264	0.1349	0.1456	0.1368	0.1052
0.3723	0.3691	0.0555	0.0096	0.3966	0.3129	0.0235	.....	.....	0.0009	0.0419
0.1189	.....	0.0299	0.0014	0.0771	0.0356	0.0044	0.0042	.....	.....	0.0021
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2.9591	1.2770	2.2407	2.4618	2.4506	2.8221	2.4203	2.7134	2.7896	2.4594	2.4551

TRACK LABOR

.....	.....	.....	0.0019	.....	.....	.....	.....	.....	.....	.....
0.1094	.....	0.1415	0.0214	0.0515	0.0922	0.1152	0.0629	.....	0.0415	0.0341
0.0367	0.0016	0.3525	0.1008	0.2122	0.1498	0.1005	0.1278	0.1299	0.0763	0.0921
0.0205	.....	0.0025	0.0025	.....	0.0077	0.0058	.....	.....	.....	0.0010
.....	.....	.....	0.0015	.....	.....	0.0028	.....	.....	.....	.....
0.1002	0.2448	0.2616	0.0947	0.5380	0.5047	0.2262	0.3084	0.3128	0.2396	0.3192
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	0.1048	0.0647	0.0468	0.1983	0.1064	0.1206	0.1064	.....	0.1085	0.0264
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	0.0155	0.0530	0.0405	0.0411	0.0581	0.0822	0.0419	0.0168
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.1243	0.0761	0.2564	0.0693	0.1323	0.1859	0.0474	0.0951	0.0457	0.0353	0.0771
.....	.....	0.0036	0.0241	.....	0.0072	0.0074	.....	.....	.....	0.0007
0.0197	.....	.....	0.0356	.....	.....	0.0413	0.1776	0.0138	0.0036	0.1036
0.0162	.....	.....	0.0038	.....	0.0051	0.0174	0.0044	.....	0.0081	0.0086
.....	.....	0.0087	0.0075	0.0074	0.0095	0.0131	0.0052	.....	0.0066	0.0091
.....	.....	.....	0.0072	.....	0.0040	0.0098	0.0057	.....	0.0109	.....
0.1005	0.1068	0.1861	0.0696	0.1841	0.1468	0.1497	0.1599	0.1463	0.0768	0.0961
0.0921	0.0286	0.0794	0.0205	0.0934	0.0829	0.0431	0.0664	0.0314	0.0212	0.0691
.....	0.0014	0.0258	0.0735	0.1556	.....	0.1041	0.0024	0.0050	0.0081	0.0096
0.1070	.....	0.0294	0.0568	0.1170	.....	0.0969	0.0075	.....	.....	0.0051
0.0015	0.0332	0.3958	0.0613	0.1311	0.1090	0.1652	0.2035	0.0437	0.0787	0.0933
.....	.....	0.0058	0.0082	0.0091	0.0158	0.0118	0.0143	.....	0.0104	0.0078
0.0051	0.0042	0.0052	0.0462	0.0063	0.0615	0.0152	0.0416	0.0051	0.0014	0.0042
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.7332	0.6015	1.8190	0.7687	1.8893	1.5290	1.2946	1.4472	0.8151	0.7689	0.9739

PAVING MATERIAL

.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	0.3471	.....	0.5222	0.1641	0.0482	.....	.....	0.7781	0.1957
.....	.....	.....	.....	.....	.....	.....	.....	0.2399	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.0664	0.0008	0.3433	0 0836	0.0131	0.2024	0.2667	0.2154	0.1300	0.1376	0.1563
0.8687	.....	.....	0.7983	.....	0.8911	0.7778	0.8620	0.8619	0.8502	0.9859
0.6302	.....	0.0088	0.5674	0.6069	0.5809	0.4149	0.5717	0.5716	0.5723	0.5809
.....	.....	0.5473	.....	.....	0.1682	0.1974	0.1962	.....	.....	0.0742
.....	.....	0.0267	0.0059	.....	0.0409	0.0036	0.0106	.....	0.0037	0.0137
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0108
.....	0.0001	.....	0.0071	.....	0.0082	0.0080	0.0050	0.0200	0.0135	0.0139
.....	0.0006	0.0460	0.0281	0.0302	0.0911	0.0612	0.1184	.....	0.0474	0.0668
0.3271	.....	0.0944	.....	.....	0.1232	0.0122	.....	.....	.....	0.0314
.....	.....	.....	.....	.....	.....	0.0844	.....	.....	.....	.....
1.8924	0.0015	1.4136	1.4904	1.1724	2.2701	1.8744	1.9793	1.8234	2.4028	2.0796

PAVING LABOR

0.1038	0.0004	.....	0.0339	0.1033	0.0416	0.0391	0.0484	.....	0.0467	0.0696
.....	.....	.....	0.0238	0.0712	0.0115	0.1511	0.0645	.....	0.1667	0.0540
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.1348	0.0009	0.1051	0.1238	0.1777	0.0384	0.1483	0.2039	0.5002	0.1286	0.1804
.....	.....	0.1042	0.0321	0.0289	0.0739	0.0333	.....	.....	0.0451	0.0276
.....	.....	0.0361	0.0022	.....	.....	0.0018	.....	.....	.....	0.0014
0.2221	.....	0.1882	0.0542	0.0289	0.0729	0.0403	0.1523	.....	0.1109	0.0223
0.0021	0.0021	0.0009	0.0462	0.0021	0.0031	0.0076	0.0092	0.0016	0.0004	0.0021
0.4628	0.0034	0.4345	0.3162	0.4121	0.2414	0.4215	0.4783	0.5018	0.4984	0.3654

REPAVING MATERIAL

.....	.....	.....	.....	.....	0.0157	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	0.0074	.....	.....	.....	.....	.....
.....	.....	0.0944	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	0.4392	.....	.....	0.4982	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0029	.....
.....	.....	.....	.....	.....	0.0383	.....	.....	.....	.....	0.0388
.....	.....	0.0944	.....	.....	0.0614	0.4392	.....	.....	0.5011	0.0388

REPAVING LABOR

0.0721	.....	0.0881	0.0026	.....	0.2571	.....	0.2943	.....	.....	0.0474
.....	.....	.....	.....	.....	0.0572	0.0109	.....	.....	.....	0.0042
0.0721	.....	0.0881	0.0026	.....	0.3143	0.0109	0.2943	.....	.....	0.0516
6.1196	1.8834	6.0903	5.0392	5.9244	7.2383	6.4609	6.9125	5.9299	6.6306	5.9644
184.7	15,419.4	367.0	7,986.5	570.5	1,543.9	2,464.8	2,663.3	1,176.9	2,445.1	5,170.8
1,614	1,559	1,573	1,542	1,625	1,550	1,549	1,557	1,545	1,583	1,598
23	24	25	26	27	28	29	30	31	32	33

on page 73 of the ELECTRIC RAILWAY JOURNAL of July 10, 1915. The concrete in the foundations and pavement was mixed with a Koehring mixer especially adapted for street-railway work. Whenever it was necessary to remove old track, the rails were cut in two with an oxy-acetylene cutting torch and loaded upon flat cars with a Brown Hoisting Machinery Company's derrick. All material, including the gravel and the paving block, was delivered to the different jobs in trains consisting of three 75-ton automatic dump cars.

In order to give the proper interpretation to the unit costs some explanation of the differences in the prices per foot for the various jobs is necessary. The complete unit cost data is shown in the accompanying tabulation. From this it will be noted that the costs are classified under headings including track material, track labor, paving material, paving labor, repaving material, repaving labor. Each of these classifications contains a detailed distribution of the various cost items, and the results obtained for each of the thirty-one track-construction jobs are recorded in the proper columns.

CHARACTERISTICS OF DIFFERENT JOBS

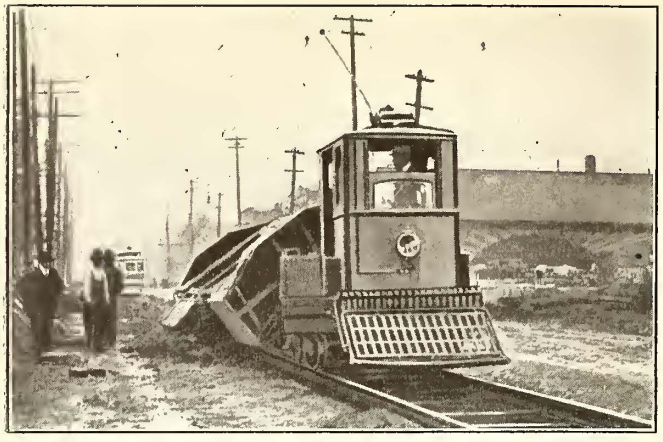
The data appearing in the table under job No. 1 applied to a stretch of single track laid in a double-track street, and this necessitated paving the old devil strip and laying a tile drain beneath the new track. In Job No. 3 the original surface of the street had been left high by a contractor, and the increase in cost was due to the unusual amount of excavation required. This piece of track was an extension of a double-track line through a dirt street. The low cost of Job No. 5 is due to the fact that it consisted mainly of resurfacing. Job No. 4 consisted of a single track laid beside the track that is included in Job No. 5. In connection with Job No. 6 it will be noted that the unit cost for watching is high, this being due to the fact that the work had to be kept open for eight months. In this job the track was taken up to permit the installation of a sewer and then was relaid and repaved with dressed Medina block.

The cost of track construction in the heart of the Cleveland business district, where traffic is heavy, is shown to be relatively high by the unit costs under Job No. 8. This work consisted of double track with the company's standard form of paving between the rails and in the devil strip, but with sheet asphalt on the sides of the street. The total cost of Job No. 9 is low because it included merely resurfacing and paving some track that had been laid over a sewer.

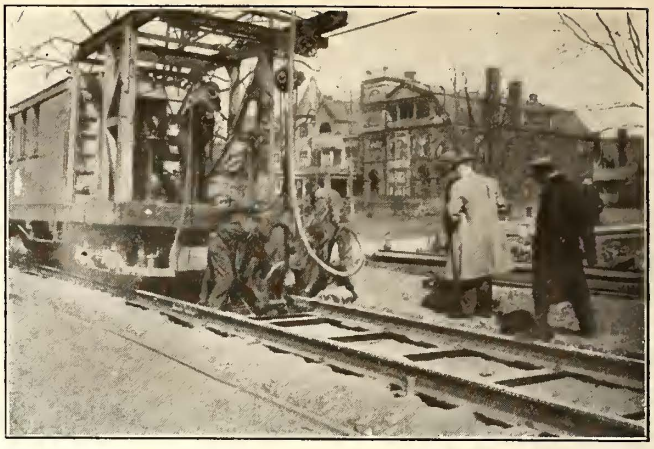
Frequently the city arranges with the Cleveland Railway's track construction forces to pave the entire street at the same time when the track is paved. This was the case in Job No. 10, where a new extension was laid through a brick paved street, the track forces repaving the sides of the street from the track to the curbs. When work of this kind is undertaken by the Cleveland Railway a careful distribution of cost is kept, and to this is added the other proper items of expense, including overhead, for the purpose of billing the city.

Job No. 11 was a double-track extension built for at least two-thirds of the length of an unpaved street. Job No. 12 included laying a double track in a street paved with macadam. The new track work was repaved with granite between the rails and in the devil strip.

The unit costs in Job No. 13 are high because this work, which included an extension in a street paved with Medina block, was delayed six weeks awaiting sewer connections. Job No. 14 was largely rehabilitation work in which the old track was resurfaced and provided with new ties. The joints were repaired and ground, and a 6-in. drain tile was laid beneath the devil strip. Eighty-pound, A. S. C. E. rail laid on wooden



CLEVELAND TRACK COSTS—AUTOMATIC DUMP CAR IN TILTED POSITION



CLEVELAND TRACK COSTS—PNEUMATIC RIVETER INSTALLING A CLARK JOINT

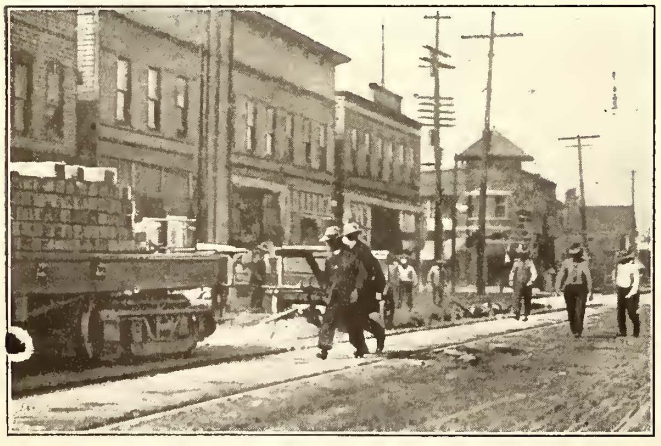
ties with 12 in. of crushed stone ballast was the type of construction used in connection with Job No. 15, the cost of excavation being relatively high because this track was built on a private right-of-way where the grading consisted of cuts and fills. The total cost of Job No. 16 is comparatively high because it involved little more than 500 ft. of track and it was necessary to do all the work during the night. In Job No. 17 all the excavation was done with a Thew automatic shovel, and the street, in some places, was lowered as much as 3 ft. In connection with this particular job a credit of 13 cents per foot should be deducted for excavating outside of the track allowance, which should have been done by the contractor.

Tracks formerly paved with brick were repaved with granite and the sides of the street were paved with brick in Job No. 18. This, of course, included the necessary material and labor for tearing up and rebuilding the new pavement. In Job No. 19 an old track paved with Medina stone was replaced with new track paved with granite block, and a drain tile was laid beneath the devil strip. The special features of Job No. 20 are the same as those for Job No. 18, namely, that a track originally paved with brick was repaved with granite block. Job No. 21 included a single track laid in a double-track street. In this job a drain was also provided, and it was necessary to pave the full width of the devil strip with granite concrete. Job No. 22 is the same as Job No. 19. The high cost of Job No. 23 is due to the fact that it was only 185 ft. long and all the work had to be done at night.

An especially low unit cost per foot is recorded against Job No. 24. It consisted of 80-lb. A. S. C. E. rail laid on oak ties spaced at 24-in. centers. The excavating is one of the largest single cost items, and it consisted of digging a trench in a dirt road beside a brick pavement. The ties were tamped with cinders and a space 4 ft. wide outside of the rail was filled with crushed stone and slag. The labor cost in Job No. 25 is high because the work was done in the congested business district where one track was laid in a double-track street. This work also included repaving the devil strip and placing a drain beneath it.

Job No. 26 included the removal of a temporary track and relaying new track over a sewer. In this instance the devil strip was paved by the city and the tracks were paved by the railway company which was afterwards reimbursed by the city. The track construction in Job No. 27 differed from the standard in that the rails were laid on wooden ties with 7 in. of crushed stone grouted beneath them. The old pavement was replaced with redressed Medina block and a tar filler. Job No. 28 was laid through an unpaved street which made the cost of excavation relatively high.

Job No. 29 differed from the standard in that a double track was laid in a street with a sheet asphalt pavement between the track and the curb. The pavement in one track was entirely of granite block and that in the other track included three different types of pavements laid for experimental purposes. One-third of this track was paved with granite block, one-third with asphalt block and the remaining one-third with granite concrete. Standard track construction was adopted for Job No. 30, which consisted of a new extension through a brick-paved street. In Job No. 32 a single track was laid beside one already in place to form a double track. This work included laying the drain tile and paving the devil strip. Job No. 33 was the same as Job No. 3.



CLEVELAND TRACK COSTS—PAVEMENT ROOTER IN OPERATION

CLEVELAND TRACK COSTS—SURFACING JOINTS WITH GRINDER

Wisconsin Association Meets

New Utility Legislation and Regulation of Security Issues Are Topics Which Were Discussed at Opening Session

NEW utility legislation and commission regulation of utility security issues were the two most important topics discussed at the opening session of the eighth annual convention of the Wisconsin Electrical Association, held in Milwaukee on March 16 and 17. More than 130 railway and supply men attended. President M. C. Ewing, manager Wisconsin Valley Electric Company, Wausau, Wis., presided. His annual address was referred to a committee for recommendations. The report of George Allison, secretary-treasurer, showed that the total receipts during the year were $5,113, with expenditures of $4,518, leaving a balance of $595. This report was referred to an auditing committee, which was also requested to report on the question of paying the secretary a salary.

J. B. Sanborn, whose address will appear in a later issue, then reviewed the State legislation during the last session. Answering an inquiry from F. W. Walker, general manager Milwaukee Northern Railway, Mr. Sanborn stated that in his opinion the law regulating jitneys did not apply to those competing with interurban railways. He did believe, however, that the laws of the various cities through which this class of jitneys operated, governed them. He felt that if the law applied only to jitney competition with street railways, it should be amended to protect all electric railways. President Ewing called attention to the provisions of one of the new laws which made it necessary for a contractor to obtain a permit and pay the cost of disturbing the property of a utility, while the city had the right to disturb any and all utility property without permission or reimbursement of the utility for the extra expense incurred.

Harold L. Geisse, secretary Railroad Commission of Wisconsin, then discussed the attitude of this commission on security issues. F. W. Walker, Milwaukee Northern Railway, opened the discussion by inquiring about the right of utilities to defer dividends and divert them into betterments and later make up for them from the proceeds of securities issued on these betterments. Mr. Geisse believed that this practice was within the law. Mr. Walker then said that he did not believe the present method of regulating security issues by commissions was just, for it allowed only a 75 per cent bond issue, and the remainder of the funds to pay for a property must be secured from stock issues. He believed that in view of the commission's authority to pass on security issues it should insist that the security-issuance value be the rate-making value. Mr. Walker also believed that, although the day of exploitation had passed in Wisconsin because no profit was allowed for exploiting purposes, exploitation was highly desirable in developing any business. Since the commission had no power to reimburse the failures, it should not limit the profit of the successes. The policy of the commission and the State should be to stimulate the extension of electric railways and power lines, to regulate them like banks and not limit their net earnings to 6½ per cent.

In rebuttal Mr. Geisse said that while security issues might form a rate-making basis in some cases, they would not in all, as in the case of competitive local utilities which later consolidated and reissued securities. The policy of the commission in regulating security issues had not retarded electric railway extensions. In fact, three companies authorized to issue securities for construction could not sell them to the public. Mr. Geisse believing that electric railway development had ceased because the operating ratio had increased through higher labor and material costs.

T. E. Lyons, member Wisconsin Tax Commission, closed the program for Thursday with an address explaining the tax methods in Wisconsin and the reasons why taxes have increased annually. On Thursday evening the annual banquet of the Electric Association and the Wisconsin Gas Association was held. L. J. Beauchamp, a famous Chautauqua lecturer, was the principal speaker.

Electrolytic Corrosion with Infrequently Reversed and Alternating Currents

Experts from the Bureau of Standards Present the Results of Investigations Showing the Electrolytic Corrosion Produced by Currents Reversed at Intervals of Different Lengths

AT a joint meeting of the American Institute of Electrical Engineers and the New York Section of the American Electrochemical Society held in New York on March 10, Burton McCollum and G. H. Ahlborn, of the National Bureau of Standards, presented a paper dealing with the subject of alternating current electrolysis. The researches covered by the paper included alternating currents of long period, such as are very common on portions of underground pipe systems of practically every city, due to the continual shifting of railway loads which causes the pipes within the large area, commonly called the neutral zone, to continually change their polarity with respect to the earth. The authors point out that alternation of current occurs not only in the ordinary negative systems of railways, but also to a greater extent and in a much larger territory in the case of negative return systems in which insulated negative feeders are used. In the latter case the potential differences between pipes and tracks can be greatly reduced, but this is accompanied by large increases in the area of the so-called neutral zone in which the polarity of the pipes is continually changing from positive to negative. With such types of three-wire systems which are now being seriously considered in some places for the prevention of electrolysis, there will also be large areas in which the polarity of the pipes will fluctuate between small positive and negative values. It has also been proposed that with the usual type of return the trolley be made alternately positive and negative on succeeding days in a week. In view of all these conditions, the authors have considered it to be of great practical importance to determine the extent to which the periodically reversed currents of these long periods will produce corrosion on subsurface metallic structures.

From the electric railway standpoint, the most important conclusions reached by the authors, after very elaborate tests, were as follows:

The coefficient of corrosion of lead, under the soil conditions described by the authors, when subjected to the action of direct current, was found to be only about 25 per cent of the theoretical value. This indicates that under the conditions of these tests, and probably under most soil conditions, the corrosion of lead is very considerably less than it was formerly considered to be.

The corrosion of lead reaches practically the maximum value with a frequency of reversal lying between one day and one week, while the corrosion of iron does not reach the maximum value until the period of the cycle is considerably in excess of two weeks.

In the so-called neutral zone of street railway networks where the pipes continually reverse in polarity,

the damage is much less than would be expected from a consideration of the arithmetical average of the current discharged from the pipes into the earth. Where pipes are alternately positive and negative with periods not exceeding ten or fifteen minutes, the algebraic sum of the current discharged is more nearly a correct index of the total damage that will result than any other figure that can readily be obtained.

The reduction in corrosion due to periodically reversed currents appears to be due to the fact that the corrosive process is in a large degree reversible, so that the metal corroded during the half cycle when current is being discharged is in a large measure redeposited during the succeeding half cycle when the current flows toward the metal. This redeposited metal may not be of much value mechanically, but it serves as an anode surface during the next succeeding half cycle, and thus protects the uncorroded metal beneath.

Reducing Insurance Rates on Unsprinklered Property

Removal of Refuse and Waste Material and Installation of Fire-Fighting Apparatus Effect a 40 Per Cent Reduction in the Insurance Rate

AN intended increase in fire insurance rates was turned into a 36 per cent decrease by the Columbus Railway, Power & Light Company, Columbus, Ohio, by expending $10,000 in cleaning up the property. A rate of 75 cents per $100 of insurable property had been charged, and the warning that the rate was about to be increased caused the management to request the assistance of the Ohio Inspection Bureau to ascertain what could be done not only to maintain the existing rate but to obtain a substantial reduction. After a thorough examination of the property, a plan for reducing fire hazards was outlined which the company followed to the letter. All refuse and combustible waste material were removed, standard hose equipments, hydrants, fire extinguishers, fire and sand buckets were installed, and fire doors and walls were provided in several buildings. Wire glass was substituted for the ordinary glass in the skylights, and it was also necessary to rewire a number of the carhouses to meet the requirements of the Underwriters' code.

Aside from the changes in the buildings, metal lockers for the employees' clothing were provided in the various carhouses and shops, and a fireproof garage was built for the company's automobiles. Rigid instructions were issued to those in charge that the company's buildings must be kept clean at all times. In order to insure this result the management arranged for four surprise inspections a year. In addition a fire inspector examines the property for defects each month. A Western Union fire alarm system was also installed in the different buildings, and a watchman's service requiring daily reports was also provided. The effect of these changes was to reduce the rate from 75 cents to 46 cents per $100 of insurable property. This plan of reducing fire hazards, rather than protecting them by installing a sprinkler system, was adopted because some of the company's property was so old that such a system would have to be scrapped in a short time. On the other hand, the company contemplated rebuilding a number of these structures in the near future, at which time a complete sprinkler system will be installed and a further reduction in the rate will be requested.

An application has been made by a mining company in Spain to construct and operate a narrow-gage electric railway between Conquidor and Tuertollano.

Electric Railway Section of National Safety Council

New Section Has Grown from Thirty-five to Sixty Members—Distribution of Bulletins and Other Safety Matter to Member Companies

THE membership of the electric railway section of the National Safety Council has now grown from thirty-five members, when the section was organized last October, to about sixty members, and reports from the membership campaign indicate a further substantial increase in the near future. The new membership is well distributed throughout the country and includes such companies as the Bay State Street Railway of Boston and the Pittsburgh Railways.

The electric railway section has begun a weekly distribution to its members of special bulletins dealing with the particular hazards of the electric railway industry in addition to the regular bulletins which have been an important feature of the work of the council. In addition to these bulletins a number of special distributions have been made to electric railway members, such as the 1916 safety calendar of the Brooklyn Rapid Transit Company, safety blotters distributed by the Chicago & Joliet Electric Railway, and copies of advertisements developed by the Beaver Valley Traction Company in a campaign to enlist the co-operation of the public.

The special weekly bulletins of the electric railway section deal with particular operating hazards such as those involved in car collisions, car and vehicle collisions, boarding and alighting accidents and cars striking persons. One appears below:

Electric Railway Series — Bulletin E-4.

Bulletins Are Read by 2,500,000 Workmen Each Week

NATIONAL SAFETY COUNCIL, CHICAGO, ILL.

That Fool Driver

Here's a stunt a motorman meets up with every day of his life. It is most exasperating and causes a fellow to cuss and put flat spots on his wheels. It results in more vehicle collisions than any other one situation.

There is no question that the driver of this touring car is very negligent. There is no excuse for his turning abruptly in front of the trolley car. However, this is a frequent practice and brings home to us the fact that, to prevent accidents, we must look out for the other fellow.

A motorman's safest course is to take it for granted that AUTOMOBILE DRIVERS ARE ESCAPED LUNATICS BENT ON SUICIDE!

READING TRANSIT AND LIGHT COMPANY, CLAIM DEPARTMENT
(Prepared By and Issued Under the Auspices of Electric Railway Section)

SAMPLE POSTER FORMING PART OF THE RECENTLY INAUGURATED SPECIAL ELECTRIC RAILWAY SERVICE OF THE NATIONAL SAFETY COUNCIL

American Association News

Manufacturers' Association Executive Committee Outlines to Membership Important Changes in Organization—American Association Holds Important Meeting in New York—Public Relations Committee Formulates Tangible Publicity Plans

Letter Issued by Manufacturers' Association

A brief account was published in the last issue of this paper of the meeting of the executive committee of the Manufacturers' Association, which was held in New York on March 8 and 9. The most important action taken at that meeting was to decide about the future activities of the association in view of the amendments to the constitution of the American Electric Railway Association passed in Chicago admitting manufacturers to company memberships in that association. In addition to the members of the executive committee of the Manufacturers' Association who were in attendance at the meeting, Charles L. Henry and James H. McGraw were present by invitation, and urged the manufacturing companies to join the American Association as company members.

As a result of the meeting, it was decided that the executive committee should send an official letter to all of its members, giving the text of the amendments adopted at Chicago, and stating that the exhibits and convention arrangements at the 1916 convention would be handled directly by the American Association, that the present offices would be given up on May 1, and that the usual yearly dues would not be collected. Finally, it was decided to urge the members of the Manufacturers' Association to become company members of the American Electric Railway Association.

The letter, which is being mailed to all members of the Manufacturers' Association the latter part of this week, follows:

LETTER ISSUED BY MANUFACTURERS' ASSOCIATION

"To All Members:

"At the mid-winter meeting of the American Electric Railway Association held in Chicago on Feb. 4, the parent association issued an invitation to companies, firms or individuals engaged in the business of manufacturing or selling apparatus, equipment or supplies used in electric railway operation to join and become members of the American Electric Railway Association, and the constitution and by-laws of that association were amended to read as follows:

"III. The membership of this Association shall consist of the following classes:

"(a) Company members, consisting of American urban and interurban railway companies, or lessees, or individual owners of urban and interurban railways, or steam railways having electrified sections, and of companies, firms or individuals engaged in the business of manufacturing or selling material for electric railways or otherwise, subject to the approval of the executive committee, intimately related to electric railway operations. Each member company shall be entitled to one vote, which shall be cast by the properly accredited delegate.

"XIV. Company members shall pay an admission fee of Ten Dollars ($10.00) and annual dues payable in advance based on gross earnings from electric railway operation, or from the business of manufacturing or selling material for electric railways or from other electric railway operations during the preceding fiscal year of the respective members as follows:

"In the case of American urban and interurban railway companies, or lessees, or individual owners of urban or interurban railways, or steam railways having electrified sections.

Gross Receipts	Annual Dues
Under $50,000	$25
Between 50,000 and $100,000	50
Between 100,000 and 250,000	75
Between 250,000 and 500,000	125
Between 500,000 and 1,000,000	175
Between 1,000,000 and 2,000,000	225
Between 2,000,000 and 3,000,000	275
Between 3,000,000 and 4,000,000	325
Between 4,000,000 and 5,000,000	375
Between 5,000,000 and 6,000,000	425
Between 6,000,000 and 7,000,000	475
Between 7,000,000 and 8,000,000	525
Between 8,000,000 and 9,000,000	575
Between 9,000,000 and 10,000,000	650
Between 10,000,000 and over	750
In the case of all others:	
Under $50,000	$25
Between 50,000 and $1,000,000	125
Between 1,000,000 and 6,000,000	325
Between 6,000,000 and 10,000,000	525
Over 10,000,000	750

"The executive committee shall provide the form in which the return requisite to the computation of dues shall be made.

"A very complete explanation of the proposed plan was made by Charles L. Henry, president of the parent association, in an article appearing on page 317 of the Feb. 12 issue of the ELECTRIC RAILWAY JOURNAL.

"Discussion of the foregoing amendments before their adoption indicated that the parent association intended in no way to interfere with the activities of our association as it exists. At that time it was thought best by President Henry that the Manufacturers' Association should continue to perform the functions for the 1916 convention as heretofore, and we were so notified, but after further consideration of the subject we were informed on March 8 by President Henry of the parent association that his association had decided to handle the convention exhibits, entertainment, etc., for 1916, and he further stated that his present intention was to appoint a committee to handle this convention detail to be composed of both representatives from railway companies and from manufacturing companies who join under the revised by-laws.

"In the light of this position as taken by the parent association, your executive committee has suspended all preparation for handling exhibits, entertainment, etc.

"Inasmuch as our organization was formed primarily to function and co-operate with the parent association in providing the exhibition and entertainment, and, since these two duties will be assumed this year by the parent association with its enlarged membership, therefore, the Manufacturers' Association as it exists to-day has little work to perform, and your executive committee has planned in the interest of economy to move its headquarters on May 1 from its present offices to less expensive quarters, the location of which will be announced later.

"We feel that with our present balance there will be no necessity for the collection of the usual yearly dues of $30, bills for which have heretofore been sent out about this time.

"The regular annual meeting of the Manufacturers' Association will be held as in the past during convention week in the fall and consideration of our future usefulness can be determined upon at that time.

"The condition which confronts the electric railroads to-day is such that it calls for the unified endeavor of all branches of the industry. Therefore, it was the sense of your executive committee that this letter be

written to inform the members of the Manufacturers' Association of the necessity for co-operation and to indicate the benefits to be derived from membership in the American Electric Railway Association.

"You will understand from the foregoing, of course, that in order that you may participate in the coming convention and exhibits, it will be necessary for your company to become a member of the parent association, the American Electric Railway Association.

"Very truly yours,
[Signed], Executive Committee,
"American Electric Railway Manufacturers' Association,
"By Thomas Finigan, President."

Committee on Use of Association Standards

The committee on the use of association standards has compiled a list of the standards and recommendations of the Engineering Association for the use of members of the association. This list is published herewith in the hope that the publication may assist in furthering the use of the standards along the line of the editorial printed in last week's issue. The first column contains the Engineering Manual section numbers.

BUILDINGS AND STRUCTURES

Section No.	
Bm 2c	Rules for instruction to employees for fire protection.

POWER DISTRIBUTION

Df 2b	Specification for galvanizing or sherardizing on iron or steel.
Df 3a	Design of cap and cone insulators.
Df 4a	Specification for overhead line material. (a) Iron and steel fittings. (b) Wood cross-arms.
Ds 1b	Specification for overhead crossings of electric light and power lines.
Ds 2b	Specification for 600-volt d.c. overhead trolley construction.
Ds 4a	Specification for wood poles. Part I—Chestnut poles. Part II—Eastern white cedar poles. Part III—Western white cedar poles.
Ds 5b	Specification for tubular steel poles.
Ds 6a	Diagram of clearances for overhead working conductors.
Dw 1c	Sections of grooved trolley wire.
Dw 2c	Copper wire tables.
Dw 3b	Specification for round and grooved high conductivity trolley wire.
Dw 4c	Specification for high voltage, three-conductor, paper insulated lead covered cable.
Dw 5b	Specification for single conductor, paper insulated, lead covered cable for 1200 volts.
Dw 6b	Electric wire and cable terminology.
Dw 8a	Specification for rubber insulated wire and cable for power distribution purposes.

EQUIPMENT

Eb 1a	Brakeshoes, brakeshoe heads and keys.
Eb 4b	Specification for air-brake hose.
Ec 1b	Dimensions for cars, including heights of couplers, bumpers and platforms. Part I—Height of couplers for city cars. Part II—Height of platforms for interurban cars. Part III—Height of bumpers for city and interurban cars.
Ec 2b	Automatic couplers for interurban cars and radial draft rigging, including M. C. B. specifications for couplers.
Ec 4a	Specification for the location of end connections on interurban cars engaged in the interchange of cars.
Ee 10a	Taper for bore of pinions.
Et 1a	Journal boxes.
Et 2a	Journal and journal bearing keys.
Et 3a	Design of axles.
Et 4a	Design for tread and flange of wheel.
Et 7a	Dimensions of rolled-steel wheels.
Et 9b	Specification for quenched and tempered carbon steel axles, shafts and similar forgings.
Et 10a	Specification for cold-rolled steel axles.
Et 11b	Specification for annealed carbon steel axles, shafts and similar forgings.
Et 12a	Specification for solid wrought carbon steel wheels for electric railway service.
Et 14a	Specification for case-hardened forged steel gears.
Et 15a	Specification for quenched and tempered forged carbon steel gears.
Et 16a	Specification for case-hardened forged steel pinions.
Et 17a	Specification for quenched and tempered forged carbon steel pinions.

POWER GENERATION

Gb 1a	Specification for lap welded and seamless boiler tubes.

BLOCK SIGNALS

Ss 2a	Use of semaphore signals.
Ss 3a	Fundamental indications in signaling.
Ss 4a	Aspects in three-position signaling.
Ss 5b	Light aspects in three-position signaling employing signals operated by contactors.
Ss 6a	Light aspects for car spacing signals operated by contactors.
Ss 7b	Use of continuous track circuits for the control of automatic signals for high-speed interurban service.
Ss 14a	Design of signal apparatus.

WAY MATTERS

W3d 1c	Location of and clearances for third-rail working conductors, structures and rolling equipment.
W3d 2b	Third-rail terminology.
W3d 3a	Protection of contact rail where protected third-rail is used.
Wf 1a	Designs of proper foundation for tracks in paved streets.
Wm 2a	Symbols for recording surveys.
Wm 3a	Specifications for splice bars for girder and high T-rails.
Wm 4b	Design for joint plates for 7-in. girder grooved and guard rails.
Wm 5a	Design for joint plates for 9-in. girder grooved and guard rails.
Wm 6a	Design for joint plates for 7-in. 80-lb. and 90-lb. plain girder rails.
Wm 7a	Drilling for standard section rails.
Wr 1b	Recommended designs for plain girder rails for use in paved streets. Part I—Use of plain girder rails in paved streets. Part II—Designs of plain girder rails.
Wr 2c	Specification for the manufacture of open-hearth girder and high T-rails.
Wr 3b	9-in. girder grooved rail.
Wr 4b	7-in. girder grooved rail.
Wr 5a	9-in. girder guard rail.
Wr 6a	7-in. girder guard rail.
Ws 1a	Layouts for track switches, mates and frogs.
Ws 2a	Rules for determining gage of track on curves.
Ws 4a	Specifications for special work.

American Association Executive Committee

A meeting of the executive committee of the American Association was held in New York on March 10 with the following in attendance: Charles L. Henry, president; L. S. Storrs, first vice-president; John J. Stanley, third vice-president; E. B. Burritt, secretary-treasurer; T. P. Kilfoyle, president Accountants' Association; R. E. MacDougall, acting president Claims Association; H. H. Vreeland, past-president; W. Caryl Ely, past-president, and C. Loomis Allen, past-president.

The president was authorized to appoint such committees as seem to him proper in connection with the forthcoming convention. A general discussion of the topics to be considered at the convention followed.

The secretary was directed to co-operate to the fullest degree with the Utilities Publication Committee to secure a wide circulation of the Public Utilities Reports Annotated. It is considered that these reports are of the greatest value to member companies in keeping them in touch with commission decisions.

The committee directed that copies of a letter be sent to the executives of all member companies urging that the men to be sent to the convention as delegates be required to attend the business sessions and to make reports of attendance and such other reports as the companies desire regarding the sessions and exhibits.

It was decided that in case of manufacturer company members dues should be assessed only on the gross receipts from business in the United States, Canada and Mexico.

Public Relations Committee

An important and resultful meeting of the public relations committee of the American Association was held in New York on March 15. Concrete plans and specific recommendations were discussed.

A resolution was passed adopting a definite plan of action for the education of electric railway employees and the general public to the necessity of solving justly in the public interest many of the acute problems now confronting the electric railway industry. This plan contemplates the adoption of definite methods for making it easy and simple for all member companies to co-operate extensively and fully. The details of the plan as adopted were left in the hands of a sub-committee to be worked out and reported on at a later date.

COMMUNICATIONS

The First Company Publication

FORD, BACON & DAVIS
NEW ORLEANS, LA., March 10, 1916.

To the Editors:

I notice one or two letters in recent issues of the ELECTRIC RAILWAY JOURNAL in regard to the publication of weekly or semi-weekly folders by electric railway companies and their distribution on street cars. I believe that the New Orleans & Carrollton Railroad was the first company in the United States to follow this practice. It was done by means of a box placed at each window containing possibly as many as twenty pamphlets and the number of boxes per car corresponding, of course, with the number of windows. This gave a larger circulation for the publications of the company than the combined newspapers of the city of New Orleans. In general this is true in any city where this method of distribution of the company's publications has been used. The date of the first appearance of these publications on the cars of the New Orleans & Carrollton Railroad was about 1897.

GEORGE H. DAVIS.

Adequate Return on Investment

BOARD OF RAILROAD COMMISSIONERS
DES MOINES, IOWA, March 10, 1916.

To the Editors:

It seems to me that erroneous ideas may be gathered from a consideration of the declining amount of new electric railway construction in the last few years. In every great new industry there is a long period when the percentage of new construction is necessarily large. When that industry becomes more established, the percentage of increase necessarily declines. This is true of steam railroad construction in all European countries, as well as in the United States. The same principle is present in the banking industry in well-settled communities, as compared to new districts. The same principle prevails with regard to construction of telephone lines and manufactures of all sorts. During the early development stage the increase is more rapid than during the later well-established condition of affairs.

There has been a slight increase in the interest rate in the electric railway industry, but this condition will also be found to be true as to bonds of European and American governments before the present war commenced. The same thing is true as to municipal bonds and other securities of almost all kinds.

What I suggest is simply the fact that the decline in the rate of increased mileage and the increase in the interest rate are not controlling on the problem of whether adequate return is being offered as an inducement for the investment of capital. On the other hand, the decline in the new construction or the increase in the interest rate may be at such a rate as to justify the conclusion that there is not an adequate inducement for capital. In other words, there is a line beyond which one does find evidence of declining credit. In order to test the adequacy of railway securities as attractive to capital, we made a rather comprehensive review of the market prices on railway, industrial, municipal and government securities during a period of fifteen years. It seems to me that no just conclusion could be arrived at in relation to electric railway securities, as a whole, without a similar analysis.

CLIFFORD THORNE, Chairman.

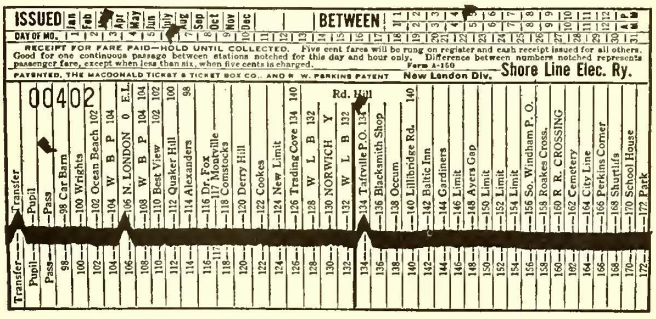
Copper Zones in Norwich, Conn.

THE SHORE LINE ELECTRIC RAILWAY COMPANY
NORWICH, CONN., March 7, 1916.

To the Editors:

I have read with some interest your editorial in the March 4 number of the ELECTRIC RAILWAY JOURNAL, as well as the article by William J. Harvie.

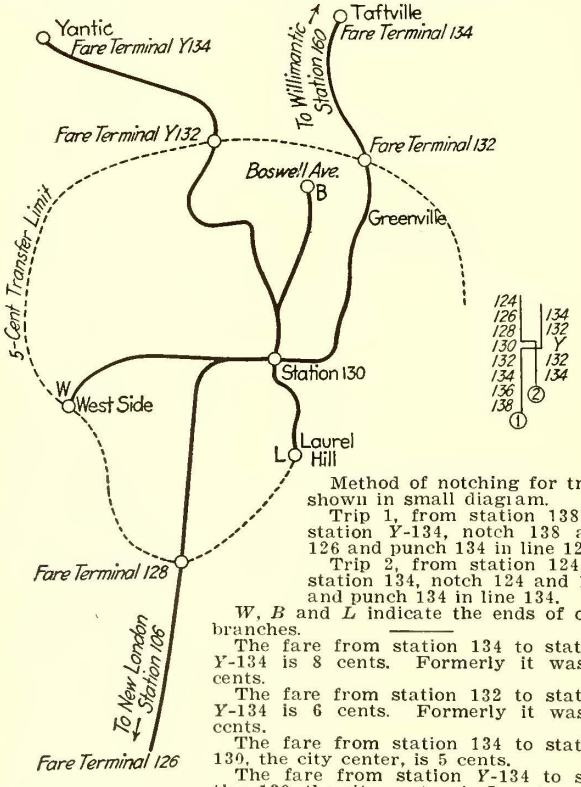
It may interest you to know that we are now using the copper-zone system on the 240 miles of property operated from this office. This system was described in your issue of Sept. 11, 1915, but at this time I want particularly to call your attention to its application in our city service in Norwich. The accompanying sketch will, I think, make this perfectly clear.



FARE RECEIPT, NEW LONDON TO YANTIC

Station 106 to Y 134, 28 cents. Rate is fixed by main line numbers 106 and 134. The punch at Y 134 indicates transfer at Norwich

We have three branch lines that we treat as single zones and two branch lines that we treat as double zones. This retains the nickel as the unit of fare from the civic center to the outlying villages immediately adjacent to Norwich, allows a transfer to and from any point within the city limits, and exacts a payment equivalent to 1 or 3 cents for a transfer where the ride is extended into three or four zones.



LAYOUT OF LINES AT NORWICH

Method of notching for trips shown in small diagram.

Trip 1, from station 138 to station Y-134, notch 138 and 126 and punch 134 in line 126.

Trip 2, from station 124 to station 134, notch 124 and 134 and punch 134 in line 134.

W, *B* and *L* indicate the ends of city branches.

The fare from station 134 to station Y-134 is 8 cents. Formerly it was 5 cents.

The fare from station 132 to station Y-134 is 6 cents. Formerly it was 5 cents.

The fare from station 134 to station 130, the city center, is 5 cents.

The fare from station Y-134 to station 130, the city center, is 5 cents.

The fare from *W* to 134 or to Y-134 is 6 cents. Formerly it was 5 cents.

R. W. PERKINS, President.

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.

Contact for a Portable Welding Machine

BY G. H. MCKELWAY
Line Engineer Brooklyn Rapid Transit System

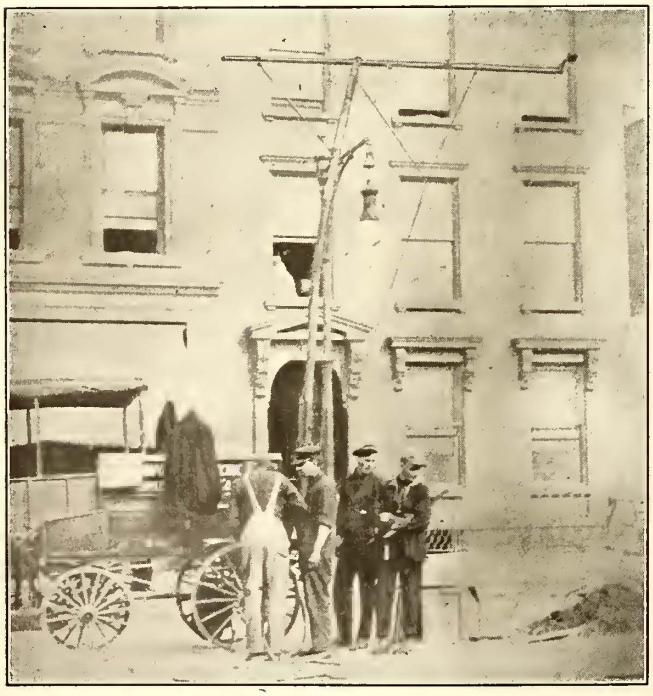
In the last few years many street railways have made considerable savings in their track maintenance costs by building up badly worn and pounded special work and joints by means of the Indianapolis portable welder, which consists primarily of a bank of resistance grids mounted on a light wagon and with connections for receiving current from the trolley wire and transmitting it to the rod of iron which is used as one terminal of the arc.

The chief objection which the writer has heard urged against the use of this machine is that the heavy current, about 180 amp., generally used in making the welds, anneals the trolley wire even if it does not actually burn it down.

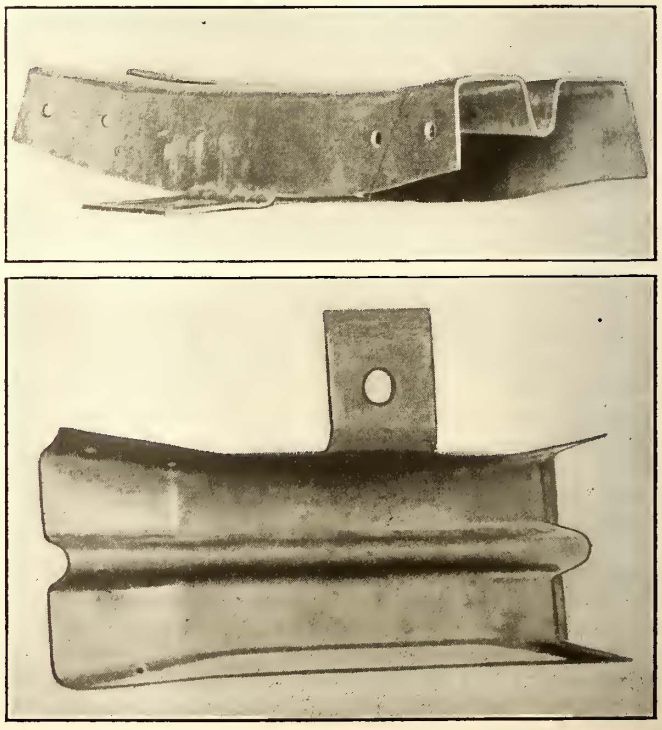
This is an accident that will occur quite often if the usual careless method of using merely a long pole with an iron hook at the end connected with a wire running to the welder is permitted. Such a contrivance was tried in Brooklyn with very poor results. An improvement on the hook was a regulation trolley-wire ear placed at the end of the pole and used with an inclined sheet metal guide which permitted quick placing of the ear on the wire with the latter in the groove of the former. This gave more contact surface than the hook but still not enough for safe operation. The next plan was to make the contact of two or more pieces of spring copper shaped so as to fit tightly around the wire when pulled down over it by means of the pole. There was no trouble with the contact obtained by this device, in fact, the great trouble with it was that the contact was too good and there was great difficulty in removing it quickly from the wire in order to let cars pass. If the spring of the copper was weakened sufficiently to allow of easy removal from the wire the contact was not good enough and the wire slipped up too far between the leaves.

The present contact was devised by E. L. Matthews, engineer of surface lines, and is working very satisfactorily. Three views of this contact, two of the contact alone and one of it in use with the welder, are shown in the accompanying illustrations. As will be seen, the contact is made from a sheet of copper shaped so that its upper surface presents a groove in which the trolley wire rests while the trolley wheels run on the bottom of the pan, which is supplied with flanges so as to prevent the wheels getting out of line while crossing the contact and then not taking the wire properly at the end.

A long bamboo pole supports a horizontal arm to which the contact is attached at about the height of the trolley wire under normal conditions, and a spring running between the pole and the arm insures that the contact will not only reach the trolley wire under all conditions but will also make good contact with it. The current required for the operation of the welder is led from the trolley wire to the resistance grids through a wire fastened at intervals to both the arm and the vertical pole. Careful observation of this contact when in operation has shown no tendency for it to either injure the wire or throw the trolley wheels from the wire. Thus there is no necessity for removing it from the wire when cars are passing and therefore the work is less frequently interfered with than it would be with the other plans mentioned.



WELDING MACHINE AND CONTACT MAKING DEVICE



COPPER PAN FOR ELECTRIC WELDING DEVICE

Steel Siding Substituted for Wood Stiffens Car

BY H. H. BUCHMANN
Master Mechanic Indianapolis, Columbus & Southern Traction Company, Greenwood, Ind.

Difficulty in obtaining good-quality poplar siding and the necessity for stiffening the old wooden framing of a number of interurban cars resulted in the mechanical department of the Indianapolis, Columbus & Southern Traction Company, Greenwood, Ind., substituting steel siding for wood. This change was made in remodeling a number of old wooden-frame cars that had been in service ten or twelve years. The poplar beaded siding had become so badly damaged that it was unsightly, and a No. 14 gage sheet steel was placed over it and fastened with screws. The sizes of the steel sheets, as well as the length and spacing of the screws, were carefully selected so that all screws would penetrate the oak framing. This made the steel serve to reinforce the car sides and thus eliminated the weaving which had developed from long years of service.

Before placing the sheet steel siding it was carefully sanded and primed on the side that came in contact with

VIEW OF COMPLETED CAR WITH SHEET STEEL SIDING

the wood. All plates were made of a standard size and drilled to templates so that the various pieces were interchangeable. After the steel siding had been fastened in place, a 1.8-in. x 2-in. belt rail, continuous from corner post to corner post, was placed over it. This was fastened with two rows of screws, one of which penetrated the old belt rail and the other passed through the steel siding to the belt rail. Vertical battens, ⅛-in. x 3½-in. in size at the joints in the siding, butt against this steel belt rail and are held in place with two rows of screws which also pass through the steel siding. Two rows of screws varying in length from 2½ in. to 3 in. secure the siding to the sills. All the screws used were No. 14 round head, blue, and after they had been put in place the slots were fitted with putty so that the screws would look like rivets. In the old underframes ½-in. round tie rods extended between the side plates and the sills at the panel posts, and three more tie rods were added on each side of the car.

In connection with the reconstruction work, it is interesting to note that the bodies were placed on horses with jacks under the center of each side sill to give a 1¾-in. camber. While in this position the tie rods were tightened and the steel siding was put in place. When this work was completed the jacks were let down until the entire car-body load was supported on the framing. All adjustments in the framing were taken up when the camber in the sills was reduced to 1 in. In addition to the siding, 6-in. I-beams were placed below the body framing at the points were the truss-rod struts rested against the sills. These needle beams were securely bolted to the underframe and to the struts, and greatly increased the transverse stiffness of the body. The steel increased the weight of these cars approximately 950 lb., but this was reduced to approximately 500 lb. net by the elimination of useless metal in the remodeled trucks.

When these cars were restored to service it was found that weaving in the body framing had been entirely eliminated, and, at the same time, the body offered much greater resistance to torsional strains. One of these remodeled cars is shown in the accompanying illustration.

Why Trolley Wire Wears Out

BY S. L. FOSTER
Chief Electrician United Railroads of San Francisco

With the price of new unmanufactured copper climbing rapidly toward 30 cents per pound a brief discussion of the causes of trolley-wire wear seems in order considering that the consumption of this metal in the shape of trolley wire alone costs the electric railway companies a very considerable sum now.

Although the difference between the price per pound of new trolley wire and that of the old wire considered as scrap may be assumed to be constant, when new copper in the shape of trolley wire costs 30 cents per pound electric railway companies will be paying about 40 per cent more per pound net for their wire than when it costs 20 cents, because the old trolley wire taken down weighs only about half as much as the new wire used to replace it.

With a wheel rolling without appreciable friction under a trolley wire one would not expect much wear to result. The reasons that wear does result and very rapid wear, too, are several. In the JOURNAL for Jan. 22, 1916, page 174, appeared an admirable explanation of how the pin friction in the purely up-and-down motion of the trolley base increases the wear on the trolley wire. This has long been understood in a general way. To avoid the trolley wire abrasion effects of this pin friction all overhead men aim to install the trolley wire at as nearly an absolutely uniform height as possible, and to maintain it as nearly level as they can by pulling it up and maintaining it at its maximum safe tension.

The trolley-base pin friction is, however, not the only cause of the trolley wire wear. For instance, there are the long-lived trolley wheel craze, the sluggish-acting retriever, insufficient contact pressure between trolley wheel and trolley wire, excessive contact pressure between trolley wheel and harp spring, the unlubricated vertical trolley-base shaft bearing, trolley wheels of unsuitable sizes, track rails out of level, the original elevation lost in the outer rail of track curves, lack of co-ordination between track and line departments, and lack of adaptation of curve trolley wire to car equipment, track curvature and elevation.

Wheel Mileage.—Mileage records for trolley wheels are a hobby with some car maintenance men. Tool-steel wheels, cast-iron wheels, "tempered" copper wheels and steel-flanged wheels are tried in the effort to get greater mileage, while in many cases the destruction of copper in the trolley wire undoubtedly far exceeds not only any possible saving in cost of trolley wheels but exceeds the total cost of all the wheels used. When one considers that in three consecutive years the total gross cost of trolley wire bought for purely maintenance purposes on one road averaged seven times that of the gross cost of all the trolley wheels on the system it is seen how relatively unimportant small trolley wheel savings are. Nearly the full weight is recovered as scrap when the trolley wheel is condemned for further use, whereas

not much more than 50 per cent of the trolley wire is left when it is finally taken down.

In the d.c. arc lamp the positive carbon burns away just twice as fast as the negative one. When one notes the characteristic green color or volatilized copper in the arc at the trolley wheel of a passing car at night it is easy to understand why the trolley wire wastes away.

It would seem wiser to expend effort in keeping the annual cost for maintenance of trolley wire plus the cost for maintenance of trolley wheels a minimum, rather than to try, as at present, to get record mileage from the wheels and stolidly continue to replace the seven times more costly trolley wire as it wears out.

The use of ordinary brass trolley wheels with no attention to mileage would probably help out an electric railway company's net earnings better than efforts to get record mileage from wheels with no attention to the trolley-wire wear.

The Retriever.—The retriever was hailed by all electric railway men as an advance in the art—a mechanical device that was almost human, that reeled in the trolley rope when it was slack, thus preventing it from catching on sundry protuberances about the car, and paid it out when needed to round a curve or to let the wheel follow the 22-ft. wire over a steam railroad crossing. Unfortunately it does not always do these things. Either the strength of the spring varies or the work to be done varies, giving un-uniform results. The retriever tension required to wind up, or the reluctance to pay out, varies greatly, depending on whether the trolley rope is new or is old, or is wet or dry. Sometimes it will not pay out at all and before the car can proceed the rope has to be cut out of the retriever. As trolley wire is not strung exactly level, but more or less in festoons, this sluggishness of the retrievers causes increased pressure between trolley wheel and trolley wire between span wires, and reduced pressure at the spans. This reduced pressure at the ears conduces to increasing the arc at this point and, as the safe life of trolley wire chiefly depends on its condition at the ears, the use of retrievers undoubtedly increases the trolley wire cost per car-mile whatever it may save in other ways.

That some retrievers tend to pull the poles off at the frogs and even in the curves, and therefore tend to excessive wear of the curve wire is shown by the many wise conductors who are seen to pull slack rope out of their retrievers upon approaching such points and to hold it out until the location is passed so that the wheel will be free to adapt itself to the overhead conditions as it was expected to do by the linemen. The vagaries of these retrievers justify careful watching and maintenance of uniform pull.

Insufficiency of Contact Between Wheel and Wire.—A "4-in." wheel is used in much city work. Such a wheel is about 2¾ in. in diameter where the trolley wire bears upon it. To roll along the wire at 10 m.p.h. such a wheel would have to revolve at more than 1200 r.p.m. At 20 m.p.h. it would have to turn more than 2400 times each minute. If it lagged a particle behind the theoretical rotative speed it would be practically sliding along the trolley wire. What takes place when one metal slides on another with an electric current passing is known to anyone familiar with the old copper brushes on the dynamo commutator. If the sparking was not checked in time the "cutting" and resultant destruction of brushes and commutator bars was very rapid and extensive.

If the pressure between the trolley wheel and the trolley wire is not sufficient to keep the wheel rolling, or if the pressure between harp contact and wheel hub acts enough as a brake on the wheel's revolution, or if the retriever's downward pull offsets the upward push of the base springs sufficiently to prevent this theoretical rolling of the wheel, the wheel will slide. That they do slide is proved by the "flats" found on many of them. When these flat wheels slide they increase the wear unnecessarily, and by bouncing up and down due to their lack of circularity they increase the arcing and burning of the wire.

The logical remedy for this sliding is to take better care of the conditions that cause it and to try to prevent the sliding while retaining the 4-in. wheel. Another and popular cure is to increase the size of the wheel to 5 in., 6 in. or even 8 in. on suburban trains. This latter move is probably the cheaper one although it involves two penalties. The extra weight in wheel and harp renders extra strength in the base springs necessary, and the extra weight at the end of the trolley pole adds to the inertia of this top hammer, and not only causes the wheel to leave the overhead frogs more readily at curves, but does more damage to the overhead construction when it does come off.

Excessive contact pressure between wheel and wire will be more likely than deficient pressure to conduce to minimum trolley-wire wear. Thirty pounds net upward pressure between wheel and wire for heavy city cars is generally considered reasonable. All trolley ropes should be tested with a spring balance or a fixed weight at least once a month to see that this pressure is maintained, as steel springs suffer from "fatigue" and change considerably with age.

Unlubricated Base Shafts.—The latest trolley bases are equipped with roller or ball bearings. Such bases turn readily and permit the trolley wheel to adapt itself to the trolley wire on curves. Many companies still retain some of the older types of bases in which the moving element rotates on a vertical shaft. If this shaft is not kept well lubricated the trolley wheel is prevented from following the curve wire as freely as it should. The wheel not only scrapes the wire savagely but comes off at the trailing frogs and sometimes even in the curve itself. This insufficiency of lubrication of the base shaft is mostly to be watched for during rainy weather, when the lubricant is washed off by the rain. Renewal of trolley wire in curves is the most expensive kind of trolley repair work per foot, considering both labor and material.

Track Out of Level.—The rules for locating the trolley wire over curves in accordance with the elevation of the outer rail apply equally rigidly to the straight track, although seldom or never so applied. If one rail is lower than the other, the car sags to the lower side and the trolley wheel scrapes on the trolley wire located, as usual, over the center of the straight track. On old unballasted lines unlevel track may very considerably shorten the useful life of trolley wire for, like a chain whose strength depends on its weakest link, if several thin places are found in a stretch of trolley wire much quite serviceable wire has often to be taken down for safety in order to get out the bad spots.

Reduced Elevation.—Engineers carefully calculate the correct elevation for the outer rail on curves of high-speed lines and, with standard gage and 19-ft. trolley, linemen locate their trolley wire 4 in. toward the center of the curve for each inch of elevation. The track foreman then permits, or circumstances beyond his control cause, this rail elevation to subside. For every inch it goes down the trolley wire is left 4 in. out of its correct position. The trolley wheels scrape, and sometimes they leave the wire. Usually the overhead construction receives all the blame for the interruption to service. With a meandering right-of-way, full of curves, this neglect to maintain correct outer rail ele-

vations at all times greatly shortens the life of the trolley wire.

Lack of Co-ordination.—It sometimes happens on a large system that in the march of improvement the centers on a stretch of straight track are changed, leaving one or both trolley wires slightly off their correct location and the linemen are not informed of the conditions. Again, a curve may be changed from a circular to a parabolic form, and again the trolley wire is left out of place. The trolley wheels somehow get around the curve and the change may not be noticed by the linemen for a long time, until it is brought to their attention by the unusually rapid wear at that point.

Obviously the line department should be kept informed of all changes of track location, however small, as otherwise their existence may greatly increase the wear of the trolley wire at the points where the changes are made.

Curve Location.—As has been shown, the proper location for the trolley wire on curves, in order to secure the minimum of wear for the trolley wire, is a function of nine variables, five of the car equipment, one of the wire and three of the track. If a whole railway system were equipped with absolutely similar cars there would exist the ideal conditions for the linemen in locating the trolley curves. As such conditions are seldom or never met, the curves have to be located to suit as nearly as possible the numerous types of cars that pass by their location. The best that the men can do is a compromise, poor at the best. The conditions are rendered more difficult and more extravagant of trolley wire when every new lot of cars put in service involves a change in some of the variables, roof height, pole-base location, truck centers, wheelbase of trucks, etc.

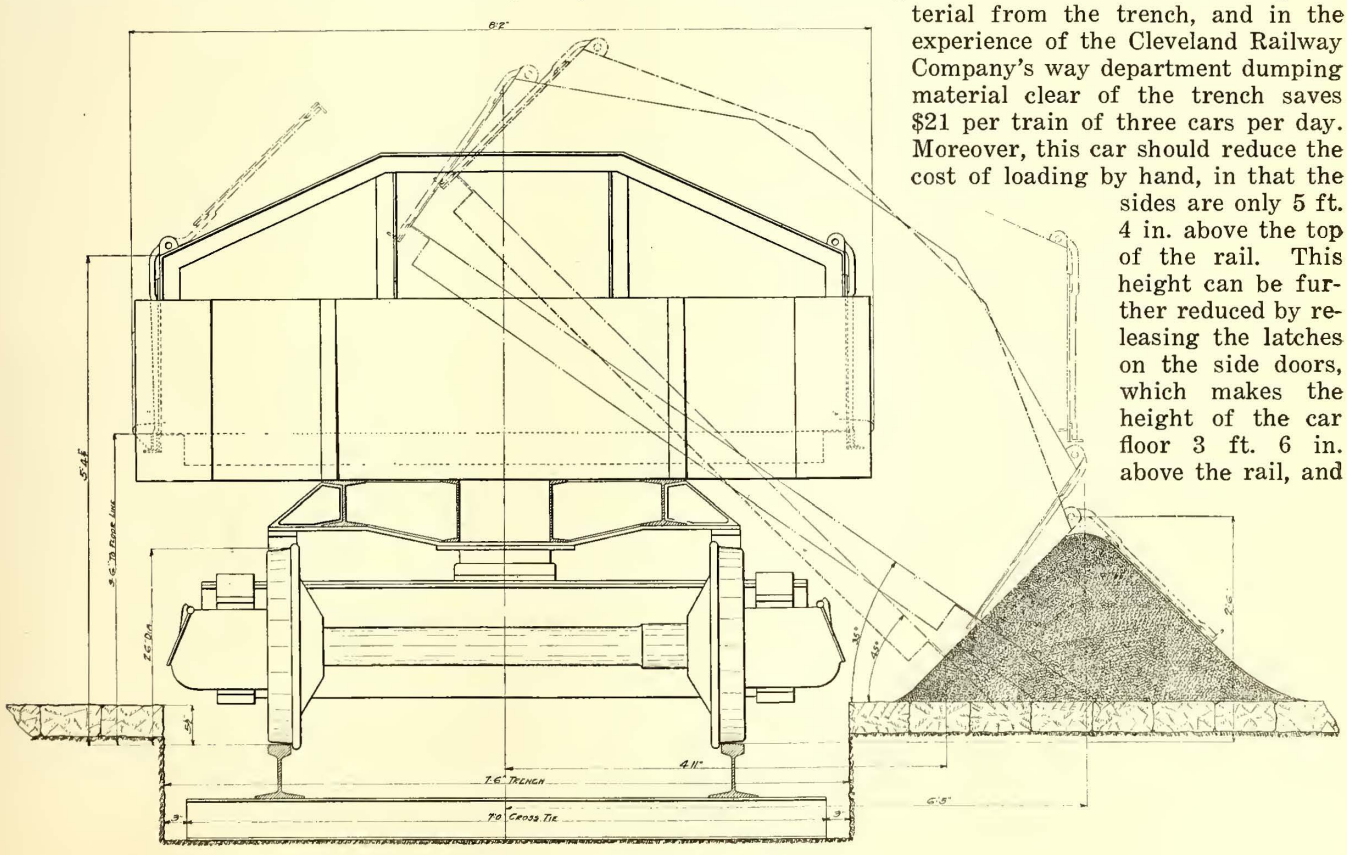
Finally, it should be kept in mind that the wages of linemen when working and their compensation when injured are usually nearly twice as large as those of trackmen or carhousemen. Therefore anything that tends to reduce the time required for the company's linework counts far more than savings in housemen's or trackmen's time.

Such subjects as soldered versus clinch ears, soft versus hard overhead construction, short versus long ears, etc., as affecting trolley wire wear have not been referred to in this article. It has been assumed that these subjects are well understood and that the linemen apply their knowledge in the most efficient manner.

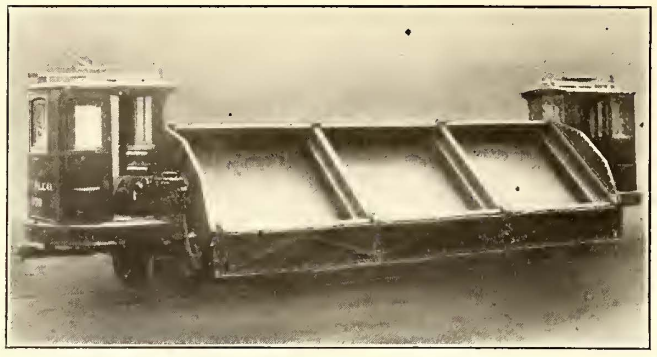
Low-Side Automatically-Controlled Dump Car

A light-weight, all-steel, low-side, electrically-controlled, 18-cu. yd. dump car with other unusual features incorporated to facilitate the handling of loose materials has just been put on the market by the Differential Car Company, Inc., Nashville, Tenn., and 141 Broadway, New York. The "Differential Electric Dumping Car," which is the trade name of this equipment, was invented by H. Fort Flowers, president and general manager of the Differential Car Company, Inc. The car shown in the accompanying illustrations is one purchased by the East Liverpool (Ohio) Traction & Light Company, and it is used in transporting coal from one of the company's mines to its power plant. This particular car weighs 46,000 lb. equipped with four 50-hp. motors, and the body is divided into three sections which hold about 6 cu. yd. of material each. The car is 39 ft. 6 in. long over the end sills, 8 ft. 2 in. wide over all, and the sides are 5 ft. 4 in. above the top of the rail. This height is low for cars of this kind and it greatly facilitates loading by hand.

Undoubtedly the greatest claim for this car, aside from its low height, is that the body may be shifted to either side so that material may be dumped clear of the track trench. The normal and dumping positions of the body are shown in the cross-section of the car. This feature is important because it saves recasting material from the trench, and in the experience of the Cleveland Railway Company's way department dumping material clear of the trench saves $21 per train of three cars per day. Moreover, this car should reduce the cost of loading by hand, in that the sides are only 5 ft. 4 in. above the top of the rail. This height can be further reduced by releasing the latches on the side doors, which makes the height of the car floor 3 ft. 6 in. above the rail, and



CROSS-SECTION OF CAR BODY SHOWING EXTREME DUMPING POSITION



VIEW OF CAR IN DUMPING POSITION

VIEW OF CAR WITH BODY IN NORMAL POSITION

material may be loaded as easily as though it was a flat car. Still another reduction in the loading height may be obtained by tilting the body to a dumped position with the sides latched. This makes the height of the sides only 2 ft. 6 in. above the top of rail.

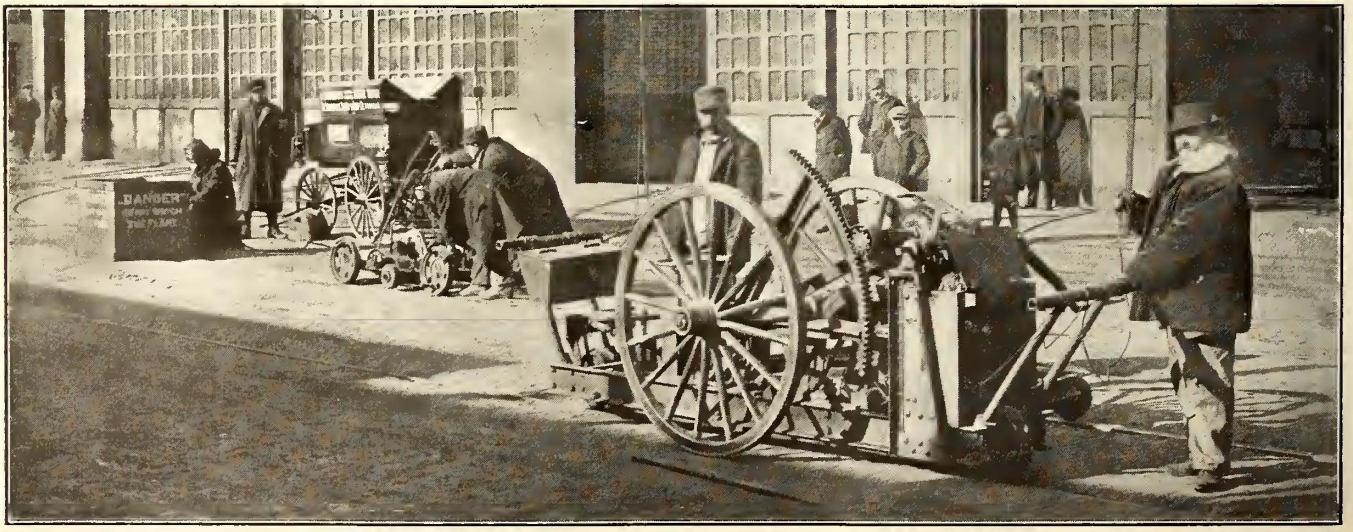
Another important feature in the construction of this car is that it weighs only 46,000 lb. complete and ready for service, although it is of all-steel construction. Essentially the car consists of an under or supporting frame to which the trucks are attached and an 18-yd. body mounted on this frame so that it may be moved sidewise by a motor-driven dumping mechanism. The mechanical features are unique, and no part of the dumping mechanism is exposed when the car body is in the normal or central position. The dumping mechanism is so arranged that the body when either loaded or empty automatically balances in all positions. The body can be loaded while tilted and then revolved and moved to the normal position for transporting it over the line.

Movement to the side permits this car to dump material at about 6 ft. 6 in. from the center line of the track. Shifting the body to either side on the underframe automatically releases the side doors when it assumes a tilted position of about 40 deg. from the horizontal. All movement of the body is controlled by the motor through a set of cables and gears. The body is stopped automatically when it has moved the maximum distance to either side, where it assumes a 45-deg. tilted position. As the body is restored to the horizontal position the side doors are automatically latched and held tight to the sides of the car by a toggle door-latch mechanism. This is operated from the end platforms and the side doors may be opened all at one time or separately. The control of the dumping mechanism is so arranged that the motorman can discharge the entire load while his car moves along the track. In the normal or central position the body is automatically locked so that it is secure for transportation.

Three of these cars have been purchased by the way department of the Cleveland (Ohio) Railway and, as previously mentioned, one has been purchased by the East Liverpool Traction & Light Company. The Third Avenue Railway, New York City, and the New York State Railways, Rochester, N. Y., have also purchased some of these differential electric dump cars.

Grinding Practices of the Connecticut Company

The accompanying illustration is somewhat unusual in showing the entire line of equipment which is used by The Connecticut Company to build up and regrind cupped joints. At the extreme left is the Indianapolis welder, then is shown the Seymour wheel grinder, and finally the reciprocating grinder of the Railway Track Work Company. The Connecticut Company finds that the best results are obtained by using the two types of grinders for different parts of the job. With the Seymour grinder the heavy preliminary grinding is done. This grinder works very rapidly and is easy to maintain, but demands care to avoid overgrinding. On the other hand, the reciprocating grinder can be used to put the finishing touches on a job even when handled by men of little experience. Further, because of the fine gradation of work which the reciprocating grinder permits, it is also used to remove inequalities at the junctions of new rail and to grind out incipient corrugations.



CONNECTICUT COMPANY'S EQUIPMENT FOR BUILDING UP AND REGRINDING CUPPED JOINTS

A Gentle Hint Eliminates Useless Weight

In conspicuous locations in the blacksmith, machine and carpenter shops of the West Penn Railways at Connellsville, Pa., are displayed posters printed in large type which read as follows: "It costs 5 cents per pound each year to haul unnecessary weight in cars. If capitalized this equals $1 per pound as the premium on keeping down weight. Trim off every pound of extra weight on all parts of the equipment unless it is absolutely necessary for strength and safety. (Signed) DANIEL DURIE, Master Mechanic." This gentle hint to the various shop employees obtained their hearty cooperation. Aside from the elimination of useless weight in various car parts, changes in design were suggested which accomplished the same end. On one particular type of car which was being constructed in these shops, the elimination of useless material reduced the weight approximately 4000 lb.

An Improved Retriever

To improve still further the operating advantages of the Earll retriever and to make its maintenance negligible, C. I. Earll, New York, has brought out Types 4-A and 5-A. Earll retrievers have been installed by thousands during the past fifteen years so that the new types are the outcome of a highly specialized experience.

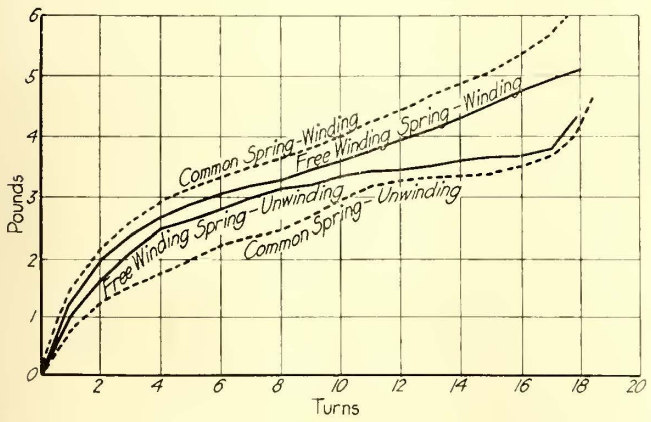
Type 4-A is a retriever for city cars which weighs but little more than a catcher and costs no more to maintain. Its higher first cost is trifling compared with its greater ability to prevent damage. It is recommended in preference to catchers for city service where running speeds exceed 15 m.p.h.

Types 4-A and 5-A differ only in that the first has no emergency release. Otherwise the two styles have their working parts interchangeable, including the socket, an advantageous feature on combined city and interurban systems.

The main features of Earll retrievers are:

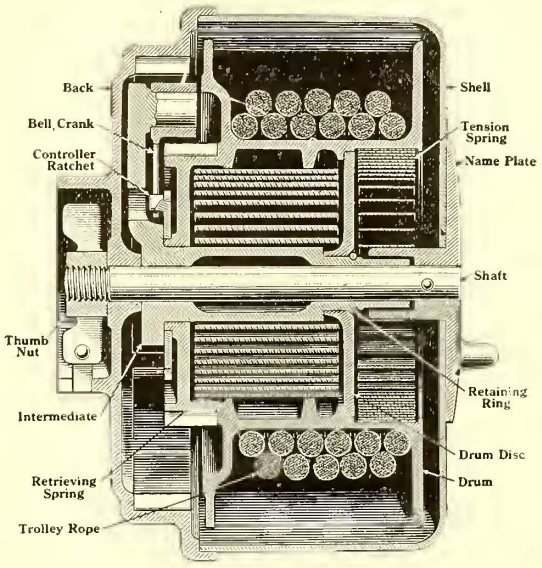
Quick positive operation. The retrieving action is certain. Instead of one, two or four teeth in the back this retriever has twelve, so that the drum cannot turn more than one-twelfth of a revolution after the centrifugal pawl has swung out before retrieving begins.

Ratchet winding. To rewind the retrieving spring of any retriever after the pole has been pulled down it is necessary to pull out the rope. With the Earll retriever it is not necessary to do this by one long continuous pull, to which conductors so much object and which makes it dangerous, if not impossible, to rewind the retriever while the car is in motion. With this retriever the rewinding may be accomplished by ratcheting or reciprocating the rope in and out, in as long or short strokes as convenient.



CURVES SHOWING FORCE EXERTED BY ORDINARY SPRING AND NEW FREE-WINDING SPRING

The emergency release. The emergency release makes it possible under any conditions to withdraw rope and run up the trolley pole at any speed. If a car should become stalled on a steam road crossing with the pole down, the pole could be run up to the wire instantly. By means of the emergency release the conductor can, by merely holding the release lever down, run up the trolley to the wire as fast as he chooses. Even if the operating mechanism should get out of order, the emergency release is always available to run the pole up to the wire. It is never necessary to cut the rope where this retriever is used.



CROSS-SECTION OF NO. 4-A RETRIEVER

The emergency release consists merely of a loose ratchet ring in the back, normally held by the release lever but capable of being released when the lever is depressed. The teeth in the ratchet ring take the place of and perform the same function as the teeth which are cast solid in the back where this feature is not used.

The emergency release is also a great convenience in handling the retrievers in the shop. When a retriever has to be overhauled it is both safer and quicker to trip the retriever by a sharp jerk on the rope and then to withdraw the rope without rewinding the retrieving spring, by means of the emergency release, before taking the retriever from the car. The emergency release also makes it unnecessary to send a man to the roof of the car to detach the rope from the pole when the retriever has to be sent to the shop.

Improvements. The teeth on the drum have been made larger and stronger, their wearing surfaces having been increased 50 per cent. The rear web of the drum is now cast integral with the drum, thereby making it impossible for it to slip out of place and thus interfere with the proper action of the controller. The improved drum runs on the intermediate, as shown in the cross-section.

The new and stronger intermediate now passes clear through the drum and runs directly on the shaft. The check pawl is made of drop-forged steel from new dies The end which engages the teeth of the drum, like those teeth, has been increased 50 per cent in strength. The set pawl, formerly made of malleable iron in two parts, is now made of drop-forged steel in one piece and its shape has been improved.

An entirely new form of tension spring has been adopted. This spring is made of one piece and is slipped in place without the use of pins, screws or any other

device for securing either end. It is so constructed that it winds and unwinds much more concentrically, and therefore with much less friction and wear of the coils upon each other, than the common types of spring.

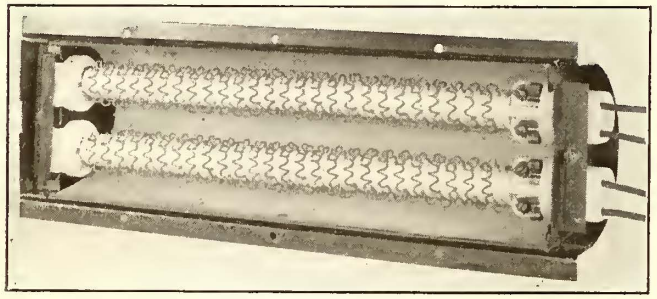
To ascertain the exact difference in the action of the two types of springs a series of tests was made, taking the reading of the force exerted at a radial distance of 2 in. for every quarter-revolution from complete relaxation until the springs were wound up tight. Then readings were taken in the reverse order until the springs were completely relaxed again. The curves plotted show the much greater efficiency of the new type —the free-winding spring.

Everyone has observed how frequently both catchers and retrievers fail to take in wet trolley rope. Yet operators object to the use of stronger springs, as every pound added to the end of the pole means a good many pounds at the trolley base, and that means a heavier pole and heavier trolley base equipment. The advantage of increased efficiency in the tension spring which merely has to take in the slack rope is that, given two springs adjusted to have adequate strength to take in a wet rope, the more efficient spring will require less force for pulling out the rope, and therefore put less strain on the trolley pole and base. The free-winding spring also lasts longer, and cannot be broken by overwinding.

New Features in Electric Car Heaters

The New York Municipal Railway Corporation will use thirty Consolidated heaters of a new type on its multiple side-door cars. The appearance of the new heater is shown in the accompanying illustration.

In the first place the heater coils are removable by taking out a single screw, as shown. Again the asbestos lining in the back of the heater has been treated with a special waterproof solution which will prevent the



ELECTRIC HEATER FOR MULTIPLE SIDE-DOOR CAR OF NEW YORK MUNICIPAL RAILWAY CORPORATION

absorption of water. A special fire wall has also been placed on the end of the case, so that there is no danger that anything outside the heater will be set on fire if a coil breaks. This feature greatly reduces the insurance risk.

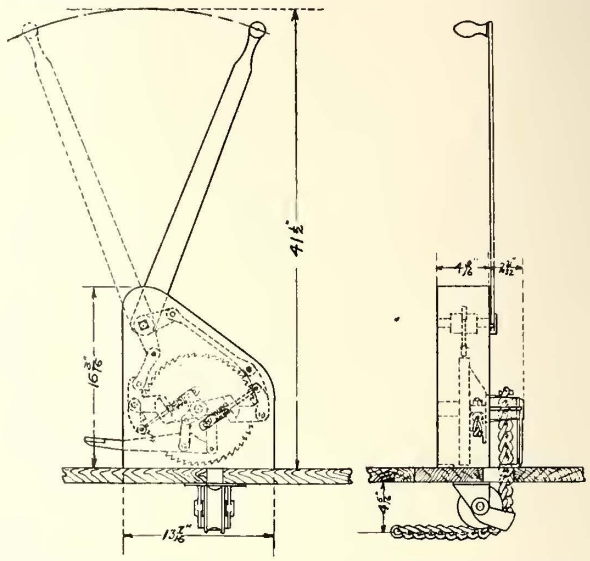
The heaters are bolted to the riser or heel board, which is made of steel, and which has perforations provided for the escape of heat into the car body. Spring terminals are provided on the coils so that the coils can be easily connected with or disconnected from the circuit.

The Union Traction Company of Indiana, Anderson, Ind., has inaugurated a study of safety methods in the public schools of towns and cities along its routes. Safety clubs will be organized in school rooms where there are children under twelve years of age. Five hundred safety primers will be distributed to teachers by the claim department of the traction company.

A New High Power Hand Brake

The Lord Manufacturing Company of New York City has placed on the market the new Horne double-acting brake which is especially adapted to one-man care on account of its compactness and lightness. The accompanying reproduction from drawings show the details.

The essential mechanical features are the eccentric drum by means of which the brake-rod tension increases



A QUICK-ACTING, DOUBLE-RATCHET HAND-BRAKE ESPECIALLY ADAPTED TO ONE-MAN CARS

automatically with the chain travel from 1200 lb. to 2600 lb., a double-acting ratchet mechanism with a vertical hand lever which renders all motion effective, and an independent release mechanism which permits the vertical handle to remain in any operating position.

The manufacturer claims for the new brake that it is simple and self-contained, no accessory parts being required, and that it effectively combines the features of quick action and high brake pressure. The slogan "The double ratchet does it" aptly characterizes the brake.

Cost of an Electric Express Building

From data filed by the Bay State Street Railway with the Massachusetts Public Service Commission in the pending fare case are taken the following first-cost figures of an electric express station owned by the company and located on Perkins Street.

The station was completed about two years ago; it is about 25 ft. x 60 ft. in dimensions, and is a one-story frame building without basement, erected on a concrete foundation with clapboarded walls and a tar and gravel roof.

Excavation	72 cu. yd.	$0.75	$54
Concrete foundation	49 cu. yd.	7.00	343
Concrete piers	5 cu. yd.	8.00	40
Brick chimney	700	24.00	17
Timber—framing	6,700 bd. ft.	45.00	302
Timber—wall sheathing	2,300 bd. ft.	50.00	115
Timber—wall sheathing	1,400 bd. ft.	60.00	84
Timber—roof sheathing	3,400 bd. ft.	50.00	170
Timber—2-in flooring	2,800 bd. ft.	45.00	126
Timber—flooring—hard pine	200 bd. ft.	60.00	12
Timber—miscellaneous	....	....	69
Timber—clapboards	1,862 sq. ft.	.08	149
Roofing—tar and gravel	1,680 sq. ft.	.06	101
Wrought-iron pipe	....	....	5
Millwork—door	333 sq. ft.	....	128
Millwork—window	250 sq. ft.	....	125
Electric lighting	....	....	38
Plumbing	....	....	150
Sheet metal	....	....	35
Painting—oil	255 sq. yd.	.18	46
Painting—cold water	348 sq. yd.	.12	42
Varnishing	168 sq. yd.	.25	42
			$2,193
Fixed charges during construction, 14.5 per cent			318
Total			$2,511

NEWS OF ELECTRIC RAILWAYS

STORMY SESSION OF NEW YORK COMMITTEE

Committee to Meet Twice a Week Hereafter—Messrs. Whitney and Hervey Confirmed as Commission Members

At the session on March 11 of the Legislative Committee which is inquiring into transit matters in New York the disorder was so great at one point that it was charged that a deliberate attempt had been made to stampede the meeting. The storm centered around Timothy S. Williams, president of the Brooklyn Rapid Transit Company. In a passage of words between Colonel Williams and Frank Moss, counsel for the committee, Colonel Williams accused Mr. Moss of lying, while Mr. Moss retorted by calling Colonel Williams a comedian. A spectator, a former assistant counsel for the commission, after the meeting also made some disparaging remarks regarding Mr. Moss. He was promptly haled before the committee and required to apologize.

At the morning session on March 11 a letter was introduced in testimony, indicating that the Interborough Rapid Transit Company stood ready in March, 1910, to build the new subways with its own money and had made a proposal to that effect to the Public Service Commission. It was subsequently shown that this communication was a matter of public discussion at the time it was written five years ago and that it was nothing but a letter setting forth possible terms and conditions.

On March 10 Travis H. Whitney, secretary of the commission, and Richard Reid Rogers, counsel for the Interborough Rapid Transit Company, were the witnesses. Mr. Whitney was questioned more particularly with respect to the changes in route of rapid transit lines in Brooklyn. Mr. Rogers said all the previous contracts led up to the making of the present contract so that all his services in the four years of negotiation were properly charged against the final contract. He said it was a matter of law that legal services are a part of the preliminary cost of construction. When Mr. Moss read the clause defining "construction" and "legal services in and about construction" Mr. Rogers insisted that this latter phrase warranted the payment to him of the $50,000 as extra compensation.

During the week ended March 11 the Legislative investigating committee announced that on account of the need for the presence of members of the committee at the legislative session in Albany the hearings before the committee would for the present at least be held on Friday and Saturday of each week. It was also announced that a public hearing would be held on March 17 to which the Mayor and other city officials would be invited as well as representatives of the Public Service Commission and civic organizations generally. Immediately following this public meeting the committee expects to submit a preliminary report to the Legislature. In this, it will be recommended that jurisdiction over all construction work on subway lines be taken from the Public Service Commission and be lodged either with the Board of Estimate, with the Borough Presidents or with a board to be appointed by the Mayor and confirmed by the Board of Estimate.

The Senate finance committee voted recently to report without recommendation, either for or against confirmation, Governor Whitman's nominations of Travis H. Whitney and Charles S. Hervey as members of the Public Service Commission for the First District, but on March 16 after a debate lasting five hours the nominations were confirmed. The vote on Mr. Whitney was twenty-seven to twenty-three and on Mr. Hervey thirty-one to nineteen. Oscar S. Straus, who is chairman of the commission, had announced his determination to resign from the commission if he was deprived of Mr. Whitney's services.

On March 14 Lamar Hardy, Corporation Counsel, announced that he would begin suit at once against the Interborough Rapid Transit Company and Alfred E. Craven, chief engineer of the Public Service Commission, to recover for the city about $4,000,000 charged by the Interborough as a "prior-determination expense" against the cost of building the dual subway. This means that the city refuses to approve of the payment of $150,000 bonus to President Shonts, $50,000 bonus to R. R. Rogers, counsel to the Interborough, and $10,000 bonus to E. F. J. Gaynor, auditor of the Interborough, which sums the company put into charges against bonds issued to pay for construction. Alfred E. Craven, chief engineer of the Public Service Commission, is made a defendant with the Interborough because it is alleged that Mr. Craven passed upon the items in the charges submitted by the company as "prior determination expenses."

HUDSON & MANHATTAN RAILROAD RECEIVES TRAVELERS' MEDAL

The gold medal presented by the Travelers' Insurance Company each year to the American employer who has done the most during the year to safeguard his employees and the public was awarded this year to the Hudson & Manhattan Railroad. The presentation was made at the annual dinner of the American Museum of Safety recently after a jury of award named by the museum had chosen the railroad to receive the medal "for achievement in accident prevention among its personnel and for promoting safety for the traveling public."

The Hudson & Manhattan Railroad is better known as the Hudson Tubes. These tubes carry a large proportion of the Jersey commuters in and out of New York every day, as well as large numbers of women shoppers from the Jersey suburbs and the most inconsiderable number of people who leave the Pennsylvania Railroad at Manhattan Transfer. They have been in operation for eight years and in that time have carried 400,000,000 passengers, or about four times the population of the United States, but in all that time there has not been a single loss of life attributable to train operation.

The system is operated between four distinct terminal points, and within a mileage of 7.91 miles there are fifteen junction points. In a year's time 660,000 passenger trains, or an average of 1800 a day, are operated in conformity with a regular schedule. During the rush hours trains are dispatched from all the terminals under a ninety-second headway with only one minute at the terminals for loading and unloading of passengers. This could not be done without separate platforms and stairways for loading and unloading. Practically all of the system is underground and artificially lighted, but there has never been an accident in the tunnels which would be attributed to a lack of illumination. As to the efficiency of the block signal system, in the year ended June 30, 1915, there were only fifty-four cases of failure in 63,866,450 signal movements.

In a letter of congratulation written by L. F. Butler, president of the Travelers' Insurance Company, to Wilbur C. Fisk, president of the railroad, Mr. Butler said:

"It seems to me that the man who so conducted the operations of the railroad that 400,000,000 passengers could be transported without a single fatality is equally entitled to commendation, not only for the safeguards installed in shops and power stations, which have proved most efficient, but for the organization of a working force so trained as to thus fully protect people against the hazards of railroad travel and also against their own careless actions.

"Indemnity for the results of accidents was the first purpose of the Travelers' Insurance Company. Constant observation of the conditions led us to believe that it also behooved us to do what we could to prevent accidents. Experience in this line, through our engineering and inspection division, enables us to understand and appreciate the value of your efforts in this direction."

The first award of the Travelers' medal was in 1910, when it was presented to the United States Steel Corporation. Subsequent awards have been as follows: 1911, Pennsylvania Railroad; 1912, New York Edison Company; 1913,

New York Telephone Company; 1913, Allgemeine Elektricitäts Gesellschaft of Berlin, Germany (special award); 1914, Commonwealth Edison Company, Chicago; 1915, Hudson & Manhattan Railroad.

ALTERNATIVE TORONTO COMMISSION PLAN

As stated in the Electric Railway Journal of March 11, page 513, City Solicitor Johnson of Toronto, Ont., in a report made to the Board of Control said that special legislation would have to be secured before a permanent transportation committee could be established.

The personnel of the commission proposed by the Mayor was the works commissioner, corporation counsel, or city solicitor in his absence, the city treasurer, the manager of the Toronto Hydro-Electric System, and the chief engineer of the harbor commission. It was intended to have the commission advise the City Council regarding the action to be taken in preparation for the acquisition of the Toronto Railway and the Toronto electric light system at the expiration of the respective franchises in 1919 and 1921; advise on all matters relating to transportation, including the radial problem within the city limits, and manage and operate civic car lines and the other systems when taken over.

In view of the city solicitor's report the latter clause has been deleted and a recommendation sent on to the Council that the officials mentioned and a member of the Council to be elected by that body, and the Mayor ex-officio, be appointed to act in an advisory capacity. The reason advanced for taking this action was the impossibility of securing legislation this year, and secondly that the work that can be accomplished by the commission this year will be sufficient to demonstrate to the public and the Legislature the need of such a body for the efficient handling of the transportation systems in the city.

The City Council of Toronto, Ont., on March 6 approved the appointment of an advisory transportation commission, consisting of the Mayor ex-officio, one member of the Council to be named later, Works Commissioner Harris, City Solicitor Johnston in the absence of Corporation Counsel Geary, Acting City Treasurer Black until a new treasurer is appointed, Engineer E. L. Couzens of the Harbor Board and General Manager H. H. Couzens of the Civic Hydro System.

INTERNATIONAL RAILWAY TO SPEND $1,150,000

Edward G. Connette, president of the International Railway, Buffalo, N. Y., announces the expenditure of $1,150,000 for the improvement of its lines in Buffalo, Niagara Falls and Lockport during 1916. All of this amount will be expended for the maintenance and improvement of roadbed, new track and other necessary features, but none will be used for new equipment. The most important construction work will be the laying of new track, concrete sub-base and paving between the tracks from the Cold Spring station in Main Street to Fillmore Avenue, a distance of almost 2 miles. This work will be started as soon as the frost is out of the ground and will cost upward of $200,000. Forty other stretches of new track will be laid, including part of the new Bailey Avenue work, a franchise for which has already been granted, and for work in the vicinity of the new Lackawanna passenger terminal at the foot of Main Street. Mr. Connette says that a plan has been worked out by the engineering department whereby the new Main Street track will be laid without inconvenience to traffic on this busy thoroughfare. Continuing the statement says:

"The entire engineering and official force are deeply engrossed in the plans for the construction and operation of the new line to Niagara Falls, which has already been started in the city of Tonawanda. This is a mammoth construction feat, especially because the original plans prepared by engineers had to be completely changed. The new line will comprise 16 miles of double track between the Buffalo city line and Niagara Falls. The road will be built entirely upon private right-of-way, and specially designed cars which will have no equal in the entire country for speed and comfort will operate over the route.

"Structural engineers say the new Niagara Falls line will not only be the most efficient interurban road in the country, but one of the most picturesque. Catenary construction will be used from the Buffalo city line over the entire route. The concrete suspension towers will be placed 200 ft. apart. The new line also involves additional power-plant facilities and seven 1000-kw. rotaries will be installed at various points along the route. It is planned to beautify the right-of-way with trees and grass plots. Construction work has been in progress in Tonawanda for several months, and with the opening of spring the construction will be pushed speedily, as it is the intention of the officials of the company to complete the road before the end of the present year."

PLANS AND ESTIMATES SUBMITTED FOR SEVEN RADIAL LINES

The engineers of the Hydro-Electric Power Commission of Ontario have submitted plans and estimates to Sir Adam Beck covering seven radial railway lines in western Ontario. Surveys and estimates of the cost of construction, operation and traffic data have been completed on the following lines, except in the case of the route through Hamilton, which is awaiting a decision as to the various routes through the city, under consideration. (1) Toronto, Port Credit and Oakville to Hamilton; (2) Hamilton, Grimsby and St. Cathariens to Niagara Falls; (3) St. Catharines, Welland and Port Colborne; (4) Dunnville, Port Colborne, Fort Erie, Bridgeburg and Niagara Falls; (5) Elmira, Waterloo, Berlin, Preston, Galt and Hamilton; (6) Owen Sound, Chesley, Brussels, Seaforth, Woodham and Kirkton. According to Sir Adam Beck the commission is prepared to recommend these projects to the municipalities separately or as a system. The next move will probably be the calling of special meetings of municipal representatives.

CENTRAL RAILWAY CLUB BANQUET HELD IN BUFFALO

Frank Hedley, vice-president and general manager of the Interborough Rapid Transit Company, New York City, presided at the annual banquet of the Central Railway Club held in Buffalo, N. Y., on March 9. The members of the club and the New York City delegation showed their appreciation of Harry D. Voght, New York, who for twenty-five years has been executive secretary of the organization, by presenting to him a purse of gold and a bundle of bills. Incidentally it was Mr. Voght's silver wedding jubilee.

Among the speakers at the banquet was John J. McInerney, Rochester. He advocated courses in practical electric railroading in colleges and universities. He said that if the sons of railway executives would follow in the footsteps of their fathers, they would be able to reach the highest points of success in the railway field. He suggested the establishment of a railway college, endowed by large steam and electric railway systems to train young men desirous of entering the service. He also advocated wholesome publicity for railroads.

PLANS FOR OPENING EAST BOSTON TUNNEL EXTENSION

The Boston (Mass.) Elevated Railway completed plans to open the West End extension of the East Boston Tunnel on March 18. The extension is about a half mile long and provides a rapid transit outlet from the Scollay Square district westward through one of the most congested areas in the city. The extension carries the East Boston Tunnel under Bowdoin Square to an incline in Cambridge Street near Russell Street, and provides continuous tunnel tracks from Maverick Square, on the east side of Boston Harbor, to the vicinity of the lower portion of the Charles River Basin. The extension contains a station under Bowdoin Square, with a loop for reversing cars from East Boston. Through service will be inaugurated between Orient Heights and Central Square, Cambridge, via the tunnel and its extension, which will facilitate travel to and from Revere Beach with respect to western suburbs of Boston. Provision has been made for the reversal of Cambridge cars at a lower level in the Scollay Square station.

MASSACHUSETTS COMMISSION RECOMMENDS REPEAL OF EXCISE TAX

The Massachusetts Public Service Commission has addressed a report to the Legislature recommending the repeal of the present excise tax upon street railways and urging that the burden be placed upon the companies of paying for the work actually done each year by municipalities in maintaining such portions of any paved streets, roads and bridges as are occupied by railway tracks and similar portions of unpaved public ways plus 18 in. on each side thereof. The commission recommends that instead of actually doing the work, the companies be required to pay for the work performed by the city and town authorities, upon the theory that the latter ought to have undivided authority over their highways. No change in the provisions for snow removal is considered necessary. The board points out that it may be urged against its recommendations that the result would be to substitute for a regular and dependable charge upon the companies an irregular charge varying widely from year to year. This difficulty, the commission points out, may be obviated if the companies will establish reserve funds for meeting such charges, to which regular amounts are yearly contributed, the practice of most of the companies in the case of snow and ice removal. To overcome the possibility of the municipalities charging the companies unreasonably for such work, the commission suggests provision for an appeal to the county commissioners in case of disagreement.

FURTHERING RAPID TRANSIT IN CINCINNATI

The Federated Improvement Associations of Hamilton County, at the regular monthly meeting at the Hotel Gibson, Cincinnati, on March 9, approved the proposed $6,000,000 bond issue for the construction of a municipal rapid transit loop. This was done after reading a resolution signed by three members of the Rapid Transit Commission to the effect that none of the funds from the bond issue will be expended until a plan of operation of the road had been determined and approved by the voters.

The bond issue will be presented to the voters on April 25 for their approval. The plan of operation will then probably be submitted at the fall election.

PRESIDENT PELLISSIER AGAIN ON STAND

L. D. Pellissier, president of the Holyoke (Mass.) Street Railway, was again called to the stand on March 14 as a witness in the pending wages arbitration proceedings. The evidence on that day concerned itself largely with the differences between the company and the men which led to the strike of last summer. Under the 1912 agreement the men contended that they were entitled to a full day's pay regardless of the number of hours worked. Mr. Pellissier pointed out that the company took the view that it should pay only for work actually performed. The witness believed that on the average the Holyoke company paid as high wages as any other railway in the State. On some small roads a greater percentage of every dollar received was paid in wages than on some of the larger systems. It is expected that Prof. A. S. Richey of the Worcester Polytechnic Institute will conclude the principal evidence for the company. He will discuss the cost of living in rebuttal to the union testimony.

PRESIDENT LILIENTHAL FOR COMPROMISE

Jesse W. Lilienthal, president of the United Railroads, San Francisco, Cal., returned to that city from New York on March 6. He was quoted in the San Francisco *Bulletin* in part as follows:

"I personally am not anxious to sell the branches west of the tunnel. Now is the time they should begin to be profitable because the city is growing in that direction. If the city authorities are anxious to buy, I have concluded, after much thought, not to make opposition. There is a fair price and it can be readily found out in the negotiations should any be commenced.

"It is the experience of cities that a street railway system cannot be a pronounced success unless it has a monopoly of city transportation. San Francisco has made a good start for municipally owned lines. The United Railroads has a big system. They are competitors, and, as such, are working against each other's financial good.

"As the president of the United Railroads, it is my duty to look after and honestly to guard vested property rights. No one realizes the situation better than I. Perhaps some owners of securities in the United Railroads have been criticising my policy. That is their right. We are all subject to criticism. I am trying to do my duty as I think it is best to be done for all the property as a distinct entity.

"I am a believer in good business compromises where we have two such conflicting aims and purposes as are embraced in the dual street railway propositions."

MUSCATINE-IOWA CITY LINE BEGINS OPERATION

March 19 was set as the date of beginning operation with gasoline-electric motor cars on the Muscatine & Iowa City Railway's line between Muscatine, Iowa City and Montezuma, Iowa. A fifty-year lease has been consummated by this company with the Chicago, Rock Island & Pacific Railroad for 104 miles of its lines, as announced in the ELECTRIC RAILWAY JOURNAL of Oct. 30, 1915, page 926. Regular service will be inaugurated with two General Electric passenger motor cars, two steam passenger and three steam freight locomotives. Two more General Electric gasoline-electric motor cars are expected to be received about April 10, when the two steam engines used in passenger service will be released. Later in the year two gas-electric locomotives for freight service will be purchased to release the steam freight engines.

Holyoke Municipal Ownership Bill Rejected.—The committee on street railways of the Massachusetts Legislature has submitted an adverse report upon the bill authorizing the city to purchase the Holyoke Street Railway.

Michigan Railway Using 1200 Volts.—Since about the first of the year, 1200 instead of 2400 volts have been used on the section of the Michigan Railway between Kalamazoo and Grand Rapids described in the ELECTRIC RAILWAY JOURNAL of June 19, 1915. The engineers are making some changes in the electrical equipment.

Illinois Legislature Investigates Home Rule.—An investigation of the public-utilities and home-rule questions in Illinois by a special legislative commission will be undertaken. This decision was reached despite the fact that the Supreme Court ruled that such a commission was without legal authority to subpœna witnesses. Hearings will be held in Springfield and Chicago, and the commission will rely on voluntary witnesses.

Storm Interrupts Long Island Traffic.—The most serious result of the storm in New York on March 15 was the crippling of the service on the electric zone of the Long Island Railroad for several hours. At 7.45 a. m. one of the high-tension feed wires on the Woodside-Winfield cutoff short-circuited and traffic on all electrified lines was brought to a standstill. All of the freight locomotives and switching engines which could be spared were pressed into service to relieve the tie-up of passenger traffic. The New York, New Haven & Hartford Railroad and the New York Central Railroad reported only such delays on their electric divisions as would naturally be incident to the storm conditions which prevailed.

Senate Passes Water Power Bill.—The United States Senate on March 8, after four weeks of debate, passed, by a vote of forty-six to twenty-two, the Shields bill to provide for the development of water power in navigable waters by private capital. As adopted, the bill permits the construction of dams in navigable waters under licenses issued by the Secretary of War, and gives to grantees the right to operate power plants for fifty years, after which time the federal government may take over the plant after giving two years' notice and paying a fair value, to be determined by the Secretary of War and the owner, or by proceedings in the United States courts. Regulation of rates and services is placed with the States in which the plants are located, or, if interstate commerce is involved, with the Interstate Commerce Commission on appeals when the states involved are unable to agree on reasonable rates and adequate service. The bill also provides that no works shall be operated in any combination to limit the output of electric power or in restraint of trade.

Washington Wage Terms Settled Without Arbitration.—Agreements signed on March 12 between officials of the Washington Railway & Electric Company and the Capital Traction Company, Washington, D. C., and committees representing their respective employees settled all differences between the two parties without recourse to arbitration. The agreements are dated March 11, 1916. The wages of all motormen and conductors of the Washington Railway & Electric Company are to be as follows: first year, 23½ cents an hour; second, third, fourth and fifth years, 24½ cents an hour; sixth, seventh, eighth, ninth and tenth years, 25½ cents an hour; after ten years, 27 cents an hour. The wages of all motormen and conductors of the Capital Traction Company are to be as follows: first year, 23½ cents an hour; second, third and fourth years, 24½ cents an hour; fifth and sixth years, 25½ cents an hour; seventh, eighth and ninth years, 26½ cents an hour; tenth year and after, 27 cents an hour. The bonus system of the Capital Traction Company and the profit-sharing system of the Washington Railway & Electric Company automatically end. The new scales apparently assure an average increase in remuneration about the same in each company over the former average compensation of bonus and wages or profit and wages combined.

PROGRAMS OF ASSOCIATION MEETINGS

Illinois Electric Railways Association

The next meeting of the Illinois Electric Railways Association will be held at 10 a. m. on March 31 at the La Salle Hotel, Chicago. The program includes a paper entitled "Power Saving in Car Operation," by G. T. Seely, assistant general manager of the Chicago Elevated Railways, and a paper on the power dispatching system of the East St. Louis & Suburban Railway by G. W. Welsh, superintendent of power of that company.

American Railway Engineering Association

The seventh annual convention of the American Railway Engineering Association will be held at the Congress Hotel, Chicago, Ill., on March 21, 22 and 23, 1916. During the week of this convention the National Railway Appliances Association will have its exhibit at the Coliseum. The address of the president, report of the secretary, report of the treasurer and the reports of standing and special committees will be presented on March 21, while at the evening session on that day there will be an illustrated lecture by Robert W. Hunt, entitled "The Nick and Break Test in the Inspection of Steel Rails" and an illustrated lecture on "Tests of Douglas Fir Stringers," by H. B. MacFarland.

On March 22 the reports of standing and special committees will be presented and announcement made of the result of the ballot for officers for 1916.

The annual dinner will be held in the gold room of the Congress Hotel at 6:30 p. m. on March 22.

On March 23 the reports of standing and special committees will be presented and the officers installed.

On March 24 the delegates will visit the exhibit of the National Railway Appliances Association in the Coliseum.

Southwestern Electrical & Gas Association

The executive committee of the Southwestern Electrical & Gas Association held its pre-convention meeting on Feb. 25. The place and date of the 1916 annual convention was confirmed to be held at Galveston, Tex., on May 17, 18, 19 and 20. The convention headquarters will be at the Hotel Galvez. The various sessions will be as follows: Interurban and street railway sessions, morning and afternoon of May 17; gas members' sessions, paralleling interurban and street railway sessions in another meeting-room; lighting and power sessions, morning and afternoon of May 18; claim agents' sessions, paralleling lighting and power session in another meeting-room; general sessions at which papers, addresses and discussions on topics common to all public utilities will be presented, morning and afternoon of May 19.

A special committee has been appointed to present to the convention a full and formal report on the present status and work of the association and to make suggestions for a broadening of its scope and activities. A special committee has also been appointed on "Publicity and Public Relations," with instructions to obtain the presence of and addresses from authorities on these subjects.

Financial and Corporate

LARGE INCREASE IN MATERIAL PRICES

Tabulation Shows Per Cent Increases in Quotations in Iron, Steel and Metal Markets Since War Began

In order that electric railway operators may have a more definite idea of the enormous increase since the outbreak of the European war in the prices of certain materials that enter into the finished products purchased for railway use, the ELECTRIC RAILWAY JOURNAL has compiled from the *American Metal Market and Daily Iron and Steel Report* the following table:

	Before the War, July 31, 1914	Now, March 15, 1916	Per Cent Increase
Metals*			
Lake copper	13.00	27.75	113
Electrolytic copper	12.75	27.75	117
Casting copper	12.62	26.00	106
Tin	33.00	53.50	62
Lead	3.72	7.75	108
Spelter	4.85	17.55	262
Aluminum	17.25	61.00	253
Antimony	5.50	44.50	709
Metal Products*			
Sheet copper	18.50	34.00	84
Copper wire	14.25	29.50	107
High sheet brass	13.87	40.00	188
Sheet zinc	7.00	25.00	257
Iron and Steel Products*			
Bars	1.15	2.35	104
Plates	1.15	2.60	110
Shapes	1.15	2.35	104
Pipe (¾—3)	1.95	2.65	36
Wire (nails)	1.55	2.40	55
Sheets (28 gage)	1.80	2.75	52
Tin plates	3.30	4.00	21
Pig Iron			
Bessemer, valley	$14.00	$20.50	46
Basic, valley	13.00	18.50	42
No. 2 foundry, valley	13.00	18.50	42
No. 2 foundry, Philadelphia	14.25	19.75	38
No. 2 foundry, Cleveland	13.75	18.80	37
No. 2 foundry, Buffalo	13.00	18.25	40
No. 2 foundry, Chicago	14.50	19.00	31
No. 2 foundry S. Cincinnati	13.25	17.90	36

*Quotation given in cents.

The foregoing quotations are based on wholesale quantities and prompt delivery unless otherwise specified. Owing to the withdrawal of all price lists by the leading manufacturers of brass and copper products, the nominal quotations in these cases are based on the outstanding market and are likely to change at any moment. Steel bars and plates in Pittsburgh and Chicago, structural shapes in Pittsburgh and blue annealed sheets in Pittsburgh and Chicago are for delivery only at mill convenience.

NEW CAPITAL FOR ROCK ISLAND

Main Details Completed for Readjustment of Rock Island Southern Railway by Transfer to New Mississippi Valley Railway & Power Company

According to J. W. Walsh, general manager, the final details will soon be completed for the readjustment of the Rock Island (Ill.) Southern Railway and its subsidiaries, concerning which items were published in the ELECTRIC RAILWAY JOURNAL of May 1 and July 24, 1915. The readjustment will be made through the immediate placing of $300,000 of eastern capital into the business and the taking over of all the properties by the Mississippi Valley Railway & Power Company. This is a new company recently organized under the laws of Delaware with $2,000,000 of preferred stock and $2,500,000 of common stock.

It is reported that the transfer has practically been completed, and the only details left unfinished are the election of officers and the placing of new bonds. A board of directors has been elected, and its first action was to authorize an issue of $1,397,200 of 5 per cent bonds dated July 1, 1915, and due on July 1, 1945. Under plans partially disclosed the new company will take up the improvement of the roadbed, the additon of new equipment, etc. The actual work of improving the property will begin this spring, but pending the election of officers and the settlement of details in connection with the outstanding old bonds, no further information is available.

The readjustment of the company and its allied lines followed a recent visit of H. C. Morand, representing H. P. Taylor & Company, New York, to Illinois for a conference with M. A. Walsh, one of the principal stockholders. Unrealized hopes as to the earning power of the property caused many of the old bondholders to desire a reorganization, and they agreed on the present solution. The companies first accepting the plan, thus making possible the readjustment, were H. P. Taylor & Company, Westinghouse Electric & Manufacturing Company, Rock Island Construction Company, Peoples Gas & Improvement Company and J. J. Fleming, trustee. It is said that under the new plan the fixed annual interest charges will be about $69,000, a decrease of about $67,000.

The Rock Island Southern Railway is principally a 72.29-mile electric system between Monmouth and Rock Island. The new Mississippi Valley Railway & Power Company takes over not only this but also the Aledo Terminal Railway, the Rock Island & Alexis Railway and the Edwards River Power Company, all of which have been operated by the Rock Island Southern Railway. The Rock Island Southern Railroad, an 18-mile leased line between Monmouth and Galesburg, is also said to be included in the present deal.

The directors of the new company are as follows: Albert M. Chambers, New York, N. Y.; T. P. Gaylord, Pittsburgh, Pa.; W. W. Gurley, Chicago, Ill.; J. J. Fleming, Burlington, Iowa; J. A. Hanley, Davenport, Iowa; M. A. Walsh, Clinton, Iowa; H. P. Taylor, Pittsburgh, Pa., and H. C. Morand, New York, N. Y.

ARE UTILITY SECURITIES A BUY?

Roger W. Babson Favors Securities of Reorganized Companies—Thinks Utilities Come Between Industrials and Railroads in Popularity

In the March 4 issue of the *Saturday Evening Post* Roger W. Babson has presented his answer to a question much asked to-day, whether or not the present time offers opportunities for investment in public utilities. In his opinion the securities of such companies are not tremendously popular now, for they no longer appear to be the gold mines they seemed a dozen years ago. On the whole they are not so popular as industrial securities, but they are not to be classed with steam railroad securities, because for many public utilities the day of readjustment has not really come as it has for the steam lines.

Mr. Babson's advice to utility investors is that the time to buy is when others are forced to sell, and the time to sell is when others are crazy to buy. In thus looking about for something unpopular he has been led to the securities of different reorganized companies of which the holders were sick and tired—it being his general belief that the best time to buy stocks is during a reorganization and the best time to sell during promotions.

At the present time Mr. Babson does not feel that one should be over-enthusiastic about public utilities, or should become bearish on them, whether reorganized or not. If one wants to buy, however, and desires to be on the safe side, he should buy only such securities as have had their water squeezed out, of which there are enough to absorb all idle money. Mr. Babson believes that it is good business to stick with any properly reorganized public utility, there being to his mind a great similarity between corporate reorganization and personal regeneration.

Presumably the foregoing advice from Mr. Babson is given from the point of view of the speculator, who can reasonably depend upon the well-known rise in the prices of reorganized securities, rather than from that of the true investor, who is more desirous of stability of income and safety of principal than of quick profits through jumps in market prices. For the investor there are many sound utility securities of companies that have not needed reorganization—securities that fully meet the investment requirements of such conservative institutions as trust companies and savings banks. Mr. Babson's advice seems in general to be better suited to a Wall Street paper than to a magazine with a clientele like that of the *Saturday Evening Post*, for popular readers are not very likely to keep in mind the difference between speculative stocks and real investment values in bonds and conservative stocks unless this difference is at least specifically mentioned.

ANNUAL REPORTS

Municipal Railway of San Francisco

The net profit on operation of the Municipal Railway of San Francisco, Cal., for the fiscal year ended June 30, 1915, was $228,157. This amount compares with a net profit of $216,541 for the calendar year 1914, the report for which is superseded by the new report for the fiscal year. After deducting the comparison charges for service rendered by other departments of the municipal government, for insurance and for taxes—thus to show the accounts as if the municipal railway were owned by a private corporation—the net profit for the fiscal year amounted to $83,135. In the comparative charges there were included $138,254 for federal, state and municipal taxes, and $7,768 for the estimated value of service of other municipal departments.

The total net profit from Dec. 28, 1912, to June 30, 1915, amount to $420,402, or after deducting comparative charges, to $187,441. This statement does not take into account the transfer of $48,971 from the surplus account of the municipal railway to the general fund of the city and county of San Francisco. The accounts as maintained at present are said to be those prescribed by the Interstate Commerce Commission as nearly as practicable, and it is recommended that an ordinance be passed formally adopting the procedure.

The statement of income, profit and loss, for the fiscal year ended June 30, 1915, follows:

Operating revenues:	
Passenger revenues	$1,630,778
Miscellaneous revenues	7,886
Total	$1,638,664
Operating expenses:	
Way and structures	$40,716
Equipment	64,787
Power	201,098
Conducting transportation	564,186
Traffic	308
General and miscellaneous	52,293
General and miscellaneous (comparison charges required by charter)	7,768
Depreciation, and injuries and accidents	294,959
Total	$1,226,115
Net operating revenue	$412,548
Miscellaneous income	10,408
Gross income	$422,956
Deductions from income:	
Taxes (comparison charges required by charter):	
State franchise, 5¼ per cent on gross operating revenue	$86,030
Municipal franchise, 3 per cent on passenger revenue	48,923
Municipal car license	2,471
Federal income, 1 per cent on net income	830
Total taxes	$138,254
Interest on funded debt	202,567
Total	$340,821
Net profit for the fiscal year 1914-1915	$82,135

Since the Municipal Railway of San Francisco really pays no taxes, and no payment is made for the services rendered by the other departments of the city, the above statement must be adjusted to show what is called the "true" net profit for the year. This is done simply by taking the profit, $82,135, and adding the comparative charges for legal and clerical service of $7,768 and for taxes of $138,254, producing a net profit of $228,157 for the year on a non-comparative basis.

On account of the change in the accounting period for the last two reports, detailed comparisons of the returns cannot well be made, but it may be noted that the total passenger revenue for the fiscal year ended June 30, 1915, was $1,630,778 as compared to $1,150,236 for the calendar year 1914, an increase of $480,542, thus indicating, in a general way, the effect of the exposition traffic and the opening of 5.8 miles of single track on Feb. 19, 1915. The total operating expenses for the fiscal year ended June 30, 1915, were $923,388 as compared to $613,939 for the calendar year 1914, an increase of $309,449. The company's passenger revenue was $0.32902 per car mile and $2.8478 per car hour in the fiscal year as compared to $0.35046 and $3.1745 respectively in the calendar year. The operating expense (taxes and depreciation not included) in the fiscal year was $0.18630 per car mile and $1.6125 per car hour as compared to

$0.18706 and $1.6944 respectively in the calendar year. The ratio for operating expenses and taxes, not including depreciation, increased from 62.42 per cent for the calendar year to 65.58 per cent for the fiscal year. Other statistics for the fiscal year are shown in the following table:

	Total Amount	Per Car Mile	Per Car Hour
Operating earnings (taxes and depreciation not deducted)	$707,390	$0.14272	$1.2353
Ratio of earnings to passenger revenue	0.4338		
Total taxes and charter charges	146,022	0.02946	0.2550
Ratio to passenger revenue	0.0895		
Operating expenses and taxes	1,069,410	0.21576	1.8675
Ratio to passenger revenue	0.6558		
Depreciation (including injuries and accidents)	294,959	0.05951	0.5151
Ratio to passenger revenue	0.1809		
Operating expenses and depreciation	1,226,115	0.24738	2,1412
Operating expenses, depreciation and taxes	1,364,369	0.27527	2.3826
Ratio to passenger revenue	0.8366		
Net income from operation (after deduction of depreciation, taxes, etc.)	266,409	0.05375	0.4652
Ratio to passenger revenue	0.1634		
Passenger car mileage	4,956,429		
Passenger car hours	572,637		
Total platform expenses (37½ cents per man-hour, 8 hours per day)	$469,328	0.09470	0.8196

The total number of passengers carried in the fiscal year was 40,369,865 as compared to 27,933,049 for 1914. The revenue passengers carried at 5 cents in the fiscal year were 32,676,932, as compared to 22,732,478 in the calendar year. Other divisions of the traffic in the fiscal year were as follows: Government fares, 24,911; school fares, 278,796; revenue transfers, 653,360; free transfers, 6,442,207, and free passengers (police, employees, etc.), 293,659. In July, 1914, when the company had 22.62 miles of single track in operation and owned seventy-two cars, the passenger revenue amounted to $85,534, or $3,781 per mile of single track operated. In June, 1915, with 43.94 miles of single track and 197 cars, the passenger revenue totaled $185,503, or $4,310 per mile of single track operated. The gradual increases in passenger revenue, mileage and equipment are shown by the following table:

	Passenger Revenue	Mileage Operated	Cars Owned
July, 1914	$85,534	22.62	72
August	97,673	*27.88	95
September	109,079	†32.12	113
October	115,227	32.12	143
November	108,704	32.12	154
December	113,645	‡37.24	197
January, 1915	121,941	37.24	197
February	150,557	§43.04	197
March	184,044	43.04	197
April	174,856	43.04	197
May	184,010	43.04	197
June	185,503	43.04	197

*New mileage opened on Aug. 15, 1914.
†New mileage opened on Sept. 7, 1914.
‡New mileage opened on Dec. 28, 1914.
§New mileage opened on Feb. 19, 1915.

York Railways

The gross earnings of the York (Pa.) Railways for the fiscal year ended Nov. 30, 1915, amounted to $828,299, an increase of $31,654 or 3.9 per cent over 1914. The deductions from gross earnings were as follows: Operating expenses, $411,346, an increase of $3,204 or 0.8 per cent; allowances for depreciation, $20,657, an increase of $3,742 or 22.1 per cent, and taxes, $46,110, an increase of $6,355 or 15.9 per cent—making a total of $478,113, an increase of $13,301 or 2.8 per cent. The net earnings amounted to $350,185, an increase of $18,353 or 5.5 per cent, while the interest and bond discount increased $16,135 or 7.2 per cent, so that the net income at $110,712 showed a gain of only $2,218 or 2 per cent.

The disturbance of trade and industrial conditions arising during the latter part of 1914 and extending in 1915, naturally resulted in a checking of the growth of railway receipts. The greatly increased use of private motor cars also contributed to this result. The return of industrial activity during the latter part of the fiscal year, however, brought about a gradual recovery, and it is the opinion of the management that business conditions are on a decidedly better basis than at the end of last year, and receipts are approaching normal.

The total expenditures charged to cost of property during the year were $377,085, of which total $335,657 was for the York Railways proper. This amount was made up of the following items: Acquisition of stock and bonds of the Merchants' Electric Light, Heat & Power Company, $325,760; acquisition of stock of five suburban electric light companies, $2,500; extensions of track and paving, $6,252, and miscellaneous, $1,144.

OCTOBER, 1915, RETURNS NOT ENCOURAGING

Association Figures Show Increase in Net Operating Revenue Over October, 1914, but a Much Greater One in Taxes

A comparison of the electric railway statistics for October, 1915, with figures for the corresponding month of 1914, made by the information bureau of the American Electric Railway Association, indicates that as a whole the electric railway business in the United States has changed but little. Data for 107 companies reporting to the association show an increase in operating revenue of 1.47 per cent, in operating expenses of 0.74 per cent, and in net revenue of 2.42 per cent, while data for eighty-seven of these companies indicate an increase in taxes of 8.30 per cent. The returns are shown in detail in the accompanying table. Similar data for July, August and September were published in the ELECTRIC RAILWAY JOURNAL of Feb. 26.

The Western group represented by forty-one companies shows a decrease in operating revenue of 4.05 per cent and almost no change in its operating expenses. Thirty-five of the companies in this group show an increase in taxes of 22.23 per cent and a decrease in operating income of 12.66 per cent. The Southern group, represented by twenty companies, though showing almost no increase in revenue and a considerable increase in taxes paid, is still able through a reduction in its operating expenses to show an increase in its operating income. The Eastern group, represented by forty-six companies, shows an increase in operating revenue of about 3 per cent, in operating expenses of about 1.4 per cent and in taxes of about 4 per cent. In the operating income of forty-one of the companies there is an increase of 6.15 per cent. All of the districts except the Western show a slight decrease in the operating ratio, the United States as a whole indicating a decrease from 57.25 for 1914 to 56.53 in 1915. The operating ratio in the Western district has increased from 62.12 in 1914 to 63.81 in 1915.

REVENUES AND EXPENSES OF ELECTRIC RAILWAYS, OCTOBER, 1915

	Companies Reporting Taxes		Companies Not Reporting Taxes	
Account	Amount, October, 1915	Increase Over 1914. Per Cent	Amount October, 1915	Increase Over 1914. Per Cent
United States				
Operating revenues	22,283,651	1.47	20,720,967	1.93
Operating expenses	12,588,380	0.74	11,715,465	0.66
Net operating revenue	9,695,271	2.42	9,005,502	3.64
Taxes	.....	...	1,304,833	8.30
Operating income	.....	...	7,700,669	2.91
Operating ratio, per cent:				
1915	56.49	...	56.53	...
1914	56.89	...	57.25	...
Number of companies represented	107	...	89	...
*Eastern District**				
Operating revenues	16,766,609	3.03	16,259,429	3.39
Operating expenses	9,219,189	1.44	8,912,506	1.42
Net operating revenue	7,547,420	5.05	7,346,923	5.91
Taxes	.....	...	966,675	4.31
Operating income	.....	...	6,380,248	6.15
Operating ratio, per cent:				
1915	54.98	...	54.81	...
1914	55.84	...	55.88	...
Number of companies represented	46	...	41	...
*Southern District**				
Operating revenues	1,338,956	0.37	567,489	d4.22
Operating expenses	713,015	d3.18	318,073	d11.43
Net operating revenue	625,941	5.38	240,416	7.13
Taxes	.....	...	47,807	16.58
Operating income	.....	...	201,609	5.11
Operating ratio, per cent:				
1915	53.25	...	56.04	...
1914	55.48	...	60.70	...
Number of companies represented	20	...	13	...
*Western District**				
Operating revenues	4,178,086	d4.05	3,894,049	d2.89
Operating expenses	2,656,176	d0.39	2,484,886	d0.25
Net operating revenue	1,521,910	d9.83	1,409,163	d7.22
Taxes	.....	...	290,351	22.23
Operating income	.....	...	1,118,812	d12.66
Operating ratio, per cent:				
1915	63.57	...	63.81	...
1914	61.24	...	62.12	...
Number of companies represented	41	...	35	...

Note—Letter "d" denotes decrease.
*Groupings are as follows: *Eastern District*—East of the Mississippi River and north of the Ohio River. *Southern District*—South of the Ohio River and east of the Mississippi River. *Western District*—West of the Mississippi River.

Bay State Street Railway, Boston, Mass.—The Massachusetts Public Service Commission has received a request from the Bay State Street Railway for permission to issue 7357 additional first preferred shares to be offered to stockholders at par; $400,000 first mortgage bonds of the Boston & Northern Street Railway, and $300,000 like bonds of the Old Colony Street Railway, the money so realized to provide for payment of floating indebtedness and purchase of property necessary to the operation of the railway. The company now has $23,265,800 full-paid stock outstanding, composed of $20,517,200 common and $2,748,600 first preferred. The commission announced that it would hold a hearing on the petition of the company on March 17.

Cleburne (Tex.) Traction Company.—The Cleburne Traction Company has been incorporated with a capital stock of $15,000 by F. C. Cotton, Ft. Worth, and Lawrence Hewitt and Daniel Hewitt, both of Cleburne, to succeed the Cleburne Street Railway, the property of which was sold recently to Mr. Cotton and his associates as noted in the ELECTRIC RAILWAY JOURNAL of Feb. 19, page 381.

Columbia Railway, Gas & Electric Securities Corporation, Columbia, S. C.—The Columbia Railway, Gas & Electric Securities Corporation will redeem on April 1 at 101 and interest at the office of the Columbia Trust Company, New York, all outstanding Series "B" convertible 6 per cent secured gold notes. The total authorized issue was $1,000,000. The notes were offered by Redmond & Company, New York, N. Y., at 99½ and interest. They are dated April 1, 1915, and are due on April 1, 1917, but subject to redemption on any interest date.

Empire United Railways, Inc., Syracuse, N. Y.—Holders of the one-year 6 per cent guaranteed gold notes of the Empire United Railways, Inc., issued under the indenture of Feb. 16, 1915, with the Bankers' Trust Company, New York, N. Y., as trustee, are called upon by the trustee to present their notes for indorsement and to receive $633.627 per $1,000 of notes from funds received from certain of the guarantors.

Kansas City Railway & Light Company, Kansas City, Mo.—The reorganization managers of the Kansas City Railway & Light Company announced that the interest to which depositors are entitled pursuant to the plan and also the interest payable on Jan. 1, 1916, upon the new securities issuable under the plan of reorganization would be paid on March 15 at the office of the New York Trust Company, depositary. It is expected that the permanent engraved securities will be ready for distribution in May.

Northwestern Pennsylvania Railway, Meadville, Pa.—The Northwestern Electric Service Company of Pennsylvania, with general offices in the Commerce Building, Erie, Pa., has been incorporated under the laws of Pennsylvania and has elected the following officers: F. F. Curtze, president; Charles M. Hatch, vice-president and general manager; A. O. Chapin, secretary, all of Erie, Pa. Through purchase of the common stock the Northwestern Electric Service Company will control the Northwestern Pennsylvania Railway, the general office of which will hereafter be in Erie, Pa. The officers previously mentioned hold like offices with the railway. The Northwestern Electric Service Company has leased for ninety-nine years the property of the People's Incandescent Light Company, Meadville, Pa., and will extend its light and power service.

Peterboro (Ont.) Radial Railway.—On March 10 just after the Ontario Legislature rose G. Howard Ferguson, minister of lands, forests and mines, announced that the Ontario government had signed an agreement with the Electric Power Company, which controls what are generally known as the Seymour enterprises, purchasing outright on behalf of the people all the interests of that corporation, including the Peterboro Radial Railway. The purchase is the result of negotiations carried on for some time. The purchase price, $8,350,000, payable in Ontario government 4 per cent bonds, is the amount agreed upon by the engineers of the Hydro-Electric Power Commission.

Public Service Corporation of New Jersey, Newark, N. J.—Drexel & Company, Philadelphia, Pa., have sold the entire issue of $7,500,000 of three-year 5 per cent notes of the Public Service Corporation of New Jersey issued to provide funds to retire a similar amount of notes which, as noted in the ELECTRIC RAILWAY JOURNAL of Feb. 19, page 382, matured on March 1.

Stark Electric Railroad, Alliance, Ohio.—A quarterly dividend of 1 per cent has been declared on the $1,250,000 of stock of the Stark Electric Railroad, payable on April 1 to holders of record on March 25. This compares with three-quarters of 1 per cent paid since 1909.

Waterloo, Cedar Falls & Northern Railway, Waterloo, Iowa.—William Marriott Canby, Philadelphia, Pa., is offering for sale first mortgage sinking-fund 5 per cent bonds of the Waterloo, Cedar Falls & Northern Railway, dated Jan. 1, 1910, and due on Jan. 1, 1940, denomination $1,000. The bonds are part of a total authorized issue of $6,000,000 and are secured by an absolute first mortgage upon all property. They are now redeemable all or in part on any interest date at 105 and accrued interest.

DIVIDENDS DECLARED

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

Eastern Power & Light Corporation, New York, N. Y., quarterly, 1½ per cent, preferred.

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

Manila Electric Railroad & Lighting Corporation, Manila, P. I., quarterly, 1½ per cent.

Northern Ohio Traction & Light Company, quarterly, 1½ per cent, preferred.

Philadelphia (Pa.) Traction Company, $2.

Second & Third Streets Passenger Railway, Philadelphia, Pa., quarterly, $3.

Springfield Railway & Light Company, Springfield, Mo., quarterly, 1¾ per cent, preferred.

Stark Electric Railroad, Alliance, Ohio, quarterly, 1 per cent.

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

West Penn Railways, Pittsburgh, Pa., quarterly, 1¼ per cent, preferred.

West Penn Traction Company, Pittsburgh, Pa., quarterly, 1½ per cent, preferred; one-half of 1 per cent on preferred on account of accumulated dividends.

ELECTRIC RAILWAY MONTHLY EARNINGS

CLEVELAND, PAINESVILLE & EASTERN RAILROAD, WILLOUGHBY, OHIO

Period			Operating Revenues	Operating Expenses	Operating Income	Fixed Charges	Net Income
1m., Jan.,		'16	$28,865	*$17,245	$11,620	$11,061	$559
1 "	"	'15	25,813	*16,027	9,786	10,961	†1,175

COMMONWEALTH POWER, RAILWAY & LIGHT COMPANY, GRAND RAPIDS, MICH.

1m., Jan.,		'16	$1,407,552	*$726,500	$681,052	$411,368	$269,684
1 "	"	'15	1,241,903	*650,972	590,931	360,376	230,555
12 "	"	'16	14,755,303	*7,863,512	6,891,791	4,557,075	2,334,716
12 "	"	'15	14,019,809	*7,534,320	6,485,489	4,229,121	2,256,368

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

1m., Jan.,		'16	$229,368	*$137,982	$91,386	$61,853	$29,533
1 "	"	'15	206,162	*123,679	82,483	63,285	19,198
12 "	"	'16	2,490,176	*1,487,895	1,002,281	754,883	247,398
12 "	"	'15	2,598,045	*1,589,618	1,008,427	717,133	291,294

LAKE SHORE ELECTRIC RAILWAY, CLEVELAND, OHIO

1m., Jan.,		'16	$113,369	*$76,819	$36,550	$36,109	$441
1 "	"	'15	98,336	*71,811	26,525	35,926	†9,401

LEWISTON, AUGUSTA & WATERVILLE STREET RAILWAY, LEWISTON, ME.

1m., Jan.,		'16	$52,883	*$40,350	$12,533	$15,963	†$3,430
1 "	"	'15	49,527	*38,608	10,919	15,578	†4,659
12 "	"	'16	741,207	*477,165	264,042	190,224	73,818
12 "	"	'15	681,150	*467,057	214,093	186,658	27,435

NASHVILLE RAILWAY & LIGHT COMPANY, NASHVILLE, TENN.

1m., Jan.,		'16	$196,585	*$116,354	$80,231	$43,083	$37,148
1 "	"	'15	184,546	*106,976	77,570	42,018	35,552
12 "	"	'16	2,155,941	*1,328,210	827,731	511,653	316,078
12 "	"	'15	2,237,022	*1,334,853	902,169	497,545	404,624

NORTHERN OHIO TRACTION & LIGHT COMPANY, AKRON, OHIO

1m., Jan.,		'16	$367,142	*$211,606	$155,536	$53,580	$101,956
1 "	"	'15	280,838	*181,978	98,860	50,251	43,609

PORTLAND RAILWAY, LIGHT & POWER COMPANY, PORTLAND, ORE.

1m., Jan.,		'16	$454,988	*$257,732	$197,256	$181,762	$15,494
1 "	"	'15	489,713	*261,404	228,309	182,361	45,948
12 "	"	'16	5,476,620	*3,069,956	2,406,664	2,207,756	198,908
12 "	"	'15	6,180,274	*3,248,001	2,932,273	2,181,758	750,515

*Includes taxes. †Deficit.

Traffic and Transportation

I. C. C. DECISION FAVORS ELECTRIC LINE

Cancellation of Joint Passenger Fares from Milwaukee, Wis., to Muskegon, Mich., Not Justified

The Interstate Commerce Commission has found that the proposed cancellation of joint passenger fares from Milwaukee, Wis., to Coopersville, Nuncia and Muskegon, Mich., on the line of the Grand Rapids, Grand Haven & Muskegon Railway is not justified and the schedules under suspension have been ordered cancelled. By schedules published to take effect on July 16, 1915, the Crosby Transportation Company proposed to cancel the joint passenger fares. Upon protest by the electric railway the schedules were suspended until May 13, 1916. The protestant operates an electric railroad from Muskegon to Grand Rapids, Mich. Grand Haven is the terminus of a branch line which connects with the main line at Grand Haven Junction. Coopersville and Nuncia are located on protestant's main line between Grand Haven Junction and Grand Rapids and are also served by the Grand Trunk system. Grand Haven and Muskegon are on the eastern shore of Lake Michigan. The Crosby Transportation Company operates a line of boats between Milwaukee and Grand Haven and Muskegon.

The Interstate Commerce Commission found in Damon v. Crosby Transportation Company, 33 I. C. C., 448, decided on March 24, 1915, that the refusal of the Crosby Transportation Company to participate in the sale of through tickets between Milwaukee and Grand Rapids in connection with the Grand Rapids, Grand Haven & Muskegon Railway while it authorized the sale of through tickets between Milwaukee and Grand Rapids in connection with the Detroit, Grand Haven & Milwaukee Railway, operated by the Grand Trunk system, unjustly discriminated against the Grand Rapids, Grand Haven & Muskegon. In complying with the commissions order in that proceeding the Crosby Company established joint passenger fares with the protestant carrier, not only between Milwaukee and Grand Rapids, but also between Milwaukee and Coopersville, Nuncia and Muskegon. The fares from Milwaukee to these points were published in the Crosby Transportation Company's tariff, concurred in by protestant, and the fares in the reverse direction were published in protestant's tariff, concurred in by the Crosby Company. Before proposing the cancellations the latter company withdrew its concurrence relative to the point fares maintained from the three points involved to Milwaukee.

In concluding its opinion the commission said:

"The real reason for the cancellation involved is a dispute relative to divisions. As stated in the report in the Damon case, *supra*, the docks used by the Crosby Transportation Company at Milwaukee are owned by the Chicago, Milwaukee & St. Paul Railway, but are leased by the Grand Trunk. The dock at Grand Haven is owned by the Grand Trunk. After the joint fares were established, the Grand Trunk required the Crosby Transportation Company to pay a charge of 60 cents for each one-way ticket sold at the fares involved, as compensation for the use of the docks and for certain accounting done by the Grand Trunk in connection with their use. The boat line endeavored to pass the charge along to protestant, but protestant refused to shrink its divisions to that extent. Disagreements among carriers relative to divisions of joint rates are insufficient to justify the cancellation of such rates. Furthermore, a similar dock charge has been made by the Grand Trunk for a number of years for passengers traveling between Milwaukee and Grand Rapids, under joint fares between the boat line and the Grand Trunk, which was not challenged in the Damon case, *supra*. The Crosby Transportation Company also participates in joint passenger fares with various rail carriers, and while it does not appear that the Grand Trunk exacts a dock charge in connection with each of these fares, or what the amount of such charge is, if any is exacted, it does appear that in no instance has any connection of the Crosby Transportation Company been called upon to pay this dock charge or any portion of it. We find that the proposed cancellation of the joint fares in question has not been justified, and the schedules under suspension will be ordered canceled."

COPPER ZONE SYSTEM OPPOSED

The Public Utilities Commission of Connecticut has concluded the hearings which it has been holding in connection with the appeal of patrons of the Groton & Stonington Street Railway, operated under lease by the Norwich & Westerly Traction Company, from alleged excessive and discriminatory fares under the copper zone system put into effect last November and similar to that of the Shore Line Electric Railway, controlled by the same interests and described in the Electric Railway Journal for Sept. 11, page 443. The 2-cent zones average about 0.8 of a mile in length. From the Velvet mill to Elm Grove cemetery on the Old Mystic branch the distance is 0.38 mile. This is the shortest zone. The longest zone is 1.58 mile. Warren G. Burrows, representing the town of Groton, favored a straight 6-cent fare. Senator Hewitt maintained that the zone system was discriminatory and that a 6-cent fare with no change in the zone limits as formerly in use would have been more satisfactory to patrons.

Christopher L. Avery for the company expressed the opinion that the present system was equitable and that the 6-cent fare would also have been opposed. He did not think the plan would be practicable of having the first three zones 5 cents and 2 cents thereafter. He expressed the opinion that under such a plan passengers would not declare their destination, but would endeavor to save a few cents by paying 5 cents every 3 miles.

The company introduced as an expert Carol E. Bailey of the J. G. White Engineering Corporation. He did not think that the property could be built at present for the amount of its capitalization. Mr. Bailey placed the cost to reproduce the property at present at $878,610, exclusive of organization expense. A summary of his estimate of the physical valuation of the property was introduced into the evidence.

In his discussion of the capitalization of the company Mr. Avery said that the opponents of the fare system had introduced no evidence to show that the capitalization was excessive. Mr. Bailey's figures were within 10 per cent of the capitalization and they did not take into account organization expenses. In twelve years the $400,000 of common stock had paid only $50,000 in dividends. Even with the increase in fare put into effect last November the company was receiving only enough to pay operating expenses, fixed charges on the $475,000 of first-mortgage 5 per cent bonds and dividends on $200,000 of preferred stock. The new rates which are under protest did not produce the amount which the company considered adequate.

Senator Hewitt in concluding said that whatever increase in revenue was needed should be produced by a system which would not be discriminatory. He advocated the system of three zones for 5 cents.

The fare matter is also before the Interstate Commerce Commission. On March 10 at Mystic, Alton Gerry, examiner for the commission, took the testimony of witnesses. It appears that an arrangement is in effect under which through tickets are sold between Stonington, Conn., and Westerly, R. I.

RAILWAY TO LEND THE PERSONAL TOUCH

Names Not Numbers Will Be Distinctive on the Cumberland & Westernport Railway

A new idea will probably be inaugurated on the Cumberland & Westernport Electric Railway, Cumberland, Md., operated by Henry L. Doherty & Company, that is expected to be popular and beneficial in its results. At the present time both motormen and conductors are designated almost entirely by number, especially so far as the public is concerned. Under the new plan each car will carry a card stating the names of the motorman and conductor, so that passengers, if they find it necessary to complain or praise, will not confine themselves to certain numerals on the badge of each uniform.

For the last year or so it has been quite common in hotels and banks of the better sort to find notices that Messrs.

So and So are on duty. It has been found that this worked out well as each guest or client, as the case may be, has, knowing the name, felt a more or less personal interest in the man behind the counter. A representative of the company is quoted as follows:

"This scheme has not yet been adopted, but it has been approved by the officers of the railway, and will be put up to the men within a short time. Such a plan, it is felt, will enable the men to feel that they are direct representatives of the company, with individuality rather than a number. There are many of them who have chafed under this apparent limitation, and we think the plan will please them. It will also benefit the company, because to any possessed of any ambition it will make him feel that he is not only a motorman or conductor, but a direct representative of the company, whose duty it is to sell further service to the public as well as give it at that time."

ACCIDENT FAKER HELD BY COURT

Maurice Abrams of New York City was arrested in Edgewater, N. J., on March 4, on a charge of attempting to obtain money under false pretences from the Riverside & Fort Lee Ferry Company, a subsidiary of the Public Service Railway. Abrams was committed to the Bergen County jail in Hackensack in default of $500 bail. On March 8 his case was called before Judge Seufort. He pleaded guilty and was held until March 22, 1916, for sentence, in order that the judge might have time to look into his history.

When he presented his claim to the ferry company Abrams alleged that on Feb. 24, when one of the boats of the company on which he was a passenger was entering the ferry slip, a broom was jarred from a seat, where it was alleged to have been left by an employee, the handle striking him on the nose, causing it to bleed and breaking his eyeglasses.

Investigation showed that Abrams had filed many similar claims against transportation and other companies in New York City and vicinity and had collected amounts ranging from $5 to $40. In addition to the name of Maurice Abrams he has also used the names Paul Abrams, Martin Abrams, Maxwell Abrams, Maurice A. Brown and Morris A. Brown.

"Passenger Directors" for East St. Louis.—The East St. Louis & Suburban Railway, East St. Louis, Ill., has stationed two "passenger directors" at principal down-town transfer stations in East St. Louis to direct patrons from 4 p. m. to 6.30 p. m. Two other directors will also be named. These men will wear special uniforms.

Bay State Fare Hearings to Be Resumed in April.—The Massachusetts Public Service Commission will resume hearings on the 6-cent fare case of the Bay State Street Railway on April 17 at the offices of the board in Boston, the company's side of the case now being completed. Evidence will then be heard by the commission from remonstrants against the proposed increase, with the cross-examination of various experts who have appeared on behalf of the company.

Newark Jitney Measure Vetoed.—Mayor Raymond of Newark, N. J., has again vetoed the ordinance providing for the regulation of jitneys in the city. This is the second time that the Mayor has disapproved such an ordinance because of the form in which it was passed by the Council. The regulations provided that a bond of $3,000 be furnished in order to afford protection to the public, while the license fees were made to range from $15 for a seven-passenger car to $75 for a bus seating more than twenty-one people.

Kentucky Compensation Measure Before Governor. — A workman's compensation law has been passed by both houses of the Kentucky Legislature. It will go to the Governor, and, since it was an administration measure, is practically assured of his signature. The measure is practically compulsory since it provides that those employers who do not come in under it will be deprived of the usual common-law defenses in case of suits by employees. No State fund is provided, and insurance may be carried in commercial companies or with mutual organizations.

Conference Regarding Service in Toronto.—On March 10 R. J. Fleming, manager of the Toronto (Ont.) Railway, called on Mayor Church in reference to the indictment proceedings for alleged overcrowding instituted by the Mayor the previous day. Mr. Fleming informed the Mayor that the company contemplated making numerous improvements, but that it was greatly handicapped by the fact that more than 600 of its employees had enlisted and there was great difficulty in filling their places. The Mayor decided to call a special meeting of the Board of Control to permit Mr. Fleming to submit his plans for the improvement of the service.

Intemperate and Dishonest Employees Will Not Be Reinstated.—W. M. Weatherwax, superintendent of transportation of the Chicago (Ill.) Surface Lines, has issued a notice that hereafter in all cases where there is proof that trainmen are using intoxicating liquors on duty, or that conductors are failing to register fares, their suspension from service will be made permanent and there can be no reinstatements. The number of discharges during the year 1915 was 381. Of this number 298 were conductors and eighty-three motormen. The records show that 95 per cent of the discharges were due to intemperance while on duty or to dishonesty. The per cent of discharges from a total of approximately 9000 trainmen is considered small. Eighty-one of the discharged trainmen were reinstated.

Kentucky Senate Passes "Jim Crow" Bill.—The Kentucky State Senate has passed the "Jim Crow" bill, which would require the Louisville Traction Company to segregate the whites and blacks in the city cars. The author of the bill, Senator C. H. Knight, stated in his address supporting the measure that there was a general demand for it in Louisville and that his measure would give the relief desired without imposing hardships on anybody. Senator D. H. Peak, Trimble County, offered an amendment requiring that a seat be furnished for every passenger. This amendment was voted down. Senator T. A. Combs, Lexington, wanted to know why, if "90 per cent of the people of Louisville were in favor of separation of the races in the street cars" the City Council did not require it, since it has sufficient power. The measure goes to the House.

Buffalo Suburban Line Petitions for Fare Revision.—The Buffalo & Lake Erie Traction Company has asked the town officials in the several towns on the Dunkirk and Erie division of the company to agree on an amendment to the franchise placing the matter of fixing passenger charges in the hands of the Public Service Commission, as is now the case between Fredonia and Buffalo. A. R. Myers, general manager of the company, points out that under the prevailing passenger tariff it is impossible to operate between Dunkirk and Erie at a profit. The Public Service Commission for the Second District decided previously that it has no power to modify the terms of a franchise granted by a municipality. This ruling was made in connection with the application of the New York & North Shore Traction Company to the commission asking that it determine that the just and reasonable fare between Mineola and Port Washington was 15 cents, instead of 10 cents, to which the road was limited by franchise terms. The decision in this case was referred to in the ELECTRIC RAILWAY JOURNAL of Sept. 18, 1915, page 610.

Memphis Jitneys Enjoined.—Chancellor Heiskell, in an opinion handed down recently, has permanently enjoined three jitney companies from operating in Memphis, Tenn. He held the jitney ordinances recently passed by the City Commissioners to be invalid. The injunction was asked by the Memphis Street Railway. It is directed against the North Memphis Transit Company, the Rapid Transit Company and the Memphis Jitney Association. In its application for a permanent injunction the street railway contended that former Mayor Love's refusal to sign the jitney ordinances passed over his veto made the ordinances invalid. Chancellor Heiskell sustained the contention, holding that the Mayor's signature to the ordinances was absolutely necessary to make them effective, and that the board of city commissioners could not validate the measures by a two-thirds vote over the Mayor's veto. The court also held that in its opinion a blanket indemnity bond of $5,000 for each company was not sufficient. The chancellor held that he interpreted the law to mean that a $5,000 bond is necessary for each car in the jitney business. The city attorney has announced an appeal to the State Supreme Court.

Personal Mention

Mr. J. D. Scott, formerly power salesman of the Portland Railway, Light & Power Company, Portland, Ore., has been appointed assistant engineer in the office of Mr. O. B. Coldwell, general superintendent of that company.

Mr. J. C. Skinner, who has been with the United Railroads, San Francisco, Cal., almost since its inception, and who for many years was division superintendent at Washington and Mason, has been retired by the company on half pay.

Mr. C. G. Stevenson, assistant shop foreman for the railway department of the Southern Public Utilities Company, Charlotte, N. C., has resigned to go into business for himself. Mr. Stevenson has been succeeded by Mr. C. C. Phillips.

Mr. J. P. Jones has been made division superintendent of the United Railroads, San Francisco, Cal., at Washington and Mason, in addition to his position at Turk and Fillmore. At Washington and Mason he succeeds Mr. J. C. Skinner, who has retired.

Mr. J. E. Richards, auditor and treasurer of the London & Port Stanley Railway, London, Ont., has been appointed manager of the road, succeeding Mr. F. T. Leversuch, resigned. Mr. Richards was formerly with the Chatham, Wallaceburg & Lake Erie Electric Railway.

Mr. C. Sims Bailey has been appointed general superintendent in charge of the Petersburg & Appomattox Railway, Petersburg, Va. Mr. Bailey was formerly general manager and chief engineer of the Richmond & Henrico Railway, Richmond, Va., during construction and operation.

Mr. George W. Lang has been appointed claim agent of the Ottawa (Ont.) Electric Railway. Mr. Lang was born in Ottawa on June 13, 1872, and entered the company's service in June, 1892. From that time until July, 1896, he was a conductor. From July, 1896, to October, 1908, he served with the company as inspector, and from 1908 to 1909 as assistant superintendent. Since 1909 Mr. Lang has been engaged in private business in Calgary, Alta.

Mr. E. H. LeTourneau has been appointed efficiency engineer of the Portland Railway, Light & Power Company, Portland, Ore., to succeed Mr. Edward A. West, who, as announced previously in the ELECTRIC RAILWAY JOURNAL has been appointed chief engineer of the Denver (Col.) Tramway. Mr. LeTourneau recently held the position of assistant engineer in the office of Mr. O. B. Coldwell, general superintendent of the company. He has been with the company for the past six years in various capacities.

Mr. J. S. Pevear has recently been re-elected president of the Birmingham Railway, Light & Power Company, Birmingham, Ala. He has also been chosen general manager of the company to succeed Mr. J. P. H. De Windt, who is now connected with the American Cities Company, of which the Birmingham Railway, Light & Power Company is a subsidiary. On Dec. 1 Mr. Pevear moved his headquarters from New York to Birmingham to take active charge of the operation of the Birmingham Railway, Light & Power Company, of which company he has been president for some time.

Mr. L. Edward Herrmann, Jersey City, private secretary to Governor Fielder of New Jersey, has been appointed to succeed Mr. Frank H. Sommer as counsel of the Board of Public Utility Commissioners of New Jersey. As announced previously in the ELECTRIC RAILWAY JOURNAL Mr. Sommer will retire on April 1 as counsel to become dean of the New York University Law School, but will continue with the commission in an advisory capacity until disposition is made of a number of matters now pending before that body. Mr. Herrmann was born in Jersey City on July 6, 1876. He was educated in the Jersey City public schools, New York University and the New York Law School. While he was studying law he taught in the Jersey City night schools, but subsequently engaged in newspaper work on the Jersey City *News* and the Jersey City *Journal*. He was admitted to the bar in 1901, and began practice in partnership with Mr. Andrew J. Steelman, Jr. He has been secretary to the president of the Senate and the Governor and a member of the Board of Education of Jersey City.

Mr. E. W. Holst, superintendent of equipment of the Bay State Street Railway, Boston, Mass., was elected president of the New England Railroad Club at the annual meeting on March 14. This is an unusual honor for an electric railway official, as most of the members of the club are steam railroad men. Mr. Holst is a native of Norway, where he received his technical education. Part of his early training was obtained with the General Electric Company, beginning with that company's student course. He has been with the Bay State Street Railway and its predecessors since 1904. Mr. Holst's election is not altogether surprising as he has always been a willing worker in railway association affairs. In 1912 he was chairman of the subcommittee on self-propelled cars of the American Electric Railway Engineering Association, the report on which subject was remarkable for the thoroughness of its text and the extensive bibliography. As a member of the equipment committee he also gave particular attention to steel wheel specifications. As a car designer Mr. Holst's work is notable not only for progress in equipment standards and weight reduction, but also for the attention given to car planning from the standpoint of the transportation department.

E. W. HOLST

OBITUARY

W. Frank Carr, Pacific Northwest Coast representative of the Chicago Railway Signal & Supply Company, is dead. He succumbed suddenly to heart failure.

William Norris, general superintendent of the Chatham, Wallaceburg & Lake Erie Electric Railway, died in St. Joseph's Hospital in London, Ont., on March 6, after a three weeks' illness, with pneumonia. Mr. Norris was fifty years old, and was formerly connected with the London (Ont.) Street Railway.

Frederick C. Stevens, formerly State Superintendent of Public Works of New York and State Senator, died suddenly in Attica, N. Y., on March 14. He was sixty-four years old. Mr. Stevens was a director with Mr. O. T. Crosby, Mr. C. A. Lieb, Mr. G. W. Bacon and others of the Columbia Railway, Washington, D. C., before that property was merged into the Washington Railway & Electric Company.

Sir Charles Rivers-Wilson, one of the vice-presidents of the Tramways & Light Railways Association of England, is dead. Sir Charles was born in 1831, and was one of the subscribers to the memorandum of association in 1897. He was elected member of the council and first president of the association in 1899, and at the time of the reconstruction of the association in 1906 he was elected a vice-president, the late Duke of Argyll having accepted the position of president.

Robert M. Jones, who since 1906 maintained an office in Denver, Col., and acted as engineer in the examination and design of many hydroelectric projects throughout the West and in Mexico, died suddenly on March 1 at Carlsbad, N. M. Mr. Jones was born in Wayne, Ohio, in 1853. He was a pioneer in both electric light and electric street railway work. In 1889 he went to Salt Lake City and built under contract the three original systems and a steam power plant there and later two electric railway systems in Montana. He then engaged in hydroelectric work. Later he constructed the plant of the Blue Hills Traction Company at Spearfish, S. D., the first installation in this country using the double-discharge type Francis turbines. He is survived by his widow and five sons.

Construction News

Construction News Notes are classified under each heading alphabetically by States.

An asterisk (*) indicates a project not previously reported.

RECENT INCORPORATIONS

*Argenta Terminal Company, Little Rock, Ark.—Incorporated to construct a belt line 2½ miles long in Argenta. Capital stock, $42,000. The company will complete the line begun by the Little Rock & Argenta Railway. Incorporators: A. C. Butterworth, C. C. Kavanaugh, C. R. Ledbetter, A. C. Read and C. G. Price.

*Northwestern Electric Service Company of Pennsylvania, Erie, Pa.—Incorporated in Pennsylvania, with general offices in Commerce Building, Erie. The company will control the Northwestern Pennsylvania Railway. Officers: F. F. Curtze, president; Charles M. Hatch, vice-president and general manager, and A. O. Chapin, secretary, all of Erie.

FRANCHISES

East San Diego, Cal.—The San Diego Electric Railway has received a franchise from the Council to construct an extension of its University Avenue line from Fairmount Avenue to Euclid Avenue.

Pocatello, Idaho.—The Pocatello Traction & Interurban Company has asked the Council for a franchise in Pocatello. [Dec. 18, '15.]

Baltimore, Md.—The Maryland Electric Railway has asked the Council for a franchise to construct an extension to Guilford.

Syracuse, N. Y.—The New York State Railways has asked the Council for a franchise to construct a new track through Oak Street from Farmer Street to Roby Street, Syracuse.

Cleveland, Ohio.—Fielder Sanders, city traction commissioner, has asked the Council for a franchise to extend the Cleveland Railway's line on West Twenty-fifth Street 1½ miles on Pearl Road.

Salt Lake City, Utah.—The Utah Light & Traction Company has received an extension of time on its franchise to construct an extension of its Capitol Hill line. The limit for completion of the line to a point opposite the east entrance of the Capitol on West Canyon Street was extended from March 1 to May 1, while Oct. 1 was set as the date limit for completion of the line north on West Canyon Street to Fourth North Street. From Fourth North Street on to De Soto Street the line must be completed within sixty days after establishment of grade by the city.

Spokane, Wash.—The Spokane Traction Company has asked the Council for a new loop franchise on Madelia Street and has asked for the cancellation of its franchise over the Boone Avenue bridge. Members of the Recreation Park Improvement Club have petitioned the Council to repair the Boone Avenue bridge and compel the Spokane Traction Company to restore car service over this route.

TRACK AND ROADWAY

Calgary (Alta.) Street Railway.—The Council of Calgary has approved an item of $20,000 for additional feeder cable for the Calgary Street Railway.

Martinez & Concord Interurban Railway, Martinez, Cal.—This company has applied to the Railroad Commission for a certificate of public convenience and necessity, and for authority to issue securities to defray the cost of constructing the first unit of its proposed line from Martinez to Concord, a distance of approximately 9 miles. The first unit of its line is to be 3.3 miles in length and will start from Martinez and run to a connection with the Atchison, Topeka & Santa Fe Railway. This unit of the company's line is estimated to cost $83,241. The company desires to issue 650 shares of stock at $45 per share, and $60,000 face value of first mortgage bonds at 90 per cent of their face value to cover this construction cost. The company further desires to issue $60,000 face value of cumulative participating bonds to be sold at par, and to be issued only as its first mortgage bonds are retired and cancelled. The company has secured a fifty-year franchise from Martinez and has arranged for practically all the rights-of-way for the first unit of its line. [Feb. 26, '16.]

*Litchfield County Company, Torrington, Conn.—It is reported that construction will be begun this summer on this company's proposed line between Torrington and Waterbury, via Litchfield, Bantam, Morris and Watertown, 22 miles. At a recent meeting the Torrington Chamber of Commerce passed by unanimous vote a resolution to co-operate in completing the plans. It is stated that a charter was secured by the Litchfield County Company two years ago, but nothing definite has been done by the company. A. J. Patton Company, Waterbury, is interested.

Wilmington & Philadelphia Traction Company, Wilmington, Del.—Announcement has been made by this company that $100,000 or more will be spent on improvements to Shellpot and Brandywine Springs parks owned by the company and located near Wilmington.

Lewiston-Clarkson Transit Company, Lewiston, Idaho.—H. C. Hartung, manager of the Lewiston-Clarkston Transit Company, reports that track construction on the extension of the company's line from its present terminus at Sixth and Sycamore Streets to Thirteenth Street and Highland Avenue, 1¼ miles, has been begun.

*Union City, Ind.—Business men of Union City, called together by the Union City Community Welfare League, have approved unanimously the proposed $150,000 subsidy for a traction line from Richmond to Portland, to connect with a northern system of electric railways. Union City's share would amount to about $35,000.

Des Moines (Iowa) City Railway.—The North American Construction Company of Chicago has received a contract from the Des Moines City Railway for the reconstruction of practically all the tracks in the West Des Moines business district and the building of a new loop on Second and Ninth and Walnut and Locust Streets. Work will be begun May 1 and the contract calls for its completion by Aug. 1. The cost will be $120,000. This work is being done in accordance with the new franchise agreement.

Kansas City, Kaw Valley & Western Railway, Bonner Springs, Kan.—This company has filed with the Public Utility Commission of Kansas revised plans for the proposed strengthening of the present Kaw River bridge at Lawrence in order to obtain the sanction of the commissioners of the company's request to operate cars across the structure. If accepted, the bridge will be repaired by the company.

Cumberland & Manchester Railroad, Barbourville, Ky.—It is reported that T. J. Anderson, Knoxville, Tenn., has received a contract to grade 8 miles of this company's line beginning at Cannon, Ky. M. E. S. Posey, Barbourville, chief engineer. [Feb. 12, '16.]

Newport & Alexandria Interurban Railroad, Newport, Ky.—Preliminary surveys have been begun on this company's proposed road beginning from the corporation line of Newport. The line will follow the Licking pike to Three Mile Creek, thence along the creek valley to the Alexandria pike. It is the intention to parallel the pike to Alexandria. [March 4, '16.]

Fort Fairfield, Me.—The Fort Fairfield Board of Trade advises that surveys have been made for its proposed railway from Fort Fairfield to Limestone, about 12 miles. As soon as weather conditions permit surveys will be made from Limestone to Van Buren, via Caswell and Hamlin, about 22 miles. [July 4, '14.]

Winnipeg, Man.—It is reported that the Board of Control of Winnipeg is considering the question of constructing several new car lines. G. J. Brown, City Clerk.

Grand Rapids, Holland & Chicago Railway, Holland, Mich.—Bids will be received until noon, March 24, by Frank F. Rogers, State highway commissioner, Lansing, for the construction of a 60-ft. span reinforced-concrete arch with 66-ft. width over all on the Grandville Avenue Road, Wyoming Township, which is also the State trunk line crossing Plas-

ter Creek and containing approximately 1008 cu. yd. of concrete. The bridge is to be built jointly by the Board of County Road Commissioners of the County of Kent, the State Highway Department and the Grand Rapids, Holland & Chicago Railway. Bids will be received on the reinforced-concrete structure complete. Travel must be maintained at all times on the highway and street railway during construction. The bridge must be completed and ready for travel by Sept. 1, 1916.

Electric Short Line Railway, Minneapolis, Minn.—Tentative plans for the extension of this company's line from Hutchinson through Thorp and Clara City to Dawson, 75 miles, have been filed with the Secretary of State.

***Schlater, Miss.**—It is reported that John H. Parson, president Southern Finance & Construction Company, Memphis, Tenn., contemplates the construction of an interurban railway to connect Schlater, Itta Bena, Greenwood and Black Hawk.

***Columbia, Mo.**—It is reported that interests connected with the Keokuk & Hamilton Power Company contemplate the construction of an electric railway from St. Louis to Kansas City via St. Charles, Montgomery City, Fulton, Columbia and Fayette, about 250 miles. The Union Trust Company of St. Louis may be able to give further information.

***Scotts Bluff, Neb.**—It is reported that Wilkinson & Vandees of Denver, who have bought the Cross & Roberts' Electric Light Company of Scotts Bluff, will build an electric railway from Scotts Bluff to Gering.

Trenton, Lakewood & Seacoast Railway, Trenton, N. J.—As soon as weather conditions permit, construction will be begun on the proposed extension along Ocean Avenue from Atlantic Avenue to the Manasquan Inlet, and it is expected that the line will be ready for traffic this summer. The road will be built under the charter granted the Point Pleasant Electric Light & Power Company, but the rolling stock and equipment of the company is to be controlled by the Trenton, Lakewood & Seacoast Railway, and the line will be operated in connection with this company's Lakewood-Point Pleasant system. An extension is being planned from Point Pleasant to Manasquan to connect with the Atlantic Coast Electric Railway. In connection with this branch the company is now considering plans for the construction of a drawbridge over the Manasquan River inlet. A survey is being made for an extension from Trenton to Lakewood. George O. Vanderbilt, Trenton, is interested. [Nov. 6, '15.]

International Railway, Buffalo, N. Y.—Plans are being made by this company for extending its line from the upper Grand Island Ferry on the Niagara River to the wharf of the Wickwire Steel Company, 1¼ miles. Application will be made to the Public Service Commission for the Second District of New York as soon as the company obtains the necessary right-of-way across private property along the river bank. The present Grand Island ferry line operates as a stub service from Riverside Park, charging a 5-cent fare for a distance of about a mile.

***Youngsville & Jamestown Trolley Company, Jamestown, N. Y.**—It is reported that this company will begin work in the spring on the construction of a line from Sugar Grove, Pa., to Jamestown, N. Y. Surveys have been made and much preliminary work done. Eventually the road may be extended from Jamestown to Erie. R. L. Davis is interested.

Long Island Railroad, New York, N. Y.—It is reported that this company contemplates bridge construction requiring about 1000 tons of steel.

Niagara River & Eastern Railway, Niagara Falls, N. Y.—A bill of incorporation has been granted by the railroad committee of the Dominion Parliament to the Ontario-Niagara Connecting Bridge Company, which has been incorporated to construct a general traffic bridge across the lower gorge in the vicinity of the Ontario Power Company's transmission cables. The new bridge will afford connections between American and Canadian electric lines, which is the primary object of its construction. It is reported the plant of the Niagara River & Eastern Railway, whose petition for a certificate of necessity to build a double-track trolley line from the Niagara River to Lockport is now before the Public Service Commission for the Second District of New York, proposes to use the structure to connect with Canadian traction lines and connecting at Lockport with the International Railway and the Lockport and Rochester electric lines. The incorporators of the Niagara Connecting Bridge Company are R. W. Wood, Toronto; Alexander Fraser, Niagara Falls, Ont., and George G. Shepard and Alexander J. Porter, Niagara Falls, N. Y. The company has already obtained a charter from Congress and from the New York State Legislature. [Nov. 13, '15.]

New York State Railways, Utica, N. Y.—The Public Service Commission for the Second District of New York has approved the plans of the New York State Railways for the new tracks made necessary in Whitesboro Street, Utica, and the village of Yorkville by the construction of the new canal bridge. The commission on March 1 approved the two franchises for the new single tracks which will be laid. The old tracks will be torn up. Both of the franchises are to be assigned, with the approval of the commission, to the Utica, Clinton & Binghamton Railway with the proviso that the franchises and the new lines will be included in the lease from the Utica, Clinton & Binghamton Railway to the Utica Belt Line Street Railway, one of the predecessors of the New York State Railways.

Cincinnati (Ohio) Traction Company.—It is reported that construction will be begun about April on this company's extension to Bond Hill.

Brantford (Ont.) Municipal Railway.—The bill which gives the city of Brantford the right to operate the Grand Valley Railway under the name of the Brantford Municipal Railway, has passed the railway committee of the Canadian House of Commons. The line extends from Brantford to Galt through Paris and Dumfries. At the instance of John Fisher, M.P., an amendment was made providing that the municipal corporation shall be subject to the same by-laws as applied to the Grand Valley Railway and that it shall be liable to the same rates and taxes as the Grand Valley Railway would if it continued to own and operate the road.

Toronto, Ont.—The engineers of the Provincial Hydro-Electric Commission have submitted plans and estimates to Sir Adam Beck covering seven radial railway lines in Western Ontario. Surveys and estimates of the cost of construction, operation and traffic data have been completed on the following lines, except in the case of the route through Hamilton, which is awaiting a decision as to the various routes through the city, under consideration: Toronto, Port Credit and Oakville to Hamilton, this line to connect at Port Credit with the Toronto-London line already approved by the voters of the municipalities interested; Hamilton, Grimsby and St. Catharines to Niagara Falls; St. Catharines, Welland and Port Colborne; Dunnville, Port Colborne, Fort Erie, Bridgeburg and Niagara Falls; Elmira, Waterloo, Berlin, Preston, Galt and Hamilton; Owen Sound, Chesley, Brussels, Seaforth, Woodham and Kirkton. This line will connect with that covering the St. Mary's, Stratford, Toronto line, and with the Toronto-London line at Granton. According to Sir Adam Beck the commission is prepared to recommend these projects to the municipalities, whether separately or as a system.

***Doylestown, Pa.**—Plans are being considered to construct a line from Doylestown to Boyertown via Perkasie, Trumbauersville and Pennsburg. It is reported the Perkasie Board of Trade has indorsed the project.

Northwestern Electric Service Company, Erie, Pa.—This company, which has taken over the Northwestern Pennsylvania Railway, will construct a 3½-mile extension to connect the present northern and middle divisions of the railway near Cambridge Springs, upon the completion of which, through service will be operated between Erie, Meadville and Linesville. Construction work will commence on April 1 and it is expected that it will be completed by Jan. 1.

***Monongahela, Pa.**—It is reported that negotiations have been completed by a number of Pittsburgh, New York and Washington capitalists, represented by Thomas A. Taylor of Pittsburgh, for the transfer of the property and rights-of-way of the abandoned Monongahela, Ellsworth & Washington Street Railway, which was formed to build a line from Monongahela to Washington. It is stated that construction will be begun at once, and as soon as wires are strung the line already completed will be placed in operation.

Houston, Richmond & Western Traction Company, Houston, Tex.—It is reported that a survey has been begun between Gonzales and San Antonio on this company's proposed line. At a recent meeting of the board of directors of the company, C. C. Godman, Kansas City, was elected president, E. Kennedy, Houston, vice-president, and C. E. Hansen, San Antonio, treasurer. James Bailey Wells and W. L. Gardien, Gonzales, and C. E. Hansen of San Antonio were elected to the board of directors. [Feb. 12, '15.]

***Marlin, Tex.**—The construction of an interurban railway between Marlin and Waco, 35 miles, is being promoted by C. C. Moser, Dallas, and associates.

Seattle, Wash.—The Board of Public Works has awarded the contract for steel rails for the Ballard and Fremont bridges to the Seattle Frog & Switch Company, Seattle, on its bid of $7,075.64. The city of Seattle will lay and maintain double tracks on both bridges and will exact a rental from the Puget Sound Traction, Light & Power Company for the use of these structures.

SHOPS AND BUILDINGS

Kansas City, Kaw Valley & Western Railway, Bonner Springs, Kan.—This company reports that contracts will soon be let for the construction of new repair shops.

New York Municipal Railway Corporation, Brooklyn, N. Y.—Bids were opened by the Public Service Commission for the First District of New York on March 10 for station finish work on seven stations of the new Broadway subway, the lowest bidder being D. C. Serber, New York, at $344,716. The lowest bid for completing station finish on the Hunter's Point Avenue station on the Queensboro subway was submitted by the Degnon Contracting Company, New York, at $32,319.

Tidewater Power Company, Wilmington, N. C.—This company's carhouse and machine shops at Ninth and Orange Streets, Wilmington, containing two city cars, a suburban car and other valuable equipment, were destroyed by fire on March 1. The loss is estimated at $50,000.

Scioto Valley Traction Company, Columbus, Ohio.—It is reported that this company is considering the construction of a new interurban station at Columbus.

POWER HOUSES AND SUBSTATIONS

Algiers Railway & Lighting Company, New Orleans, La.—It is reported that this company is contemplating improvements to its power plant.

Kansas City, Kaw Valley & Western Railway, Bonner Springs, Kan.—A report from this company states that it will construct two new substations. The company will purchase two substation outfits complete.

Alabama Traction, Light & Power Company, Ltd., New York, N. Y.—Plans have been made by the Alabama Traction, Light & Power Company to make expenditures totaling more than $2,000,000 on the properties of the Alabama Power Company, its principal subsidiary, in order to meet the heavy demand for electric power in the Birmingham district. A fifth unit of 15,000 kw. will be added to the hydroelectric station at Lock 12 on the Coosa River, which now has 60,000-kw. capacity. A new steam generating station of 20,000-kw. capacity will be erected on the Black Warrior River in the center of the Alabama coal fields, giving the company 40,000 kw. of steam capacity, it already having 20,000 kw. at Gadsden. In addition to this the company will largely extend its system of transmission and distributing lines.

Goldsboro (N. C.) Electric Railway.—This company reports that during the next two weeks a contract will be placed for one 150-kw. motor generator set.

Mansfield Railway, Light & Power Company, Mansfield, Ohio.—This company is contemplating the purchase of a new 3000-kw. turbine with condenser and cooling tower and a 500-kw. 60-cycle rotary converter.

Choctaw Railway & Lighting Company, McAlester, Okla.—A court order has been issued authorizing the receiver of this company to issue receiver's certificates in the amount of $130,000 for improvements and extensions. Among other plans, it is proposed to extend the lines of the company to furnish power to mine operators and to purchase the power plant at Wilburton.

Manufactures and Supplies

ROLLING STOCK

New York Central Railroad, New York, N. Y., is asking for prices on equipment for new multiple-unit cars.

Freeport Railway & Light Company, Freeport, Ill., expects to purchase one single-truck closed motor car.

Frankford, Tacony & Holmesburg Street Railway, Tacony, Pa., has remodeled six short double-truck vestibule cars into folding-door, pay-within cars.

Indianapolis Traction & Terminal Company, Indianapolis, Ind., is contemplating the purchase of twenty-five inclosed city cars of the pay-within type. The cars will be substantially of the same design as now operated in Indianapolis, except that they will be of the prepayment type.

City Light & Traction Company, Sedalia, Mo., has ordered seven cars from the American Car Company. This order was published as a report in the March 4 issue, but the cars will be of the American Car Company's light weight type, and not the "Haller" type as previously reported.

Grand Rapids, Grand Haven & Muskegon Railway, Grand Rapids, Mich., has ordered three freight car bodies from the Niles Car & Manufacturing Company, eight trucks from the Baldwin Locomotive Works, ten No. 201-A railway motors from the General Electric Company and five P.C. control equipments.

Manhattan & Queens Traction Corporation, New York, N. Y., noted in the ELECTRIC RAILWAY JOURNAL of Feb. 12, as having ordered seven new prepayment center-entrance cars from the Cincinnati Car Company, has specified the following details for this equipment:

Seating capacity	54
Weight of car body	15,000 lb.
Bolster centers	2.2 ft.
Length of body (no vestibules)	43 ft. 6 in.
Width overall	8 ft. 11 in.
Height, rails to sills	26 in.
Body	All steel
Interior trim	Cherry
Headlining	None, carline finish
Roof	Arch
Underframe	Steel
Air brakes	West.
Control	West. K.
Curtain fixtures	Cur. Sup. Co.
Destination signs	Hunter
Door-operating device,	Nat'l Pneum. Co.'s, manually operated
Fare boxes	Johnson
Fenders	H. P.
Heaters	Consol.
Motors,	2 West. 337-C. (To be transferred from present cars)
Seats	20 slat cross-seats
Step treads	Feralun
Trolley retrievers	Earle
Trucks,	St. Louis 99-D (to be transferred from present cars)
Ventilators,	Ry. Utility, Honeycomb

TRADE NOTES

Perry Ventilator Corporation, New Bedford, Mass., has received an order to equip with ventilators the 100 new cars which are now being built by the Cincinnati Car Company for the Pittsburgh (Pa.) Railways.

Edison Storage Battery Company, East Orange, N. J., has appointed George D. Smith, for the past two years supervisor of agencies for the General Vehicle Company, Inc., as special assistant to Harrison G. Thompson, vice-president and general sales manager of the Edison Company.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., held its sixth annual banquet under the auspices of the Westinghouse Club at the Fort Pitt Hotel. The principal speaker, William L. Saunders, vice-chairman of the Naval Consulting Board, and chairman of the board of directors of the Ingersoll-Rand Company, New York, gave an address on "Industrial Preparedness for Peace and War."

Capt. A. M. Wilson, formerly representative of the Galena-Signal Oil Company on the Pacific Coast with headquarters at Portland, Ore., has been appointed resident manager of the company at Indianapolis, Ind., as successor to L. J. Drake, Jr. As announced on page 482 of the March 4 issue of the ELECTRIC RAILWAY JOURNAL, Mr. Drake has been elected vice-president and director of the Galena-Signal Oil Company and will move to New York City.

Canton Culvert & Silo Company, Canton, Ohio, has received from the Court of Appeals of the District of Columbia exclusive right to use the word "No-Co-Ro" as a trademark in connection with the use of its sheet metal. This decision was the result of a suit between the Canton company and the Consolidated Car Heating Company, in which the

Canton company stated that it had used the term since February, 1909, as a trademark in connection with the sale of its sheet metal which it claimed was particularly adapted to the use of electrical resistances.

ADVERTISING LITERATURE

Sprague Electric Works of General Electric Company, New York, N. Y., have issued a catalog describing and listing their various types of electric fans.

Ohmer Fare Register Company, Dayton, Ohio, has issued a bulletin entitled "Human Nature Analyzed and Utilized," in regard to its fare register system.

National Tube Company, Pittsburgh, Pa., has issued sheet No. 1 which makes a notation of some corrections to be made in this company's Catalog J-1915.

Drew Electric & Manufacturing Company, Indianapolis, Ind., has issued a sheet on its motorman's safety mirror for reducing boarding and alighting accidents.

Union Switch & Signal Company, Swissvale, Pa., has issued a bulletin which outlines the facilities of its forging and casting department for making railroad and general forgings.

R. D. Nuttall Company, Pittsburgh, Pa., has issued a condensed reprint of the specification for heat-treated gears and pinions, as recommended by the American Electric Railway Engineering Association, 1915.

Westinghouse, Church, Kerr & Company, New York, N. Y., have issued a circular, "Testing the Aggregate," which shows the saving resulting from blending sand and stone screenings in concrete construction.

William Wharton, Jr., & Company, Easton, Pa., have issued bulletin No. 2 describing their specialties, including "W-J" switch stands, Wharton-O'Brien insulated switch rods, adjustable switch cranks and insulated gage rods.

Titanium Alloy Manufacturing Company, Niagara Falls, N. Y., has issued a bulletin which analyzes the composition and describes the application of its various types of titanium aluminum and other standard bronze castings. Magnified cross-section views of the alloys are reproduced. The bulletin contains additional information regarding its alloys and also other scientific data, besides that which was published in the company's last year's catalog.

Electric Service Supplies Company, Philadelphia, Pa., has issued a general catalog of the Garton-Daniels lighting arresters. The catalog is divided into four sections, so arranged as to make easy the selection of proper apparatus for any set of conditions. Part 1 contains descriptions and price lists of a.c. arresters up to 20,000 volts, d.c. arresters up to 2400 volts, arc circuit lightning arresters for both a.c. and d.c. circuits, panel-board arresters and lightning arrester cross-arm hangers. Part 2 covers choke coils and disconnecting switches. Part 3 explains the construction and operation of a.c. and d.c. arresters. Part 4 includes general rules for the installation of lightning arresters, grounding, distribution, inspection, and contains diagrams showing the proper method of installation.

Titanium Alloy Manufacturing Company, Niagara Falls, N. Y., has issued a 110-page book of high technical caliber on the subject of ferro carbon-titanium in steel-making. This begins with a brief description of the material, and a discussion regarding its use in general in connection with the manufacture of steel. Following this, more extended discussions are presented on the treatment of various forms of steel, such as steel castings, forging steel, structural steel, rails, sheet steel, wire and tubing. There is given, also, a study of the action of the alumina in steel and a brief treatise on the determination of alumina in steel. The book concludes with two chapters covering castings of bronze and titanium aluminum bronze. Throughout, the book is notable for its illustrations, among which are some remarkable microphotographs and sulphur prints of steel in various forms as well as a number of highly magnified cross-sections of galvanized and tinned material.

NEW PUBLICATIONS

Purchasing. By H. B. Twyford. D. Van Nostrand Company, New York, N. Y. 236 pages. Cloth, $3.

To electric railway purchasing agents who desire a comprehensive and critical discussion of the proper methods to be used in purchasing work, no publication known is as worthy of commendation as Mr. Twyford's book. Covering in nineteen pages the general theory and ethics of buying, the author then devotes all his attention to the practical side of the question—to an analysis of the purchasing organization and its functions, to a description of its work and the devices used therein, and to an illustration of general methods by the actual practices in certain specific and diversified lines. The practical side of the book is well indicated by the fact that it contains 112 charts, diagrams and forms aptly emphasizing the main points of the text. Electric railway purchasing agents will find information of particular interest in the special chapter about purchasing for railway construction and operation, based on the writer's experience with the Underground Electric Railways of London, England, and in a similar chapter describing the purchasing routine of the J. G. White Engineering Corporation. The book as a whole shows the results of the writer's personal experiences in the endeavor to secure economies through regulated and right buying, and as such is worthy of careful perusal.

Cost of Urban Transportation Service. By F. W. Doolittle, Director Bureau of Fare Research, American Electric Railway Association. Published by the Association, 8 West Fortieth Street, New York. 467 pages. Cloth, $3.50.

About a year and a half ago the Bureau of Fare Research began its work of investigating the many factors affecting the cost of passenger transportation service. Special studies of the bureau on particular points have been published from time to time in the technical and association press, but now all the investigations bearing on the cost of service have been assembled under the above-stated title. The book constitutes Volume II of the *Proceedings* of the American Associate, bound in the usual report form. A copy will be sent to each member company, but in view of the contents the book will also be sold separately to anyone interested in the economics of electric railway operation.

An extended reference to the invaluable character of this work is made in the editorial columns of this issue. The book is divided into five sections, Part I dealing with the costs occasioned in creating electric railways and with the costs of developing and operating them as going concerns. Part II is devoted to an analysis of the nature, tendency and measurement of costs, or according to the chapter divisions, the anatomy of the 5-cent fare, the tendency of operating costs, utility capital and its replacement, the actual returns secured in the traction business and units of comparison. Part III contains six chapters on the characteristics and measurements of service, most of which information was published last year in the Electric Railway Journal in Mr. Doolittle's series of articles on traffic survey work.

With Part IV the author turns from outlining general parts and principles to applying them to the concrete and specific problems of cost involved in the extension of the area served, in the extension of transfer privileges, in the compliance with service standards and in the study of rapid transit. In this section Mr. Doolittle also discusses at length the cost of competing forms of transportation and the effect of the rate of fare upon the riding habit.

Part V describes briefly the cost-of-service and value-of-service theories, and summarizes the considerations which have made cost of service a controlling factor in rate regulation. Mr. Doolittle mentions the relation between the cost-of-service theory and efficiency in management, and then shows the importance of this theory in two types of regulation—that by contract, as exemplified by the Cleveland Railway case, and that by continuous regulation, well illustrated by the case of The Milwaukee Electric Railway & Light Company.

ORGANIZATION OF EXPORT BUYERS

The Export Buyers' League is about to be formed by J. R. Pels of the Warner Sugar Refining Company, and F. M. Moore of Alexander & Baldwin, Ltd., representing Hawaiian Island sugar interests. It will be associated with the Purchasing Agents' Association of New York, which is a branch of the National Association of Purchasing Agents, of which E. G. Hendricks, New York, is secretary. The New York association holds meetings monthly. The next meeting is to be held on March 21, and will be addressed by several prominent speakers.