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The Annual Maintenance Issue

Every department of an electric railway company is intimately concerned with the way in which the maintenance work is conducted. Upon the engineering department devolves its direction and execution. The accounting department is anxious to obtain a proper distribution of the expenses; the claim agent is interested because of the close relation which exists between the care of the work performed in shops and the reliability of the equipment in service; finally the general manager considers the subject from all of these aspects as well as from that of their co-ordination in the operation of the road as a whole. Over the original design of its equipment the average electric railway has comparatively little control after the general type of its cars, motors, overhead equipment and power station apparatus has been selected, but the details of the maintenance work devolve practically in their entirety on the railway engineer. While he usually is not able to modify radically the original design of the apparatus he can often greatly improve and strengthen it as it passes through the repair shops. The result is that many of the important advances made in electric railway equipment have had their origin in the maintenance department.

The present issue is the third annual maintenance number of this paper. Each of these issues has been published during the first week in April, because the work of preparing for next winter must be done during the coming summer months. Outside maintenance must be carried on, the closed cars must be put into condition and plans must be completed for the new equipment required. To some companies it may seem premature to order now cars and other equipment which will not be used until next autumn but it is by no means too early. There is no economy in waiting until a short time before apparatus is actually needed and then placing a rush order. Such a plan, of necessity, must mean less satisfactory work and prices and probably less satisfactory deliveries.

Railway Motor Maintenance a Perpetual Problem

Observation of the causes of car equipment breakdowns in service emphasizes the fact that no matter how far designers of railway motors may travel in the search for reliability, constant vigilance on the part of operating companies will ever be necessary to obtain the best results in car mileage per failure. The secret of success, of course, is to determine the cause of the trouble, but for each fault there is usually a large number of possible causes, occurring over a wide area and at irregular periods. To assist in the diagnosis, it is interesting to find that most companies now expect the car crew, or the motorman, to report motor troubles with considerable thoroughness and to indicate, if possible, the cause. As the motorman is the only source of primary information regarding service troubles in the equipment, it will be wise to encourage him to give as

full a report as possible rather than simply a fragmentary statement upon his return to the car house. Allowing for differences between men, there is opportunity in many instances for giving more facts than usually appear on reports of failures. If the trainmen are given to understand that all that the company desires is to learn the utmost about each failure with the object of preventing similar occurrences in the future, and if the car house supervisor or starter, or even the car house repair foreman, is authorized to ask questions in some detail as to the performance of the equipment when the motorman comes in there is no doubt that light would be shed upon many defects. Under the ordinary system of requiring the motorman to make a report of only a line or two when an equipment failure occurs, the company may lose valuable information. The preparation of certain stereotyped questions for use at car houses in the discretion of the foreman or starter might help, and while such lists of questions would lack flexibility, they could be used effectively to stimulate the memories of the men. Thus, if an armature flashes over, it is desirable to know if possible what was the position of the controller handle at the time, where the car was running and about the speed, whether the main fuse blew, what was the immediate appearance of the commutator and brushes if examined, and other like points which a car house examination cannot disclose, but which bear directly upon the difficulty. Continued reports of flashing on a certain line might show, for example, that the trouble occurred whenever the car passed from one feeder section into another, and the trouble, if traced, might be charged to too high voltage on crossing the gap. The nearer the mechanical department can come to surveying the whole field of motor performance, the more certain will be the reduction of failures, with their indirect cost in traffic delays and their direct charge upon revenue.

Home Repairing by the Small Company

One of the hardest problems before the manager of the small railway property is to convince his board of directors that a well-equipped shop is a necessity and not a luxury. The average director will admit without question the desirability of a few of the most commonly used machine tools, but when the subject of special tools comes up he is apt to take the narrow view that it does not pay to have devices which are required only occasionally. This idea is undoubtedly correct when applied to manufacturing. There it is often more economical to send out a greater part of the work. But a different rule must be followed in electric railway maintenance because so much repairing is of an emergency character in which the time element is most important. An inadequate shop outfit places the company at the mercy of the local carpenter and machine or blacksmith shops which are rarely equipped with tools exactly suitable for electric railway work and as many of the jobs turned over to them are wanted in a hurry, they feel more than justified in exacting exorbitant prices. In cases of this kind, the extra cost and loss of revenue through delays incident to outside repair work usually far exceed the fixed and running charges on a modest shop outfit. Even a 10-car system can afford to have such tools as a lathe, boring mill, wheel press and grinder, together with a smithy. An equipment of this character may be adapted readily for other purposes by the use of inexpensive attachments. Thus the lathe may be employed for commutator slotting, the boring mill for drilling and the wheel press for straightening axles and shafts. In recent years, also, a number of combination tools have been placed on the market expecially suitable for the road too small to use individual machines for any considerable part of the day. Some car-house space usually can be spared for placing the machines, while conveniences like an overhead runway for armatures, motor cases and other heavy parts can be built up from worn-out rails, obsolete railway motors and other old material which had been waiting for a good bargain with the junk man. An adequate shop equipment for the track, line and power departments is just as useful as in the maintenance of the rolling stock.

Premium and Piece-work Systems

No discussion on maintenance would be complete if it did not take into account the influence of labor charges on the total expenditures. The problem of getting the most labor for the minimum total outlay is always difficult because it involves a psychological factor, namely, the attitude of the workmen toward any scheme which seems to threaten the amount contained in their pay envelopes. In view of this fact, it may be of interest to point out that the large electric railway systems in New York have developed labor accelerating methods, which have proved successful from the standpoint of both the employer and employee. Thus, in the case of the Metropolitan Street Railway Company, whose shop practices are described in this number, the premium system was applied while converting 250 cars to the prepayment type. Instead of employing straight piece-work rates, the shop superintendent, assisted by the foreman of each department, fixed a minimum period in which a given job could be done by a good man under the old conditions, and then provided that the workman should share equally with the company the profit accruing from any saving in time. Thus, it was made clear to the men at the outset that they would not earn less but that they could earn more. The result was that, instead of spending $23,035.75 as estimated on the day-rate basis for the job under consideration, the cost on the premium basis was but $18,401.24. The saving to the company on this contract considered by itself was 20 per cent, but the actual gain was greater, because through a saving in time of 42 per cent, a large number of cars was available for the transportation service earlier than otherwise. As the men were working practically on their own time, it was necessary to examine only the quality of the finished job and not to keep watch over them continuously.

The method adopted last year by the Third Avenue Railroad Company for doing similar work was somewhat different but equally successful. Detailed piece-work prices were fixed on the assumption that the men would do from 25 per cent to 30 per cent more work on the new basis. A bonus was given for carrying out a series of operations, like the complete power wiring of a car in less than the usual period. The company found that the average increase in daily earnings per man under these conditions ranged from 25 cents to 50 cents. Both the Third Avenue Railroad Company and the Interborough Rapid Transit Company have gone into piece-work painting also. The latter company found that the adoption of this practice saved 25 per cent in labor cost, while it increased the earnings of the men some 20 per cent.

Of course, the full benefits of piece-work can only be obtained through the co-operation of the working force. It is not proper to assume that the mere existence of piece-work

in place of a former hourly-payment scheme will bring in the millenium of maximum output and maximum daily wages, while maintaining the highest quality of workmanship. The shop foreman who takes up piece-work must ordinarily do considerable missionary work before his department gets into line for efficient service under the new régime. The individual workman must be shown how to make the most of his time, and such matters as the location of tools within constant reach, plans for the machining of a second piece as soon as the first is out of the tool, reduction to the minimum of the number of hammer strokes in every similar operation, proper position for quickest adjustment of material, and anticipation of supplies needed for a given number of consecutive jobs, are all worth the personal attention of the head of the department. When a good man goes to the foreman and complains that he cannot earn as much under the piece-work plan as before, it will pay to spend a couple of hours with him if necessary in determining the cause. If others do not have that difficulty, it may be simply a little lost motion or the personal inefficiency of the man which interferes with his success. If the workman cannot rise to the situation after these points are brought to his attention, he must inevitably be superseded, since a fair piece-work scheme is based upon reasonable average times of performing given tasks instead of records in production. In the paint and motor repair shops enough operations are specialized duplications to make piece-work very attractive when carefully planned and administered.

Preservation of Ties

The steam and electric railways of the United States spent more than $60,000,000 for cross-ties in 1908, which was a year of strict economy in expenditures for maintenance and new construction. The normal demand each year for renewals alone is close to 120,000,000 ties, and the construction of new lines is constantly adding to the yearly consumption for renewals. Where is the future supply of cross-ties coming from and what will be their cost? In many parts of the country, the local supply has long since been exhausted and the user of ties there has to add to the purchase price of the tie at the place of cutting the cost of a long haul by land or water. Timber producers, guided by the advice of forestry experts, have made a start on the conservation of the remaining forests and the cultivation of timber on a large scale. In time, these steps may restore a closer balance between production and consumption, but it is equally important that every effort should be made to reduce the consumption of timber, especially such as results from decay or exposure, by the general use of preservative treatments. Electric railways which are to-day buying and installing untreated ties and poles will discover within a few years, when they have to make renewals, that the present-day prices of timber no longer prevail.

There can be no greater fallacy than that preservative treatment does not pay at the present prices of timber, and it is a significant fact that the use of treated timber is more general in the Southern States, where the supply is still comparatively plentiful and prices are low, than in the Northern States where most of the supply has been exhausted. One reason for this is, no doubt, that the atmospheric and soil conditions in the South are more conducive to rapid decay than in the North. On the other hand, the cost of timber is almost half. Preservative treatment is an investment whose profit is as capable of almost as exact a calculation as that of a bond.

A misconception exists in many quarters of the cost of applying preservative treatment. It may be done for as low as 10 cents per tie or as much as 40 cents per tie, depending on the quantity of the preservative used and the method of applying it. For street railway work, the less expensive methods usually are quite as efficient as the more costly. The difference in expense is largely dependent on the depth of penetration and the character of the preservative used. When a large part of the tie surface is exposed to rain and sun and the ties rest on a soil which holds the moisture, larger quantities of preservative and deeper penetration are required than when the ties are imbedded in concrete. The opinion is held among many engineers that a tie into which has been injected a moderate quantity of creosote or other antiseptic oil will last indefinitely, if completely imbedded in concrete.

Maintenance Records

It is very common and absolutely correct to speak of electric railroading at the present time as a science. The fixed rates of fare charged and the increasing costs of the labor and material required for operation have greatly reduced the margin of profit for most electric railway companies during the past few years, and, except in the case of a few favored properties, guess-work methods of operation can mean nothing now but bankruptcy. Every avenue by which the income of a property can be increased and by which its expenses can be decreased must be scientifically studied by the manager of to-day. But the etymological meaning of the word science is knowledge and a scientific study of electric railway operation presupposes possession of significant facts relating to operation, an analysis these facts and an ability through this analysis to reach ... t conclusions. The fundamental basis of scientific operation, therefore, is the records of results produced by different types of equipment and by various methods under given conditions. To provide a basis by which these results can be intelligently compared is the aim of the joint committee of the Accountants' and Engineering associations on shop accounts, an object, in our opinion, commensurate in importance with those of the other committees on standards of these two associations.

If maintenance records are carefully kept they have a cumulative value, but if carelessly compiled they are worse than useless because they are misleading either by reason of incompleteness or of actual clerical errors. Conclusions based upon any set of maintenance records should therefore include a knowledge of the manner in which these records were compiled. In many cases it would undoubtedly be the part of wisdom to have these detailed shop and maintenance records in charge of a clerk employed especially for that purpose. On a medium-sized road his time would be fully occupied, and on a smaller road other work could be found for him to do if he had the spare time. The expenditure for such clerical help in classifying and systemizing these records would usually not only more than counterbalance the cost, but would often be the means of preventing wasteful or inefficient practices. Of course, it is possible to introduce too much system in work of this kind, but there is greater danger on the side of inaccuracy. A few carefully prepared forms, either on cards or in bound books, whichever may be preferred, with the records kept constantly up to date, with appropriate summaries daily or for a not longer period than weekly, and with comparisons of payrolls, as well as the cost of materials, are usually all that are required.

The value of accurate and concise maintenance records in economical operation has been proved so often that no argument is needed in their favor. They have many times eliminated the use of expensive materials and have helped the movement toward standard apparatus and standard practice. If a company is testing different makes of apparatus, the results should include the records of each so that the most efficient may be adopted. Railway supply houses welcome the establishment of competitive trials of this kind as they assist the manufacturer in overcoming prejudices which sometimes exist in the minds of even the most progressive managers.

Another and most important use of maintenance records is that of perpetuating the experience of a company through several administrations. The successor of a master mechanic, power station or track engineer, or the head of any other department, is placed in immediate touch with the practice which preceded him if records of this kind have been maintained. Whatever the reason which actuates a company to establish maintenance records, the results will nearly always be found to be the greatest help in reducing operating expenses.

Light Cars

Perhaps in no department of railway work has there been such a radical change in opinion during the past two or three years as in the question of car weights. A few years ago the only popular conception of a light car was a single truck car. Now, engineers all over the country are endeavoring to see in what directions the weights of cars, particularly for city service, can be reduced. The subject has a very broad application because a reduction in the weight of cars is reflected in the cost of track maintenance and of power station operation, as well as in car maintenance itself.

The ideal car should be of the lightest weight consistent with sufficient strength and rigidity of all parts to withstand the stresses of operation without undue depreciation. It is apparent that a reduction of the weight of one part will reduce by so much the stresses on its co-related parts. Thus a lighter roof will permit the use of lighter side framing which, in turn, may be carried by a lighter underframe. The body with its weight thus reduced can be mounted safely on lighter trucks and, last but by no means least in importance, car motors of less capacity and weight will be required to propel the car at the same speed.

Any comparison of car weights must take into account local conditions. If one road has steep grades, frequent sharp curves and rough track and another road is favored with smooth, level tracks, manifestly then the same type and weight of cars will not be the best for both services, even though the same traffic is handled. Other things being equal, the road with the best track can operate the lightest cars. There has been a marked improvement in the general condition of electric railway tracks during the past few years but this improvement has not been accompanied, until very recently, by any material reduction in car weights which better track would warrant. On the contrary, the tendency in the past with most roads has been continuously to increase the weights of cars ordered. This condition has been due in many instances to the purchaser's desire to develop a type of equipment that would require less maintenance than the cars previously operated. As each lot of new cars has been bought the purchaser has arbitrarily increased the sizes of certain parts with an economical end in view but often without regard for the effect on the other component members of the car structure. In designing a car of minimum weight, each member must be proportioned to carry a definite load with an ample factor of safety but without the addition of any ineffective material, whose weight would unnecessarily stress other members. This analytical method of design requires a clear understanding of the principles of structural mechanics, but the results in the way of reducing operating expenses warrant a study of these principles by all progressive engineers who may be planning new cars.

Although the movement for lighter cars began to gain impetus long before last fall it was undoubtedly accelerated by the Denver convention where an excellent opportunity was afforded visiting railway officers to observe the service given with light cars by the Denver City Tramway Company. Car builders will testify that since the Denver convention many purchasers of cars have shown a keen desire to reduce the weight of new rolling stock and designers have attacked the problem with renewed vigor.

The new semi-convertible cars of the Boston & Northern and Old Colony Street Railway which are described elsewhere in this issue are typical examples of cars reduced in weight by eliminating every ounce of superfluous material. While retaining the same seating capacity and approximately the same general dimensions as in a previous standard design of car the total weight has been lowered from 48,700 lb. to 42,090 lb. or 165 lb. per seat. The data on weights of parts which are included in the description form a tabulation as unique as it is valuable. A study of these detail weights will show where further savings, if any, can be made in building future cars. That the effort spent in designing these light weight cars was not wasted is evident from the results of the power consumption tests made before the new cars were placed in service. A saving in power alone of 73 cents per car per day is well worth while when it can be made, as in this case, with no additional initial investment.

A good example of a road which has been operating light cars for some years is the inter-city system of the Cincinnati, Newport & Covington Light & Traction Company. The cost for maintenance and the average power demand under the operating conditions existing on this property both reflect the value of light equipments. The schedules require about 100 cars, each of which seats 32 passengers and weighs not more than 13 tons. Small cars with center aisles and cross seats are well suited for the short-haul traffic which is handled. Although the company has a trackage of 61 miles and loops many of its cars across the Ohio River and through the business district of Cincinnati, the average length of ride is short. Space within the car bodies is utilized fully with seats and not quite so much space per seat is provided as would be necessary if the length of the ride were longer.

The Covington cars weigh approximately 810 lb. per passenger seat. They operate over steep grades; on some lines the rise is fully 350 ft. During 1909 the cars on this road made a total of 4,100,000 miles and the cost for car maintenance was only about 2 miles per car-mile. An important feature in the economy of operation of the Covington system, due largely to the operation of light cars, is the low power demand. The total actual power delivered in 1909 to the railway feeders, which, of course, includes all tracks and line losses, averaged very close to 1.6 kw-hours per car-mile. For some months the consumption was as low as 1.5 kw-hours and under severe winter conditions as high as 1.8 kw-hours. Most of the cars are

equipped with two motors of an old type, the Westinghouse No. 39, rated at 35 hp. Out of the 179 cars operated with two motors each, but 12 armatures failed in 1907 and the cars were kept in good operating condition with only three men working in the repair pits and one man in the armature shop.

The examples cited above show some of the possibilities of the light car; they are not intended as arguments in favor of the use of cars of small size which may increase unduly the platform cost per passenger seat. All the factors of platform labor, power and repair costs are functions to be considered in designing rolling stock and the possibility of improving car construction so as further to reduce these costs is an incentive for future effort on the part of car designers and builders.

A Sane Public Utility Commission Law

The bill creating the New Jersey Public Utility Commission was signed by Governor Fort on March 24. It is an amendment of the railroad law enacted in 1907, and changes the Railroad Commission to a Board of Public Utility Commissioners with enlarged powers. The amended law extends the authority of the commission to all classes of public utilities and in that respect is broader than the legislation of the other leading States on this subject. This commission will take rank in importance with the commissions of Massachusetts, Wisconsin, New York and Vermont.

The powers of the New Jersey commission are not all-inclusive and the plain definition of the duties imposed by the Legislature will mean that the commission will devote its time and earnest attention more to the questions of service, in which the public is directly interested, than to practical corporate affairs and details of operation which concern the companies alone. In the railway law of 1907 provision was made for a court review in case of dissent from an opinion and this fair and just safeguard is, therefore, retained.

No drastic, thunderous phrases appear in the New Jersey law. It is stated that the commission shall have general supervision over all public utilities. It shall have power to require: First, compliance with the laws of the State and performance of the public duties imposed thereby upon public utilities; second, safe and adequate service; third, a uniform accounting system; fourth, discontinuance of rebates or other unjust, unfair and unreasonable discriminations. In addition to these broad powers, the commission shall pass upon all issues of securities in order to see that they conform to the laws of the State. These laws provide that stock shall be issued at not less than par and 5 per cent bonds at not less than 80. Bonds bearing less than 5 per cent interest, which has been issued under a trust deed executed prior to Aug. 14, 1906, may be issued at 70 until Feb. 13, 1911.

One of the most important sections of the New Jersey law is that which limits the amount of annual expenditure by the commission to $50,000. This means that the commission will have, above the salaries of its three members, $32,000, out of which the salary of the secretary, not to exceed $4,000 per annum, and other necessary expenses may be met. The Railroad Commission law of New Jersey, which was passed in 1907, allowed a total expense not to exceed $30,000 per annum. The constant observance of affairs in New York by the many residents of New Jersey whose business is on Manhattan Island makes it apparent that this feature of the law arises from a studied determination to prevent any such excessive burden for salaries and expenses as has been imposed by the Public Service Commission of the First District of New York upon the public that it was designed to serve. This commission expended for its general expenses, in the period from July 1, 1907, to Dec. 31, 1908, $1,383,313. This is a tax upon the public which no ends accomplished by the commission can justify.

It will be observed that the New Jersey law does not confer any direct power upon the commission to make rates. It is in this respect that the act differs most conspicuously from the regulative measures passed by other States which have recently enacted reformative laws on this subject. The New Jersey board, however, may hear and examine complaints concerning rates and may make recommendations thereon. That is to say, the commission has power publicly to air grievances and when convinced, after investigation, that rates should be changed, it can recommend an increase or reduction.

In comparison with the recommendatory action conferred by the New Jersey law respecting rates, the measures of the other States are drastic. The most severe, of course, both in design and in possibility of execution is that of New York. It is a fact of importance, however, and astounding to the public, that comparatively few reductions have been ordered by the New York commissions, even after the searching analysis and investigation which the law and a wide-open treasury for expenses permit. It is of equal importance to state that in both Wisconsin and Massachusetts, where supervision over rates exists, a number of advances have been permitted because of the manifest inability of companies to maintain their properties and earn a fair return on the reasonable investment therein at the rates with which they started operation. Such advances help to relieve the companies affected, to conserve their investments and to maintain the service they render to the public. But so long as the rate-making power is conferred by statute, the danger exists that commissioners will be appointed who will use the great authority of their office to enforce unwarrantably low rates, to the ultimate detriment of both the property and the service.

Many people whose opinions are entitled to respect will criticize the law on the ground that it does not confer upon the commission the rate-making power. These critics believe that any public utility law which does not give the commission mandatory power over rates is foredoomed to failure. With these views we are not in sympathy. We believe that much depends upon the personnel of the commissioners. Regardless of the details of the law under which it acts, a commission composed of men of courage and common sense, having at heart the interests of the whole public—both the corporations and their patrons—can do much to promote, among all parties concerned, that fair dealing and spirit of amity which will result in good service. To accomplish this in a constructive way is, in our opinion, one of the chief functions of any public utility commission.

The complete law under which the New Jersey commission will act is a sane measure. The exclusion of rate-making power from the law is, in reality, a statesmanlike recognition of the fact that the public is more interested in securing adequate service than in unreasonably low rates. The law is a consistent expression of the principle that it is not the true mission of the State to adopt and hold an attitude of paternalism toward public utility corporations. If a regulative policy is the will of the public, the State should not go further than to supervise so as to prevent financial excesses, undue discrimination and poor service.

DEPARTMENT OF ROLLING STOCK AND SHOPS OF THE METROPOLITAN STREET RAILWAY, NEW YORK

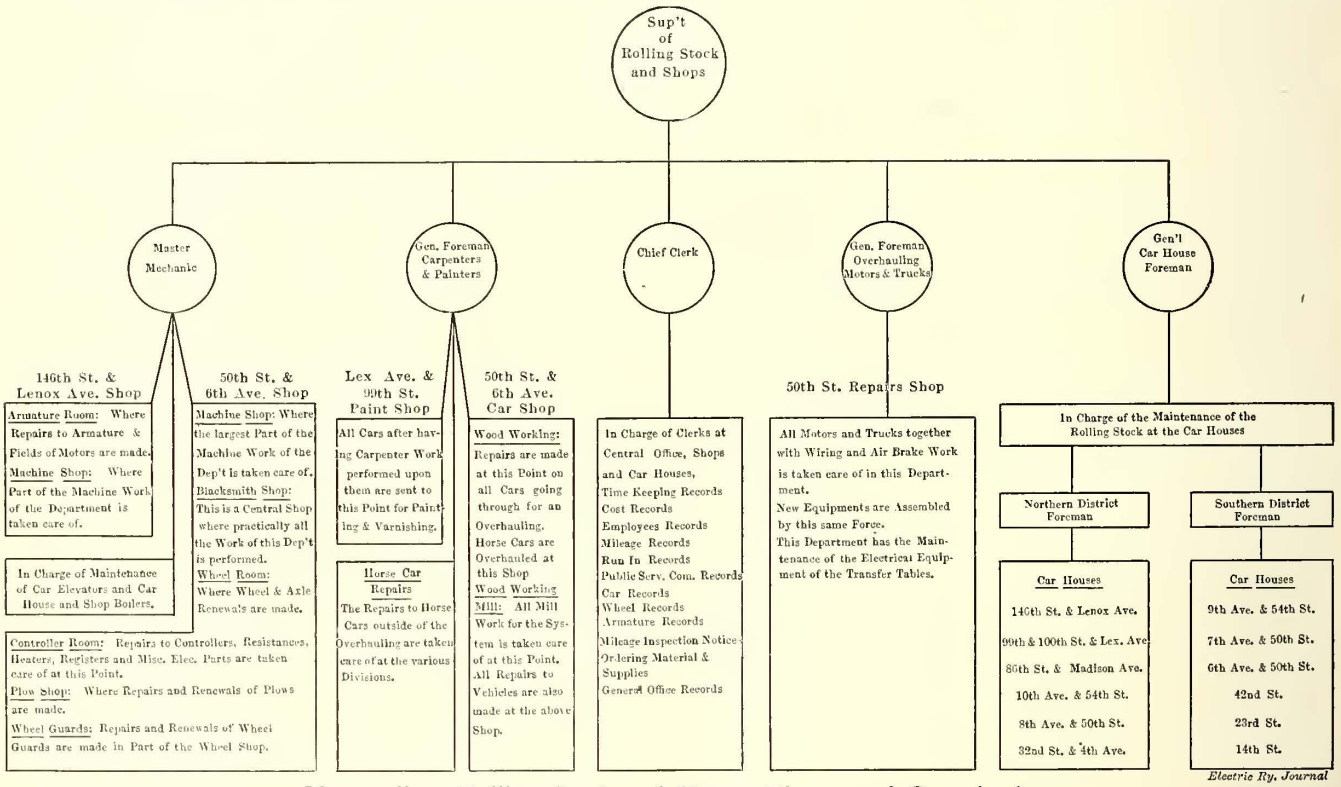
Important Improvements which Have Been Made Since the Appointment of Receivers

AN article last week described the important changes which have occurred during the past 2½ years in the surface railway system of New York as they have been affected by the rehabilitation and reorganization of the Metropolitan Street Railway System. The task set for the receivers on taking possession of the property was a gigantic one, as the Metropolitan system, when it went into the hands of receivers, was the largest, measured in gross receipts, of any in the country. The only possible way of attaining success and a high degree of efficiency and economy was first to determine what was to constitute the Metropolitan Street Railway System of the future, and coincidently to make a scientific study of each department so as to introduce all the improvements which the latest developments in the art permitted. In following out this policy the receivers were actuated by the belief that by this course only could the real earning power of the property be demonstrated. If the system was capable under more favorable operating conditions of making a better showing than when it was obliged to default on its fixed charges, the interests of stockholders, bondholders and creditors lay in the development of that fact. This plan having been decided upon, and having received the sanction of the court which was directing the affairs of the company, an active but conservative campaign of improvement was inaugurated.

The first step was to obtain technical information of the practice and the performance of apparatus in other cities. The adoption, or adaptation, of these methods when suitable to the conditions in New York was then taken up and an effort was made to give each problem such treatment that the decisions reached would apply, not only to present needs, but to future requirements. Naturally one of the most important departments to which this plan of systematic selection was applied was that of rolling stock and shops, and it is the intention in this article to outline the principal steps taken in reorganizing this department.

CHIEF OBJECTS SOUGHT

The chief purposes of the management in following out the policy just outlined was to secure general economy and efficiency, but the correlative advantage of reliability is greater in New York, perhaps, than in any other city. The reason for this is the great cost of real estate, which means high fixed charges per car for car storage and increases the desirability of reducing the number of cars required to supply a given service. The congested nature of the streets and the importance of developing the short haul traffic, which can be attracted in New York by continuous and regular service, also make it very important to reduce the number of breakdowns on the street. Hence reliability of operation was the chief object sought in the work of rehabilitating the car equipment of the Metropolitan Street Railway Company, but, as will be shown in this article, economy and general efficiency were also secured.



Metropolitan Rolling Stock and Shops—Diagram of Organization

ORGANIZATION

At the time of the appointment of the receivers on Sept. 24, 1907, the department now known as the rolling stock and shops department was divided into three separate departments. One was in charge of the general master mechanic, who had charge of the woodworking and painting repairs to all cars and vehicles, as well as the operation of the plow shop and the general machine shop. The second department was under the jurisdiction of the master mechanic in charge of shops. This department took care of the armature, field, controller and miscellaneous electric repairs, together with such machine shop work as was incident to this work. The third department was in charge of the superintendent of equipment, who supervised the regular maintenance of the cars at the car houses, including such truck

and electrical repairs as might be made at such points.

A reorganization was gradually effected and a superintendent of rolling stock and shops was placed at the head of the department, the reorganization of which, as it now exists, is shown in the accompanying chart.

The change in the organization of the rolling stock and shops department as outlined above would in itself have tended eventually to improve the condition of the maintenance of the equipment of the system, as, with all the departments concentrated under one head, very much better results can be attained than where there are two or three subdivisions. The greatest factor, however, of improvement in the maintenance of the rolling stock was due to the rehabilitation of the car bodies, trucks and electrical equipment. This took place principally during 1908, and followed lines which will be described later in this article.

IMPROVEMENT IN EMPLOYEES

Early in the work of rehabilitation a number of the car houses were rebuilt, and the improved facilities thereby provided, not only added greatly to the character of the maintenance carried on at the car houses and shops, but the bettered surroundings enabled the management to obtain a superior class of workmen in both car houses and shop departments than would otherwise have been the case. This was particularly desirable, as during the period of prosperity terminating in the fall of 1907, it had been exceedingly difficult to obtain proper workmen. Consequently a large foreign element had gradually worked into the car houses and shops, principally the former. Many of these men were not able to speak the English language, and it was hard to obtain the proper character of work from them. During 1908-1909 especial effort was made to eliminate these men. This has now been accomplished, with the result that the company is obtaining more intelligent and better results in car maintenance.

INSPECTION OF EQUIPMENT

Improved methods have also been put into force in connection with this class of work. The principal one perhaps was the establishment of the mileage system of inspection of equipment. Formerly cars were inspected once a week, irrespective of the amount of service that each had performed during that period. But the transfer of the individual car mileage records from the office of the supervisor of division office organization to the office of the superintendent of rolling stock and shops made it possible on Feb. 15, 1909, to inaugurate a system of inspection upon a mileage basis.

The number of miles made between inspections varies somewhat, according to the type of electrical equipment. Motors of the older types are inspected upon a basis of 700 miles, with an allowance of 100 miles more or less. Equipments of the more modern types are inspected upon an 800-mile basis, also with the same allowance. Two additional clerks were placed in this office for this work, and it was found possible after the mileage inspection had been in force for several weeks to make a reduction of 22 men in the various car houses. These men were all engaged on the inspection of cars, and the saving effected amounted to about $12,000 per year.

The inspection is carried on by what is termed the inspection force, under an inspector who acts as an assistant car house foreman, and is held personally responsible for the work under his supervision. Each member of the inspection force is assigned to the inspection of certain parts of the car bodies, trucks or electrical equipments. The practical result of these systematic examinations is that a large number of defects are discovered and troubles are corrected before they become serious. Very valuable assistance in this work has been afforded by a test car which was placed in service during the early part of 1909.

The benefits derived from this plan are strikingly illustrated in Table I, which is a record of the number of run-ins during 1908 and 1909. As will be seen, the percentage reduction in

TABLE II.—STORAGE CAPACITY OF CAR HOUSES, MEASURED IN SINGLE TRUCK CARS, 32 FT. 6 IN. OVER ALL

Location of car houses.	Lin. ft. of tracks.	Ground floor.	Second floor.	Total.
(b) 14th St. and Ave. B	2642	77	...	...
	*259	..	...	..
	1507	..	46	123
23d St. and 11th Ave	3092	92	...	92
(a) 24th St. and 11th Ave	1618	44	...	44
32d St. and 4th Ave	5551	165	...	..
	*968	31	...	196
42d St. and 12th Ave	2781	92	...	92
50th St. and 8th Ave	2680	78	...	78
50th St. and 7th Ave	4649	123	...	123
50th St. and 6th Ave	3460	104 (c)	...	..
	*182	..	...	..
	3694	..	110	..
	2045	..	61 (d)	..
	*3810	..	109 (e)	384
54th St. and 9th Ave	4711	133	...	..
	4989	..	140	273
(b) 54th St. and 10th Ave	3034	97	...	..
	*528	13	...	110
(a) 85th St. and Madison Ave	2574	76	...	..
	*368	8	...	84
99th St. and Lexington Ave	2770	82	...	..
	2881	..	82	164
	*176	..	...	..
100th St. and Lexington Ave	2686	82	...	..
	2740	..	79	161
146th St. and Lenox Ave	8376	251	...	..
	8133	..	245	496

Note.—(a) Signifies a storage yard. (b) Signifies space rented. (c) Signifies 32 cars stored on repair tracks are included. (d) Third floor. (e) Fourth floor. (*) Signifies tracks not slotted.

TABLE I.—RUN-INS DURING 1908 AND 1909—METROPOLITAN STREET RAILWAY, INCLUDING CARS RENTED TO 59TH STREET LINE (C. P. N. & E. R. R. CO.).

	Chargeable to Car Houses									Not Chargeable to Car Houses									
Week ending 7 a. m.	Air brake.	Hand brake.	Car body.	Control.	Motor.	Plow.	Wheel.	Miscellaneous.	Total chargeable.	Accident.	Channel rail.	Derailment.	Collision.	Track obstruction.	Tight slot.	Switch.	Glass broken.	Total not chargeable.	Grand total.
Jan. 6, 1908, to June 29, 1908	327	7,168	5,884	3,197	4,800	6,578	1,267	2,195	31,416	193	266	44	933	283	150	..	1,279	3,148	34,564
July 6, 1908, to Dec. 28, 1908	98	2,757	4,409	980	1,625	1,635	404	699	12,607	104	1,588	250	623	143	9	1	509	3,227	15,834
Total, 1908	425	9,925	10,293	4,177	6,425	8,213	1,671	2,894	44,023	297	1,854	294	1,556	426	159	1	1,788	6,375	50,398
Jan. 4, 1909, to June 28, 1909	108	1,838	2,707	532	747	1,393	351	445	8,121	122	1,140	139	659	175	37	54	498	2,824	10,945
July 5, 1909, to Dec. 27, 1909	95	1,014	1,771	383	732	1,159	158	463	5,775	78	627	105	503	251	..	133	191	1,888	7,663
Total, 1909	203	2,852	4,478	915	1,479	2,552	509	908	13,896	200	1,767	244	1,162	426	37	187	689	4,712	18,608
Reduction, in per cent, 1909 over 1908	52	71	56	79	77	69	70	69	69	33	5	10	25	0	77	..	61	26	63

1909 over 1908 of run-ins chargeable to car houses varies between 52 per cent and 79 per cent.

The division of work adopted in repairs is that at the car houses regular renewals are made of such equipment as brake shoes, the wearing parts of brake riggings, carbon brushes, etc. Armatures and wheels are also replaced at the car houses.

Any small amount of carpenter work or painting made necessary by accidents is also taken care of there. In car houses where the work of this character is sufficient in amount to keep one or more carpenters or painters busy, such men remain at the car house. Otherwise it is thought better to send workmen of this kind from the main repair shop to do the work, rather than to send the car to the repair shop. Minor plow repairs and lubrication are also attended to at the car houses.

DAILY INSPECTION

In addition to the regular mileage inspection, cars are inspected at night when run off the road. The plows, plow leads and body terminals, plow fuses, springs, bolts attaching plow to plow yoke, and plow sleeve nuts are carefully examined, as well as the wearing plates. Brakes are examined to see that they are properly adjusted, and a general examination is given to all parts of the motor that might be liable to become loose during the day's run.

CAR CLEANING

Car cleaning is followed up as nearly as practicable along the following lines:

Cars coming in are stationed close to a given point in the car houses, where they are first thoroughly sprinkled and swept. As it is desirable to have this done before the other workers start on the cars, the sweepers report somewhat earlier than the rest of the car-cleaning force. The interior of the car is then wiped with cheese cloth and the dust removed from the ventilators, hand-strap rail and window ledges.

In polishing the glass, two men usually work together, one on the interior and one on the exterior of the car. This is done to facilitate the work, as the small marks on the glass can be detected more readily and cleaned. If the dust on the outside of the car body is not too heavy to be dry wiped without injuring the varnish, this is done by men who are detailed for the purpose. Special attention is given to keeping the incandescent lamps and shades bright and clean.

The washing of cars is done either during or after a rainstorm, long, soft-haired brushes and plenty of clear water being used for the purpose. The interior and exterior of the vestibules are washed at inspection periods, soap being used in connection with warm water. The cleaning of ventilators is taken care of at regular periods, when they are thoroughly washed, dryed and polished.

All dry wiping, scrubbing of vestibules and car washing is done at the car houses during the day time when possible.

LIST OF CAR HOUSES

Table II gives a list of the car houses of the company.

METHOD OF CHECKING RUN-INS

Run-ins are checked up by the general car house foreman, who obtains from the foreman of each car house a statement of the reason for each trouble occurring to cars under his authority. These run-ins are then tabulated weekly by car houses and causes and a report is prepared showing a comparison with the record for the previous week and for the corresponding week of the previous year.

REPAIR SHOP MAINTENANCE

Regular maintenance work at the repair shops has also been placed on a systematic basis by the adoption of a schedule requiring that a certain number of each of the various types of cars shall be sent to the shop at the ends of definite periods varying between 12 and 18 months. At this time the car body is given a thorough overhauling, and is painted and varnished or touched up and varnished as may be necessary. At the same time the trucks and electrical equipment, as well as the air brakes if the car is so equipped, are also overhauled. This work, at present, is concentrated at two shops. The woodworking, truck and electrical equipment work is carried on at Fiftieth Street and Sixth Avenue. The cars are then shifted to Ninety-ninth Street and Lexington Avenue, where the painting and varnishing work is done on the second floor of these shops.

CONCENTRATION OF MAINTENANCE WORK

In regular maintenance one of the principal objects sought has been the concentration of the work, and where in the past it was customary for gear wheels to be changed at the car house or in the motor and truck repair shop, this work is now done in the wheel shop. This change has permitted the management to use a solid gear, instead of the split gear formerly employed. The solid gear has practically eliminated all trouble with loose gears, and gives much more satisfactory service.

Another part of the maintenance work which has been concentrated is that of changing bearings and pinions. It was formerly customary to do this at the car houses, with the result that good bearing and pinion fits were not always obtained. This work is now taken care of at the One Hundred and Forty-sixth Street armature room, and passes through the hands of one man, so that uniform results in bearing fits are assured. During the past winter, the repairs to electric heaters have been concentrated at the controller room at Fiftieth Street and Sixth Avenue, and results comparable in degree to those in the previous cases described have been obtained.

As far as possible, the blacksmith work has been concentrated at Fiftieth Street and Sixth Avenue. In the past it was customary to have a blacksmith and helper located at practically every car house on the system. With the rearrangement of the blacksmith shop at Fiftieth Street and Sixth Avenue, better facilities were installed.

CONDITION OF ELECTRICAL EQUIPMENT

In judging the condition of electrical equipment from the maintenance standpoint, one of the best criterions is the condition of the work going through the armature room, and in particular the number of armatures received at this point for all classes of repairs. The average number of armatures received per week for the year ending Dec. 31, 1909, was 65.03, or an average of 9.24 per day. This shows an exceedingly good condition of the electrical equipment, especially when, as in this case, these figures cover armatures sent in for mechanical as well as electrical repairs.

In fact the number quoted above also includes a large number of armatures sent in for the turning and slotting of the commutators, which is a wear and tear item and not what might be termed a breakdown repair. Expressed in another ratio, the average number of armatures sent to the armature room per day is less than one-quarter of one per cent of the total number of motors of the system.

EXTRAORDINARY MAINTENANCE

During the past two years the company has also carried out a large amount of extraordinary maintenance on its cars to adapt them to the standards now selected. A large part of this work was done during 1908, although some of it was started in the latter part of the year 1907. An account will now be given of this work.

OPEN-CAR REHABILITATION

The first cars that were rehabilitated systematically were the open cars. Two hundred of the double-truck cars were forwarded to the works of the John Stephenson Company, at Elizabeth, N. J., where the car bodies were overhauled and painted. The rest, consisting of 82 double-truck open cars, were rehabilitated in the company's own shop at Ninety-sixth Street and First Avenue. The trucks and electrical equipments of all of these open cars were overhauled at the shop at Ninety-sixth Street and First Avenue. In addition, 272 single-truck open cars were rehabilitated entirely by the department of rolling stock and shops. The bodies were repaired and painted and the trucks and electrical equipment thoroughly overhauled.

Work upon the open cars was not completed until some time during July, 1908.

CLOSED-CAR REHABILITATION

The work of rehabilitation of the closed-car equipment was started during the latter part of May, 1908, and to obtain additional facilities so that this work could be taken care of by the company's own employees, a shop was started at the Kingsbridge car house, and, after some time, all of the carpenter and painting work for the rehabilitation of the double-truck closed cars was concentrated at this point. The single-truck closed cars were rehabilitated at Fiftieth Street and Sixth Avenue.

After a few of the closed cars had been so renewed and painted yellow, the management decided to change the color from the then standard yellow to the present standard green, which is known as "Coach Painters' Green, Medium." The first car that was painted green was turned out of the shop on July 15, 1908, and as soon as possible thereafter all of the other cars were painted in the same manner.

The cost of this work, covering car body, truck and electrical equipment rehabilitation, averaged as follows:

Single-truck open cars	$298.00 per car
Double-truck open cars	504.01 per car
Single-truck closed cars	304.68 per car
Double-truck closed cars	551.00 per car

From July 1 to Dec. 7, 1908, 502 single-truck closed cars and 622 double-truck closed cars, or a total of 1124 closed cars, were rehabilitated.

The following statement shows the rate at which these cars were turned out according to months:

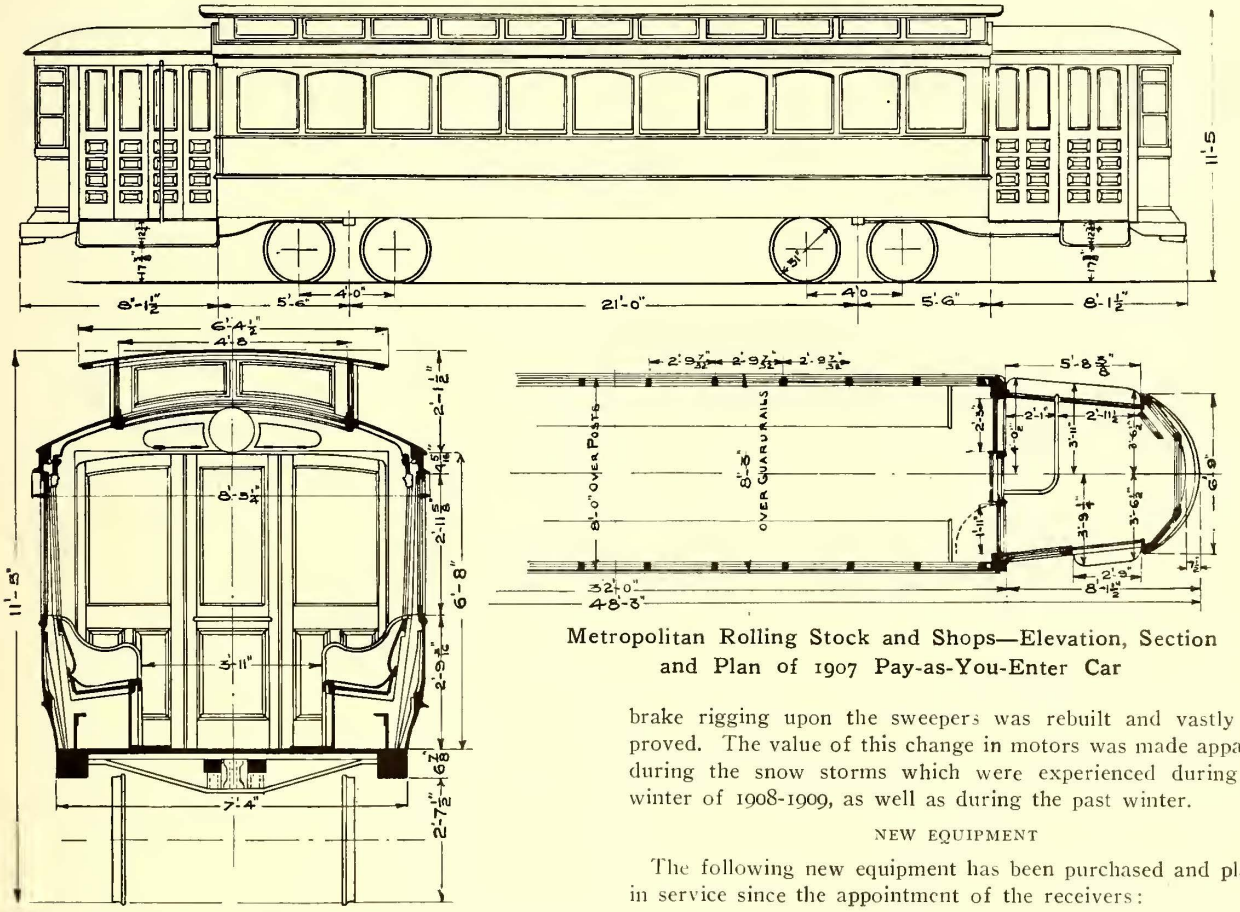
Month.	Single truck closed.	Double truck closed.	Total.
July	24	66	90
August	73	143	216
September	75	181	256
October	149	140	289
November	119	90	209
December	62	2	64
Totals	502	622	1,124

In rehabilitating the electrical equipment the cables were renewed in all of the double-truck closed cars and placed in cable boxes on the interior of the car. Wherever the cables came below the floor of the car they were placed in conduit, forming what is termed the "semi-conduit" system. The cable boxes were lined with ¼-in. asbestos lumber. The installation of this work was inspected and approved by the electrical branch of the local Board of Fire Underwriters.

The single-truck closed cars were equipped with the cables taken from the double-truck closed cars, but, previous to their installation, the cables were tested by the Bishop Gutta Percha Company, and any defective wire was removed. These wires were then made up into a cable by the Bishop company. Where the wires were exposed below the flooring on these cars, conduit was used for their protection.

SNOW-SWEEPER IMPROVEMENT

Previous to the winter of 1908 the 70 snow sweepers of the system were stripped of the GE-1000 motors used for driving the car and GE-57 motors were substituted. In addition the brake rigging upon the sweepers was rebuilt and vastly improved. The value of this change in motors was made apparent during the snow storms which were experienced during the winter of 1908-1909, as well as during the past winter.



Metropolitan Rolling Stock and Shops—Elevation, Section and Plan of 1907 Pay-as-You-Enter Car

NEW EQUIPMENT

The following new equipment has been purchased and placed in service since the appointment of the receivers:

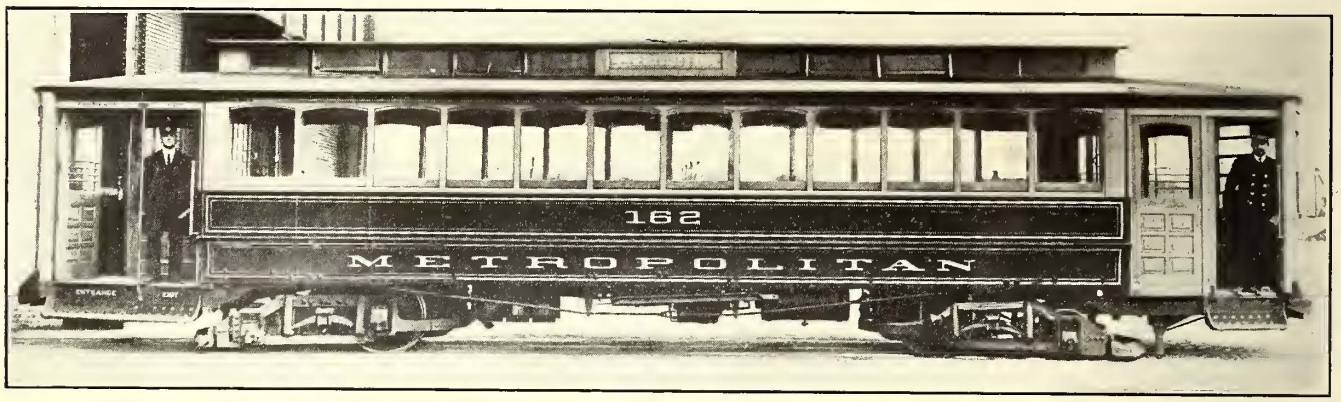
Passenger Cars.		
Pay-as-you-enter cars, 1907 type	155	
Standard closed cars	89	
Prepayment cars, 1908 type	126	
Total	370	
Under purchase:		
Standard cars	6	
Prepayment cars, 1908 type, semi-steel	2	
Grand total passenger cars		378
Service Cars.		
Snow sweepers	22	
Power slot scrapers	10	
Derrick or construction car	1	
Total		33
Grand total of all cars purchased or now being constructed		411

THE 1907 TYPE OF PAY-AS-YOU-ENTER CARS

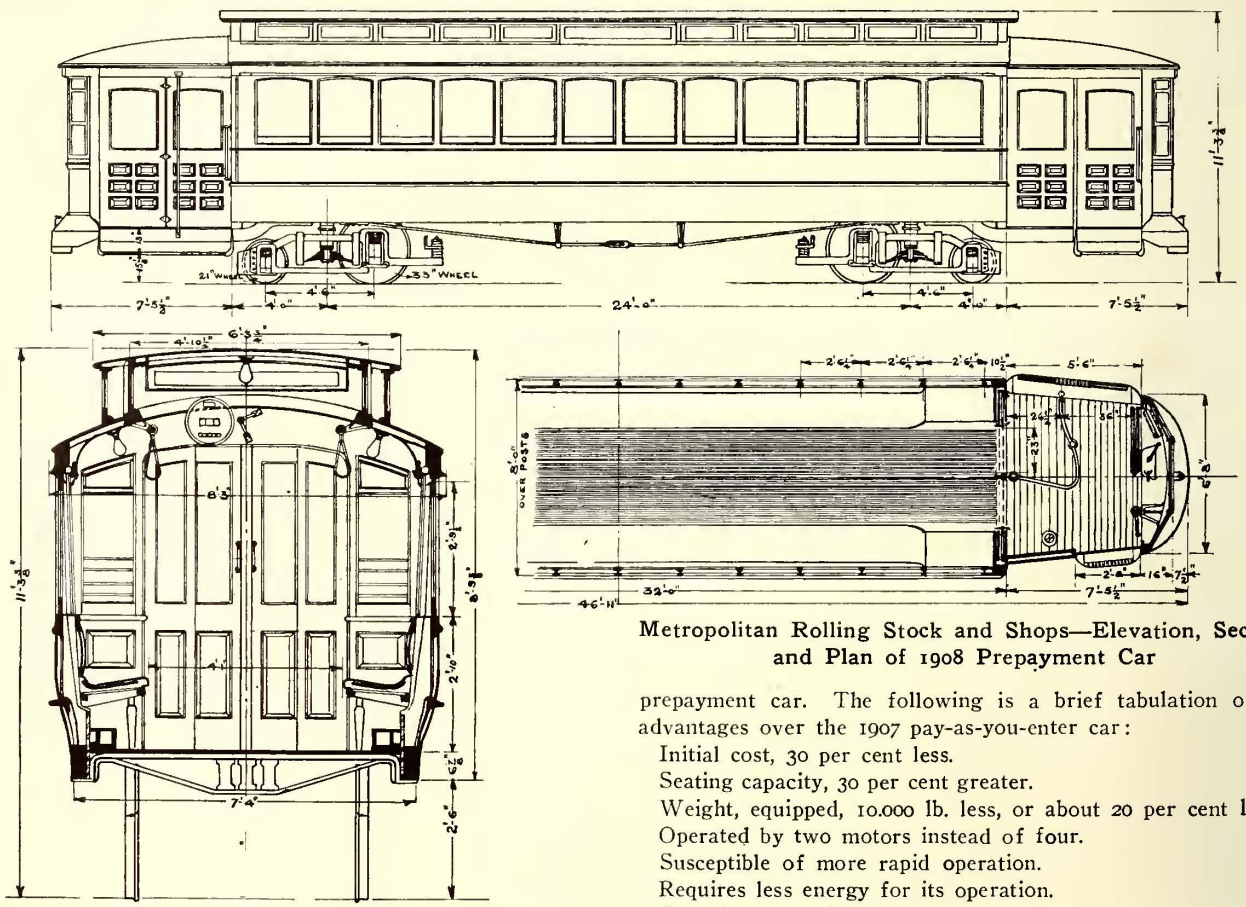
The Metropolitan Street Railway Company was one of the first in the country to adopt pay-as-you-enter cars, and in 1908 155 of this type of car were placed in service on the Madison and Fourth Avenue line. They were approximately 48 ft. over bumpers and had a body 32 ft. in length, whereas the previous standard car of the company had a 28-ft. body and was

37 ft. 2 in. over bumpers. These cars were equipped with four motors each.

The 1907 pay-as-you-enter cars met with instant success with the public, and clearly demonstrated the expediency of operating cars of this general nature under the conditions prevailing on Manhattan Island, as well as the wisdom of the management in adopting them. But, as frequently occurs in cases where so radical a departure is made from previous standards, the company found that for its conditions certain changes in design were desirable. Before adopting any standard, however, an extended study was made of types of cars used in different cities, as well as tests of all the different types used in New York, to determine the minimum average length of car stop, quickest practical rate of acceleration and average current consumption. It will not be necessary to review here the extent and scope of the study conducted in the endeavor to reach the solution of this question, as an account of the investigation was published on page 500 of the Electric Railway Journal for Dec. 5, 1908. As there stated, the conclusions reached were in favor of the light type of car described in that article. The extent of the investigation and the conclusions derived, including the estimate made of the cost of operation per annum per pound weight of car, attracted a great of attention at the time, as the study was probably the most exhaustive given to that subject before or since. Briefly, it showed that in New York the cost of transporting each additional pound in weight of a car cost 7 cents per year, of which 5 cents was for the additional power and 2 cents represented track maintenance. From these data the company ordered 126 of the modified type of car which its examination had indicated was the most desirable for New York conditions. This car became known as the 1908 prepayment car. The following is a brief tabulation of its advantages over the 1907 pay-as-you-enter car:



Metropolitan Rolling Stock and Shops—Side View of 1908 Prepayment Car



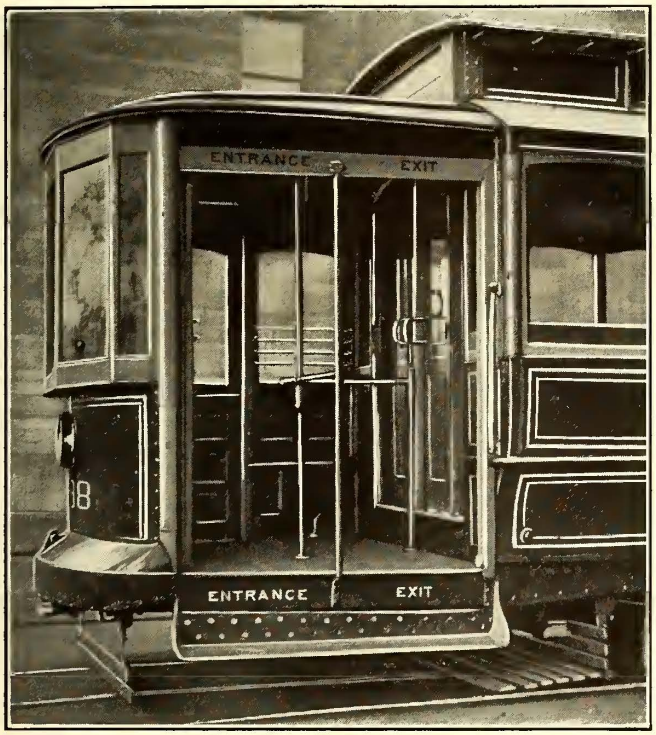
Metropolitan Rolling Stock and Shops—Elevation, Section and Plan of 1908 Prepayment Car

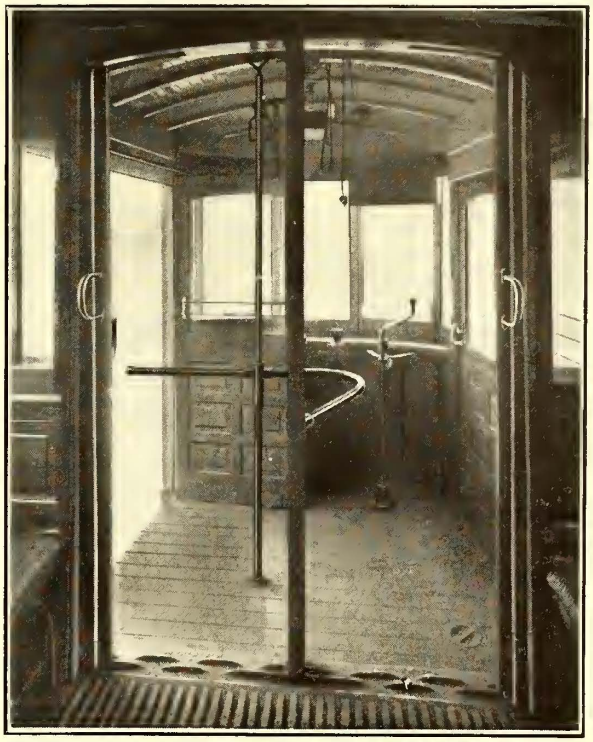
- Initial cost, 30 per cent less.
- Seating capacity, 30 per cent greater.
- Weight, equipped, 10.000 lb. less, or about 20 per cent less.
- Operated by two motors instead of four.
- Susceptible of more rapid operation.
- Requires less energy for its operation.
- Costs less to maintain.
- Materially saves the wear and tear on the track structure.

CAR MOTORS

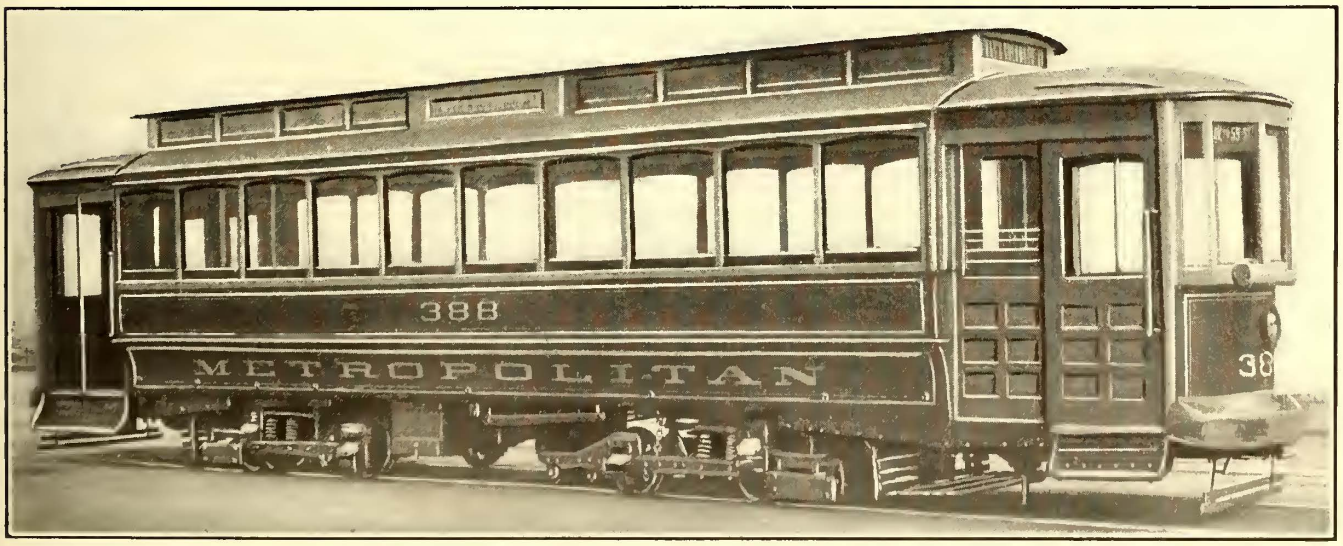
The improvements in car designs introduced in 1908 by the company were by no means confined to the design of the car body itself. The rolling stock was taken up as a whole, and one of the most important parts of the equipment was, of course, the motor. To reduce armature trouble due to water in the motor casings, an improved mummified wire-wound coil was developed with special reference to its moisture-resisting qualities and was adopted as standard. The subject of motor

design itself was then taken up with the manufacturers of electrical equipment and following along lines suggested by the company, each of the two largest manufacturers of motors developed a type of commutating-pole motor with a frame in one piece, making the casing practically water tight and eliminating the possibility of the lower half of the frame dropping on the pavement. These motors also have a high rate of acceleration. They have been adopted by the company as standard for its future car equipment, and are known to the trade under the names of GE-210 and Westinghouse No. 310.





Metropolitan Rolling Stock and Shops—Front and Rear Platform of Converted Car



Metropolitan Rolling Stock and Shops—Side View of Converted Car

These motors were installed on the 1908 prepayment cars mentioned above and also upon 80 of the standard closed cars, to which reference has been made.

TRUCKS

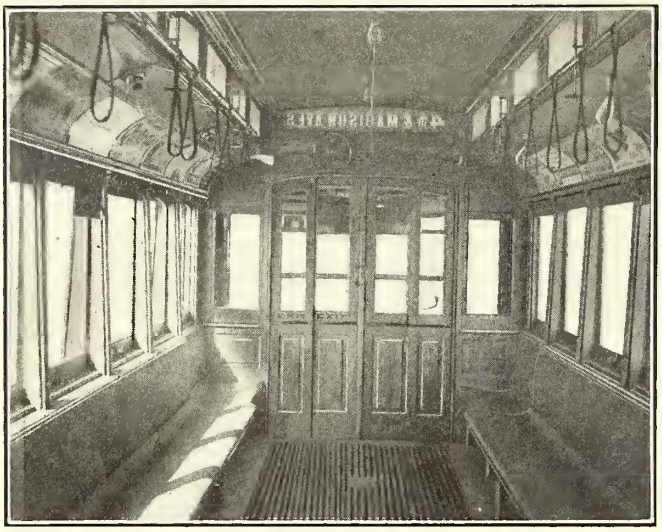
An interesting feature in connection with the trucks upon which the 1908 prepayment cars are mounted lies in the fact that the position of the pony wheels has been reversed—that is, the car is mounted on the trucks in such a manner that the pony wheels on the front truck precede the driving wheels and the pony wheels on the rear truck follow the driving wheels. By this means the overhang on the cars has been materially reduced and it has been possible to increase the truck centers from 21 ft., as in the case of the 1907 pay-as-you-enter car, to 24 ft. in the case of the 1908 prepayment car.

REBUILT CARS

The 1908 type of car proved so satisfactory that the company decided to change over a number of its old cars to prepayment cars. The first so altered were 13 cars, known as "combination" cars, owing to the fact that when they were originally purchased one end of the car was open and the other end closed. During 1907 these cars had been rebuilt so as to make them entirely closed, one end having a drop platform, while the other end had a platform level with the interior floor. It was these cars which the management decided to convert first into the "prepayment" type of car, and in December, 1908, work was started upon them in the shops. In addition to these 13 cars there was one car which had been partially rebuilt into a regular pay-as-you-enter car. The design was changed and the

car was completed according to the 1907 model. Later six standard double-truck closed cars were converted to the "prepayment" type. These cars were placed in service during the spring of 1909 on the Madison Avenue line. Later they were transferred to the 116th Street Crosstown line.

These cars demonstrated the practicability of converting the old cars to the prepayment type and early in the summer of 1909 the management decided to change over a lot of 250 of standard double-truck closed cars in the same way. The work of converting these cars was started in July, 1909, and they were completed by the end of December.



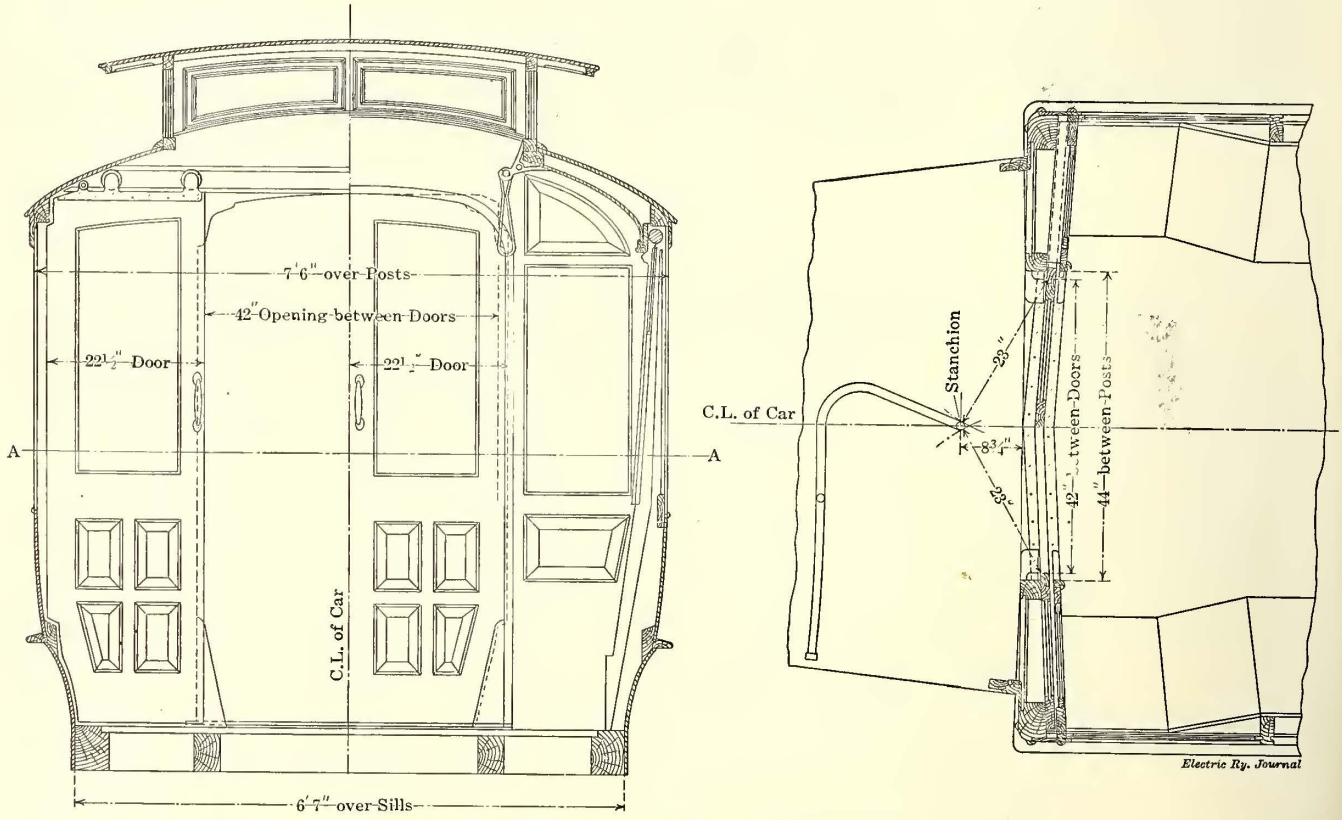
Metropolitan Rolling Stock and Shops—Double-Piece Door as Used in Converted Car and 1908 Prepayment Car

The cars so altered were some originally built by The J. G. Brill Company and were of the type of car which had been standard on the Metropolitan Street Railway, with only minor changes, from 1898 to 1906. The cars measured 6 ft. 7 in. in width over the sills, had a 28-ft. body and an over-all length of 37 ft. The cars with trucks and motors, but with hand brakes, weighed 27,040 lb.

DETAILS OF CONVERSION

Some particulars of the mechanical changes made in these cars to adapt them to prepayment operation may be interesting. The platforms were increased in length from 4 ft. 6 in. over bumpers to 6 ft. 6½ in. over bumpers, making the total length of the cars over bumpers 41 ft. 1 in. To extend the platforms, the platform center and side knees were spliced and reinforced with ⅜-in. steel plates, the hood was extended to accommodate the increased length of platform, and double folding doors were installed on the platform. To increase the seating capacity, which before the change was 36 persons, a seat for three persons was placed on one side of each platform and a folding corner seat for one passenger on the other side. As the cars are double ended and as these seats were lowered only on the front platform, the seating capacity was increased to 40 persons. The addition to the length of the platform required additional strength in the side trusses. In consequence, the side truss rod was lengthened and the truss was deepened 10 in. At the same time a truss was built under the end sills so as to take in the platform center knees.

The original cars, of course, were equipped with double sliding end doors with an opening, when open, 34 in. in width. This, of course, was too narrow for a car operated on the prepayment plan, and on the first lot of cars two-piece bulkhead doors were used in which one part slid over the other to provide an opening 47 in. in width. Toward the end of the work of converting these 250 cars, a new arrangement was developed whereby it was possible to use a single door on each side of the center line of the bulkhead instead of the two-piece door. This arrangement was installed upon the last car that was converted of the lot of 250 cars, and is working in a very satisfactory manner. The design, which has been patented by H. H. Adams, superintendent of rolling stock of the Metropolitan Street Railway Company, is illustrated in the accompanying engraving. It will be seen that additional space for the door runway is secured by placing the single-piece doors on a slight angle, so



Metropolitan Rolling Stock and Shops—Section and Plan Showing Arrangement of Bulkheads and Single-Piece Door in Latest Converted Cars

as to pass by the inside of the corner posts. This change has been found to reduce the cost of conversion so far as the end bulkhead work is concerned and insures a simpler operation of the doors.

COST OF CONVERSION

The cost of conversion, including the equipment of the cars by air brakes, was $276.28 per car for labor and $613.08 per car for material. The addition in weight to the car, including the weight of the air-brake equipment, was about 2000 lb. Against this there were four additional seats.

COMPARISON OF THE WEIGHTS OF THE THREE TYPES

All three cars are illustrated in the accompanying engravings. The following statement in regard to the weights may be interesting. These weights include motors, trucks and brakes.

1907 pay-as-you-enter car, scale weight, 47,800 lb. The electrical equipment consists of four GE-80 motors. The trucks are Brill 27-GE.

1908 prepayment car, scale weight, 38,000 lb. The electrical equipment of this car consists of two Westinghouse 310 interpole motors. The trucks are Brill 39-E.

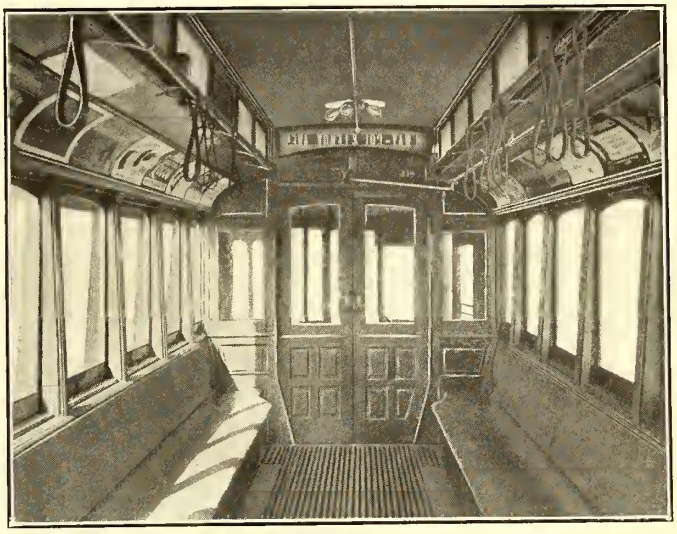
The converted prepayment car (converted in 1909), scale weight, 30,530 lb. The electrical equipment under this car consists of two GE-57 motors. The trucks are Brill maximum traction No. 22.

LINES OPERATED BY DIFFERENT TYPES OF CARS

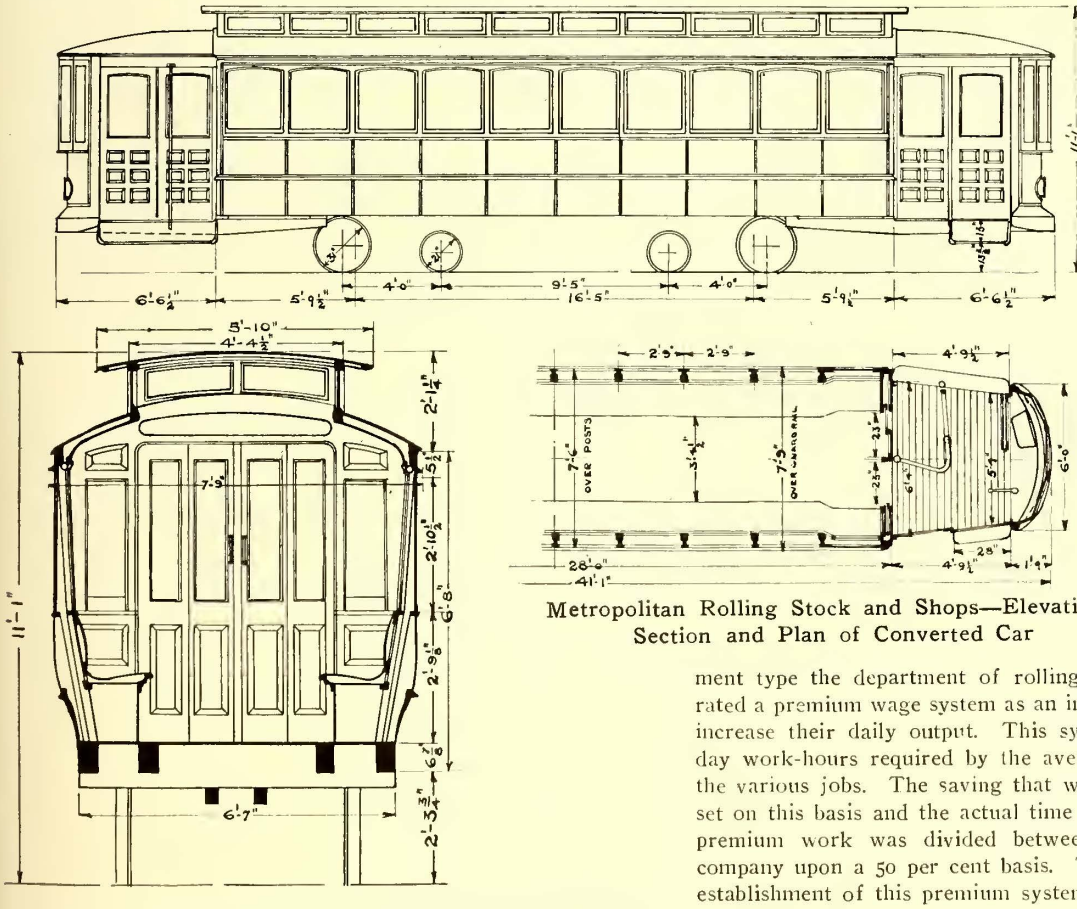
The following is a brief summary of the routes on which the different types of cars run. The Broadway & Amsterdam Avenue and the Broadway-Columbus-Lenox Avenue lines are operated by the 250 prepayment cars, which have been converted from standard box cars.

The Fourth & Madison Avenue line is served by 125 1908 prepayment cars and approximately 50 of the 1907 type of pay-as-you-enter cars. On the Eighth Avenue line approximately 100 of the 1907 type of pay-as-you-enter cars are operated. The 116th Street Crosstown line has 20 of the converted prepayment cars.

All of the work in connection with the conversion of the 250 standard cars was done by the company's employees in its own shops, with the exception that the rattan covering for the seats was installed under contract in the shops. The mill work was taken care of at Fiftieth Street and Sixth Avenue; 160 of the cars were completed at Fiftieth Street and Sixth Avenue and 90 at 146th Street and Lenox Avenue. The painting and varnishing work were done at the shops at Lexington Avenue and Ninety-ninth Street.



Metropolitan Rolling Stock and Shops—Single Piece Bulkhead Door



Metropolitan Rolling Stock and Shops—Elevation, Section and Plan of Converted Car

A vast amount of work passed through the carpenter shop mill in conjunction with this job. One item alone consisted of 4000 doors and partitions. The amount of work that could be gotten through the carpenter shop mill was the limiting feature to the rapidity with which the work could be completed.

PREMIUM WAGE SYSTEM

To move forward the conversion of the 250 cars to "prepayment type the department of rolling stock and shops inaugurated a premium wage system as an incentive to the workmen to increase their daily output. This system was based upon the day work-hours required by the average workmen to perform the various jobs. The saving that was made between the time set on this basis and the actual time taken by the workmen on premium work was divided between the workmen and the company upon a 50 per cent basis. The notice announcing the establishment of this premium system read as follows:

New York, Sept. 20, 1909.

The System As We Propose to Introduce It:

It is proposed to introduce the premium system in connection with the alteration of 250 standard cars to prepayment cars, and this statement is drawn to give the workmen a fair understanding of what is proposed.

The premium system is based upon the following conditions:

(1) The basis for the system will be the estimated time in hours required for an average workman to complete any particular job on what is known as regular work.

(2) The amount of the premium is determined by the saving in hours or fractions thereof that the workman makes from the time set for each job, and the amount of the premium will be half the time saved on each job at the rate of the particular workman.

EXAMPLE: A certain job is rated at 40 hours and is completed in say 30 hours; the workman will receive the 30 hours plus half of the 10 hours saved, or a total of 35 hours for the job. In other words, he receives 35 hours of pay at his rate for working 30 hours.

(3) Under the premium system, workmen will not make less than their regular rate of pay, and this system is introduced in order to enable the workman to increase his pay by putting extra effort on his work.

(4) The time allowed for any job will be fixed by the superintendent of rolling stock and shops, together with the foreman of a department, and will be as near as can be estimated the time which the average workman would take to complete the work. Should it be found that the hours set for a premium job are too low, it will be reconsidered before a similar job is again put in work.

(5) The time allowed will include all time necessary to procure tools, set up scaffolding, etc., but, of course, in the case of any extraordinary delay, the time so lost will be added to the time allowed. In the case of extraordinary delay, the foreman will decide the allowance in time to be made.

(6) All work will be checked and passed by the foreman or shop inspector before being accepted, and the workman will only be paid the premium after the work has been found satisfactory. In the case of dispute, the matter will be referred to the superintendent of rolling stock and shops, whose decision will be final as to the quality of workmanship.

(7) In the case of overtime, the premium will be calculated on the wages due for the actual time worked without taking into account the extra allowance of time for overtime on the day work basis.

(8) In the case of a job requiring more than one workman in a crew, the time set for the complete job will be figured on the basis of the number of men to the crew. The total time taken by the crew will be calculated for premium, which will be paid each workman in the crew in proportion to the hours he has worked on the job.

General Remarks:

The largest premiums will, we expect, be earned by those workmen who arrange their work systematically and who keep their tools in good order and make every move count.

In starting this premium system, it is the desire of the company to place this proposition before the workmen in the clearest possible manner, and any explanations or questions that may be asked by the workmen will be fully explained.

In introducing this system, the company does so in the hope that the workmen may make better wages by giving an increased effort to the company, and the company gains by having the work out of the shop sooner.

The standard of the workmanship must be the same as that at present in practice upon the day work system.

Typical copies of job orders follow. As will be seen they give the title and number of the jobs and a description of all of the work entailed by them.

Work on 250 Standard Cars Altered to Prepayment Cars.
Job No. 1601.
Putting in New End Bulkhead.
(This job does not include tearing out old bulkhead.)

The first operation is to square the end of the car. Next, shaping header, mortising header and gaining end sill. Installing the door and center posts, putting in sash rails, strainer rails and strainers, top sash rails and blocking. Installing head panel and corner post plates or irons. Putting in top and bottom panels and toe board. Installing end fenders, fender plates and concave corner irons. Finish fender irons to vestibule post line. Scrimp panels on inside. Install all bulkhead moldings and clean bulkhead for painting.

1 end of car..... 40 hours

Work on 250 Standard Cars Altered to Prepayment Cars.
Job No. 1602.
Putting in Vestibules.

Fit castings to corner posts. Install all vestibule door headers, square up posts and headers and screw posts to crownpiece and bonnet. Put in center dividing post to header and sub-platform knee. Fit vestibule at corner posts and top at bonnet and bottom at dashrail; attach canvas at top under bonnet, put wooden rim on dashrail; put corner irons at junction of corner posts and dashrail. Screw vestibule to posts and dashrail. Put in filling blocks and facia inside of vestibule. Sliding door track, blocking and door track at top. Fit facia panels on outside of vestibule. Face body corner posts on outside with ⅜-in. whitewood from sash rails to letter boards. Put in all glass in vestibule and all moldings. Put on vestibule post cappings. Clean up all joints and all around in and outside for painting.

1 end of car..... 55 hours

Work on 250 Standard Cars Altered to Prepayment Cars.
Job No. 1603.
Platform Flooring.

Level all platform beams and lay flooring. Screw flooring to platform beams and subknees. Cut floor at junction of door tracks and round edges at step entrances on both sides.

1 car—2 platforms per car..... 15 hours

SAVING BY THE PREMIUM SYSTEM

Four thousand seven hundred and ten jobs were performed upon the premium basis, with the following results:

Estimated time required to perform the work upon a day rate basis, 85,909½ hours, at a cost of	$23,035.75
Actual time required by the workmen upon premium basis, 50,020½ hours, at a cost of	18,401.24
Saving in time required upon the premium basis, 35,889 hours, 42 per cent; saving in the cost, 20 per cent	$4,634.51

The company has been as well satisfied with the moral effect of the establishment of the premium system as with its financial results. Its experience has been that where men are working upon a day-rate basis, it is necessary to watch them to see that they are giving an honest day's work, and also to watch the character of their work. On the premium basis it is not necessary to watch the workman, but, of course, attention has to be given to the character of his work.

DIRECTION

All of the work described in this article has been carried out under the general direction of Oren Root, manager for the receivers and under immediate supervision of H. H. Adams, superintendent of rolling stock and shops. During the earlier months of the receivership period, and before the reorganization of the rolling stock and shops department was accomplished, the electrical engineer, J. R. C. Armstrong, rendered service in a consulting capacity in connection with various improvements to which reference has been made above.

OTHER ARTICLES

In an early issue of the paper particulars will be given of improvements in minor equipment made in the departments of rolling stock and shops of the Metropolitan Street Railway Company.

RICHMOND BRAKE SHOE PRACTICE

The Virginia Railway & Power Company, Richmond, Va., has given considerable attention to the brake-shoe question within the last year or two, having eliminated the original seven or eight styles of shoes for replacement by one type, and it has also made its single-truck brake rigging interchangeable. The standard shoe, which is used on both single and double-truck cars, is the American Brake Shoe & Foundry Company's design M-1091, which is not exactly the same as the American Street & Interurban Railway Association standard, owing to the fact that the Richmond company started the standardization before the association's designs were promulgated. The company had on hand at the time hundreds of heads which it could not afford to throw away, and hence the shoe adopted is unique to Richmond. The shoe itself is of gray iron, but no attempt is made to get the lowest possible scrap value, owing to the fact that in Richmond there are grades as high as 12 per cent and 13 per cent. It has been found, however, that the shoes can be worn down to the back, if desirable. The brake shoes are examined carefully every night.

PAINTING PRACTICE IN CHARLESTON

The Charleston Consolidated Railway, Gas & Electric Company, Charleston, S. C., has recently decided to give up the use of the present straw body color in favor of the Sherwin-Williams traction green. This decision was reached on account of the difficulty which has been experienced in matching up the straw color. The management is a strong believer in the long schedule, allowing four weeks to be taken for painting a car from the wood up. When this work is done in connection with the general overhauling of a car, about six weeks elapse before the completion of the job, as the company does not employ a comparatively large shop force to hurry matters along. Trucks and car-bodies usually require considerable touching up every nine to 12 months owing to the salty atmosphere of Charleston.

Although the painting is done in the company's shops, the work itself is performed under contract with a boss painter. The latter hires his own help, but uses the material furnished or specified by the railway company. Every step of the work is checked by the master mechanic. Contracts are made for retouching, complete repainting and the handling of specified parts, as roof, floors, doors, trucks.

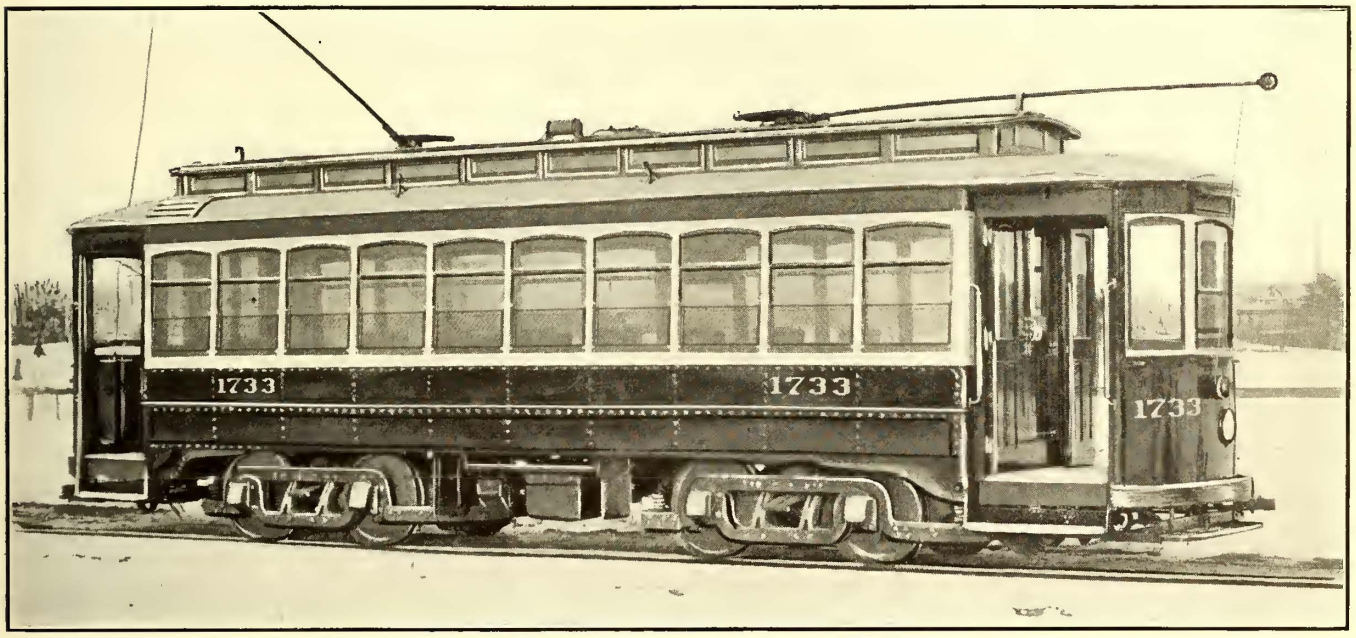
The average cost for painting a vestibuled doube-truck car with 30 ft. body and 37 ft. over-all is $62. This work includes burning off and removing all interior varnish and applying three coats of varnish to the exterior. A single-truck car with 20-ft. body and 28 ft. 7 in. over-all costs $46 under the same conditions, and a shorter single-truck car, 24 ft. over all, costs $40. One coat of varnish outside and inside costs $15 for a double-truck car and $10 for a single-truck car.

REDUCED WEIGHT SEMI-CONVERTIBLE CAR

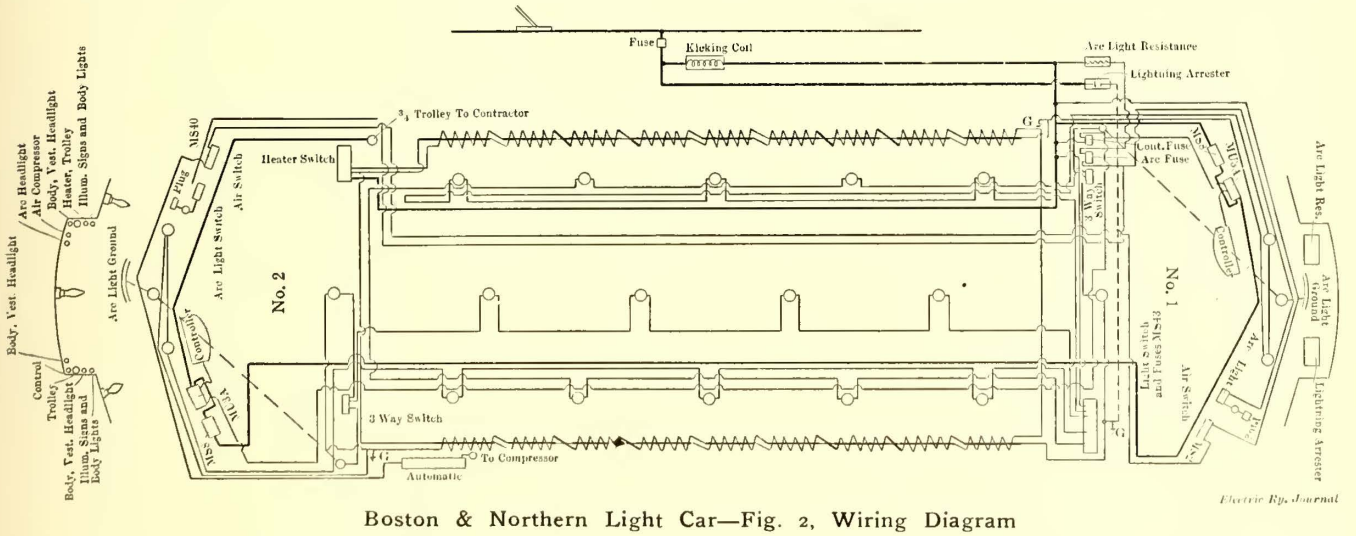
An Interesting New Design of Car Built for the Boston & Northern and the Old Colony Street Railways

ONE of the significant tendencies in the field of rolling stock design at present is the interest of operating companies in the reduction of car weights. In the campaign to accomplish a decrease in the cost of operation, car design has been one of the latest points of attack. The advantages of reduced weight need no demonstration, so long as the decrease is accompanied by no sacrifice of strength in working parts. Lessened cost of power, lower maintenance expense, more rapid acceleration and braking for the same expenditure and absorption of energy, decreased cost of replacing fittings in certain instances, and less wear of track and joints result from the operation of lighter cars.

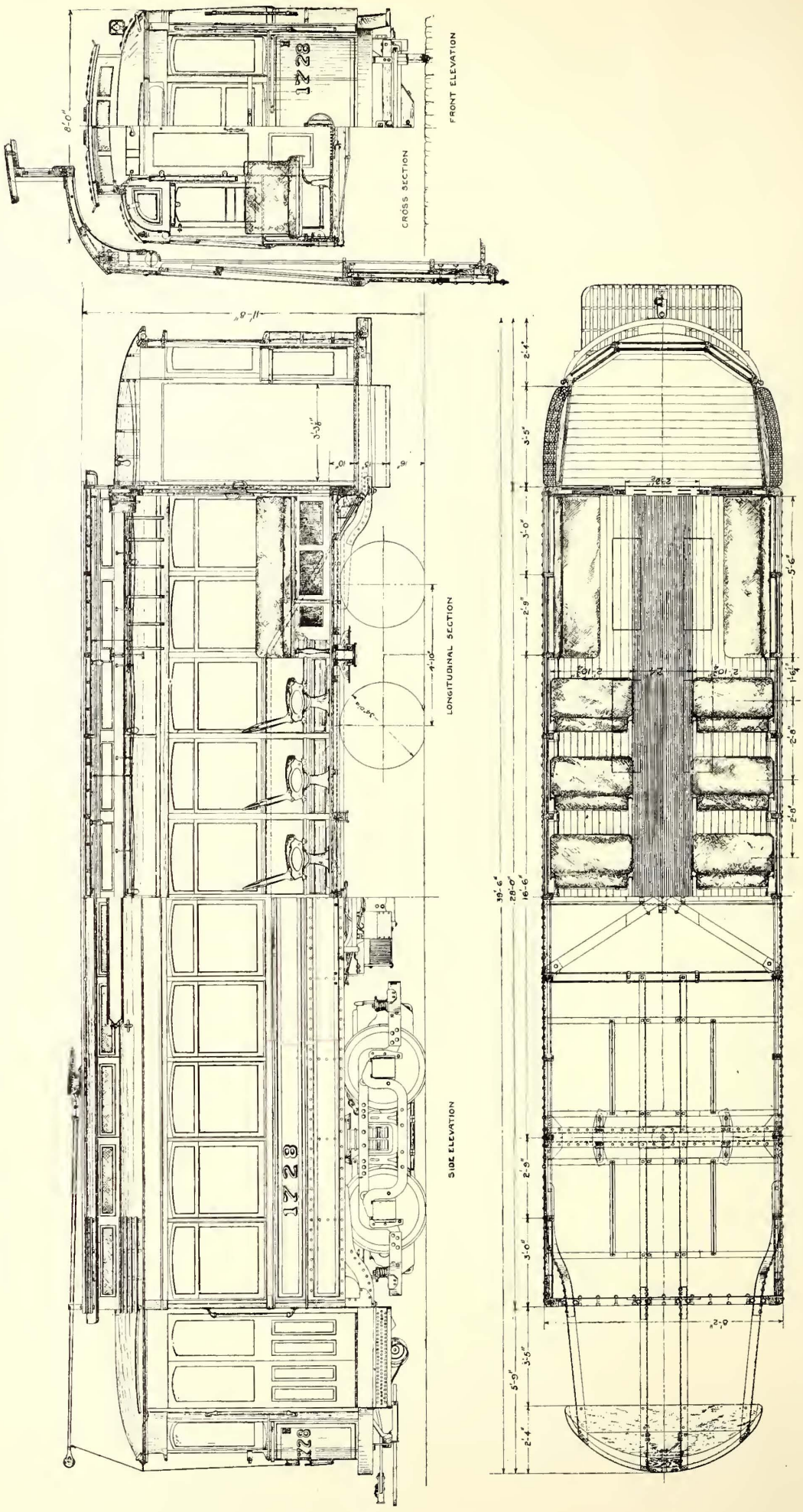
In appreciation of these points the Boston & Northern and the Old Colony Street Railway Companies have made a thorough study of car design in relation to weight during the past 18 months, and are now placing in service 44 new semi-convertibles of the so-called "1909" type which are 6,610 lb. lighter per car than the "1907" type of semi-convertible car used by the two systems. These cars were designed in detail by E. W. Holst, superintendent of equipment for the two roads, which are operated under the financial administration of the Massachusetts Electric Companies. In general the plan of design was to duplicate the seating capacity and more important dimensions of the 1907 cars so as to produce the same type of transportation unit, and at the same time, to cut down practically every ounce in weight which could be spared without sacrifice of necessary strength. Upon the completion of the design and award of the contract, a systematic inspection of the progress of the work in the shop was set in motion, including the careful weighing of every item under the control of the railway companies. These accumulated weights form one of the most complete analyses of car body and fitting equipment ever made in American street railway practice, and are printed herewith. Following the assembly of the new type of car, official weigher's records were taken of the complete rolling stock unit. Finally, to demonstrate the actual saving in power of the new car over the old type tests were made of the energy consumption of each type in successive commercial runs over rep-



Boston & Northern Light Car—Fig. 1, Exterior



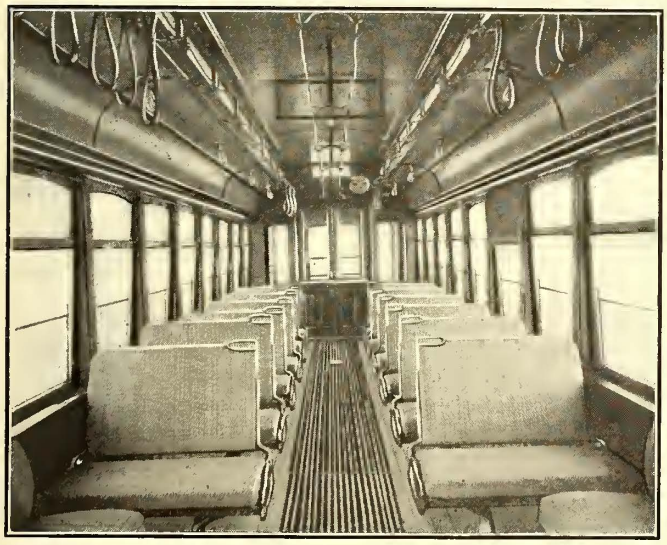
Boston & Northern Light Car—Fig. 2, Wiring Diagram



Boston & Northern Light Car—Fig. 3, Half Side and End Elevations, Cross Sections and Plan Above and Below Flooring

resentative urban and interurban routes, with meter checking before tests and the exchange of motormen to get average results. The result of these tests indicated that if the 44 1909 type of cars should be substituted for the 1907 cars on the urban service subjected to electrical measurement, there would easily be a saving of $0.732 per car per day, or $11,756 per year; and similarly, if the substitution were made in the interurban service, the saving in power consumption per car per day would be $0.873, or $14,020 per year for the total 44 cars placed in service. This has been accomplished with no increase in the cost of the new cars over the 1907 type.

Fig. 1 shows a photographic view of the 1909 semi-convertible car exterior, and Fig. 4 shows the interior. The car body is 28 ft. long and the total length of the car over the bumpers is 39 ft. 6 in. The width of the car over the weatherboards is 8 ft., and the seating capacity is 40 passengers. Twelve cross and four longitudinal seats are provided. The height from the rail to the trolley board is 11 ft. 8 in. Four GE-80 motors are provided per car with K28-J controllers, and the trucks are of the Standard O-50 type, with 34-in. solid steel wheels of Schoen make, 2½-in. thread and 4¾-in. axles. The wheel base is 4 ft. 10 in. The total weight of the car complete



Boston & Northern Light Car—Fig. 4, Interior View

and ready for service, but without passengers, is 42,090 lb., compared with a total weight of 48,700 lb. in the case of the 1907 car. The 1909 car was built by the Laconia Car Company works, Laconia, N. H., according to the designs of the purchaser. Fig. 3 shows the car in plan and section.

In addition to the improvement in weight which the 1909 cars afford, the steps are 2 in. nearer the ground and the space inside the car is nearly 100 cu. ft. greater than in the 1907 type. The vestibules are also 1 in. wider and 1½ in. longer in the 1909 car, and the seats are 1¼ in. longer, with 1⅝ in. increase in the length of cushion, the aisle width being the same as in the 1907 car, 24 in. Instead of being carried up in an arched construction, as in the earlier car, the posts in the new car are straight, and approximately 92 cu. ft. of additional head room are thus gained. The windows are built in two unequally high sections, the lower portion being carried downward into a pocket extending slightly below the floor level, while the comparatively light upper sash is carried up past the weather board into the roof. This reduction in the weight of glass carried up into the roof enabled the company to secure a much lighter roof construction, although the car has the same dimensions from floor to roof and the same outside dimensions over the weather board as the 1907 car. Table I shows the comparison in detailed dimensions between the 1907 and the 1909 cars.

Comparison with the 1907 car shows that while nearly all the important dimensions are substantially unchanged in the new car, the comfort of the passenger is materially increased by the later design. The gain in head room affords improved ventilation, and the increase in seat and cushion length though slight comes at a place where it will be highly appreciated. Two persons per seat can be more comfortably accommodated than in the earlier car. In each car 10 windows are provided on a side, but the windows in the new car are 1½ in. wider than in the older type. In the new car the underframing is of the composite type. The car body has been brought down to a height of 39 in. from the rail to the top of the floor, in spite of the use of 34-in. wheels, and the underframing is designed to permit a free swing of the wheels for a curve with a center radius of 30 ft. Nothing but the floor is located immediately above the wheels, and the step heights above the rail are as follows, compared with the 1907 car:

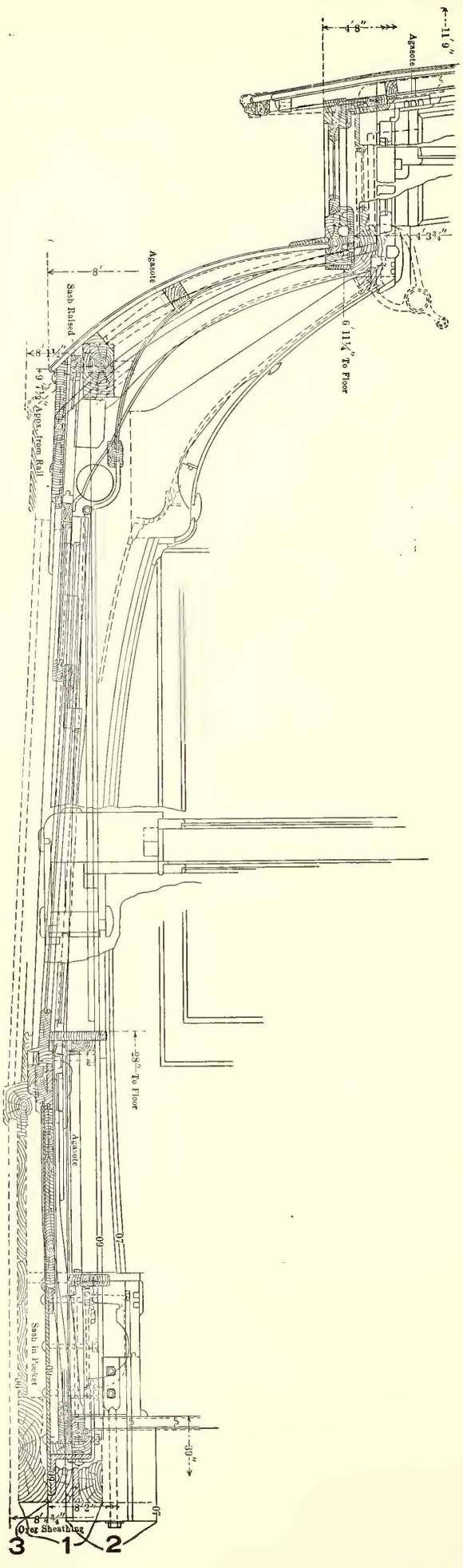
	1909 car, inches.	1907 car, inches.
Height of step, above rail	16	18
Height of step to platform	13	14
Height, platform to floor	10	10

In the new car the steel sill formerly placed on the inside of the post has been located on the outside, making use of the sill as the bottom member of the side of the car and installing an

TABLE I.—COMPARISON OF SEMI-CONVERTIBLE CARS (28 FT.) BUILT IN 1907 AND 1909.

	Car No. 1703, 1907 Type.	Car No. 1728, 1909 Type.
Type of car	Semi-Convertible	Semi-Convertible
Builder	Brill Company Kuhlman Shop	Laconia Car Co.
Length of car body	28 ft.	28 ft.
Length over bumpers	39 ft. 9 in.	39 ft. 6 in.
Length over dashers	38 ft. 5 in.	38 ft. 7 in.
Seating capacity	40	40
Seating arrangement	12 cross, 4 longitudinal	12 cross, 4 longitudinal
Height from rail to trolley board	12 ft.	11 ft. 9 in.
Truck centers	16 ft.	16 ft. 6 in.
Width of vestibule	6 ft. 7 in.	6 ft. 7 in.
Length of vestibule	4 ft. 7 in.	4 ft. 8½ in.
Length of step	3 ft. 4½ in.	3 ft. 5 in.
Width of car over weatherboard	8 ft.	8 ft.
Width of car over window stool	8 ft. 2 in.	8 ft. 4 in.
Width of car over side	8 ft. 2 in.	8 ft. 2 in.
Width of car body at bottom sill	7 ft. 10¾ in.	8 ft. 2 in.
Height from floor to monitor	8 ft. 3½ in.	8 ft. 3½ in.
Width of monitor	45½ in.	52½ in.
Height of monitor	14½ in.	14½ in.
Height of rail to step	18 in.	16 in.
Height of step to platform	14 in.	13 in.
Height of platform to car floor	10 in.	10 in.
Width of aisle	24 in.	24 in.
Total length of seat	2 ft. 7½ in.	2 ft. 8¾ in.
Width of cushion	17 in.	17 in.
Length of cushion	2 ft. 7⅜ in.	2 ft. 9 in.
Number windows per side	10.	10
Distance of seats on center	2 ft. 8 in.	2 ft. 8 in.
Length of longitudinal seats	5 ft. 6 in.	5 ft. 6 in.
Location of register cord	Center	Center
Type of seats	Brill Winner cane	Heywood, cane
Kind of fenders	Pfingst, 5½ in.	Pfingst, 5½ in.
Kind of snow scrapers	Root spring	Root spring
Kind of draw-bar	O. C. & B. N. standard	O. C. & B. N. standard
Kind of shackles	O. C. & B. N. standard	O. C. & B. N. standard
Kind of sand-boxes	Brill standard	Kilbourn
Type of trucks	Brill 27-E-1	Standard "0.50"
Wheel base	6 ft. 4 in.	4 ft. 10 in.
Cast or steel wheels	Steel tire	Solid steel
Make of wheels	National	Schoen
Diameter of wheels	34 in.	34 in.
Tread of wheels	2½ in.	2½ in.
Size of axle	4¾ in.	4¾ in.
Kind of journals	M. C. B. 3¾ in. x 7 in.	M. C. B. 3¾ in. x 7 in.
Kind of brakes	National air and hand	G E air and hand
Type of compressor	National A-4	C. P. 27, G. E.
Kind of automatic governor	National	G. E.
Kind of hand brakes	Double purchase, 13-in. Brill ratchet handle	Peacock geared
Type of motors	four, GE-80	four, GE-80
Gear ratio	22-64 and 17-69	22-64 and 17-69
Kind of gear	Solid	Split
Type of resistance	C. G.	R. G.
Type of controllers	K-28-J	K-28-J
Circuit breaker	M. S. 8 and M. U. 3A	M. S. 8 and M. U. 3A
Type and number of heaters	18 two-heat, 20-in. circular consolidated	18 truss plank consolidated
Heater current-amperes	6-12-18	6-12-18
Kind of trolley base	U. S. 11	U. S. 13
Distance between trolley stands	13 ft.	13 ft.
Single or double trolley	Double	Double
Kind of trolley catcher	Victor	Wilson, No. 2C
Kind of wiring	Conduit	Conduit
Type of lightning arrester	M. D.	M. D.
Kind of contactors	S. B. 402 C-1	S. B. 402 C-1
Kind of fuse box	M. A. 13 A	M. A. 13 A
Number of lights inside car	14	14
Total lights per car	22	22
Kind of arc light	Mosher	Mosher
Kind of incandescent headlight	Dayton	Neal
Kind of register	Two International	Two International
Location of whistle	Under platform	Under platform
Color painted	Standard yellow	Standard yellow
Weight of car, complete	48,700 approx.	42,090 approx.

angle iron in place of the sill. From the bottom of the seat to the window rail the side of the car is filled in with wood plated on the outside with steel. The lower window sash drops into a pocket between the end of the seat and the outside panel, the truss plank being cut between the posts up to the bottom of



Boston & Northern Light Car—Fig. 5, Half Section Showing the Comparison Between the 34-ft. Easy Access Car, 28-ft. Brill Semi-Convertible Car and the 28-ft. Standard Car

Electric Ry. Journal

the seat. Agasote panels are used to fill in between the posts from the bottom of the seat to the window sill. The lower window sash is provided with a hinged cover, and the latter cannot be opened when the window is closed, thus avoiding the trouble often experienced from passengers who expectorate, or throw cigar butts and other debris into the window pocket.

The car is equipped with 18 Consolidated truss plank heaters, the number being the same as in the 1907 cars, but the space taken up is somewhat less on account of the use of a steel sill on the inside of the posts. The heaters are placed in between each post and fitted with a special cap which extends around the post, making substantially one continuous heater from end to end of the car. The seats were redesigned to fit in between the posts on the truss planks instead of being attached in the usual manner to the side of the car. Each seat weighs complete only 70 lb. The bolsters are built of pressed steel, and the frame is tied at the ends with plate reinforced by wood, and the two center angle irons are fitted at the end of the bumper at each end with a heavy oak block acting as a shock absorber. The bumper sill is therefore somewhat smaller in cross-section than is common, the arrangement being to distribute the blow as much as possible in the car framing instead of trying to absorb it in the platform and vestibule.

The trucks are equipped with roller center and side bearings. The journals are of the M. C. B. type. The distance between truck centers is 16 ft. 6 in. The maximum weight of the wheels is 550 lb. each and a ¾-in. flange is used. All the trucks were designed to take the M. C. B. M 512 shoe, and each truck is equipped with a non-chattering brake hanger patented by Mr. Holst. The new cars are equipped with General Electric air brakes, CP-27 compressor, K-28-J controllers, with lightning arresters, kicking coil and arc headlight resistance mounted on the roof, and a contactor switch is provided beneath the floor of the car to break the main circuit away from the controller. One fuse is mounted on the roof. In addition to the contactor box, tripping switches and breakers, a fuse box is located underneath the car. Fig. 2 shows the general arrangement of the wiring circuits. The car is wired in conduit beneath the floor, and each circuit is provided with a separate enclosed fuse. Fuses controlling auxiliary circuits are mounted in groups in appropriate cases.

The interior finish of these cars is in natural cherry, the floors being Georgia pine. The steps are composite, the fronts being of galvanized steel and the rear of ash. Toe guards are of compressed steel, and the sides of resistance grid boxes are of pressed steel. A feature of the interior equipment is the location of the air brake governor beneath one of the longitudinal seats. The governor is mounted upon a sliding wooden base and is easily detachable for inspection or repairs. The air reservoirs are installed in the form of two tanks located beneath the longitudinal seats. The sand boxes, of Kilbourn make, are located close to the end heater coils, in order to secure the maximum drying action, and a deflector is provided at the mouth of the chamber containing the sand box to enable a free circulation of air to take place. The register cords are carried in holders located in the center of the aisle, to avoid interfering with the comfort of passengers by conductors who are usually required to lean over the seats in ringing up fares and transfers. Motormen's seats are provided in these equipments. The posts are narrow enough at the vestibule doors to enable the conductor to see every person in the vestibule. The arm guards at the windows were specially designed for these cars in the general plan of construction. Wired-glass monitor sashes are used and Agasote was employed freely in the monitor and roof lining. The cars are equipped with Mosher arc headlights, and each car is provided with 14 inside incandescent lamps. At the ends the company's standard illuminated sign is installed, two 16-cp lamps being placed in a pocket underneath the hood and protected by a galvanized-iron reflector painted white. The signs are arranged with sheet steel slides, carrying six readings. The exteriors of the cars are painted yellow.

Table II shows the car weight in detail, the chief subdivision

TABLE II.—DETAILED WEIGHTS OF 1909 SEMI-CONVERTIBLE CAR.

	lb.	oz.	Total lb.	Total oz.
Heater switch	17	..	..	..
Heaters	90	18	..	..
Heater shields	256	8	..	..
Heater shields (malleable)	34	..	..	..
Heater shields	5	2	403	12
Sand box without hopper	42	..	..	..
Sand box lever and casting	26	7	..	..
Sand box rod	11	9	..	..
Sand box hoppers	14	4	..	..
Sand box bearing	1	..	..	..
Sand box spouts	22	4	117	8
Scraper staff and wheel	47	..	..	..
Scrapers	392	14	..	..
Scraper chain	14	12	..	..
Scraper collar	1	10	..	..
Scraper timber	23	8	479	12
Fenders—Pfingst	108	..	..	..
Fenders—Castings	56	4	164	4
Peacock brakes (2)	100	..	..	..
Truck brake rods (2)	52	..	..	..
Brake lever link	4	9	..	..
Brake rod carrier (2)	5	13	..	..
Brake cable rollers	13	4	..	..
Brake pins	6	11	..	..
Sway bar	41	..	..	..
Wire cable	15	4	238	9
Headlights, incandescent (2)	32	..	32	..
Registers (2)	49	..	49	..
Trolley catchers (2)	27	..	27	..
Draw bars (2)	134	..	134	..

ELECTRICAL EQUIPMENT.

	lb.	oz.	Total lb.	Total oz.
Conduit	358	..	..	..
Fittings and straps	23	..	..	..
345 junction boxes	9	8	..	..
362 junction boxes (2)	54	..	..	..
365 junction boxes (2)	57	..	..	..
Made up cables (2)	134	..	..	..
Made-up resistance cables	59	8	..	..
Light wire Air wire Trolley wire Heater wire Arc wire	230	..	230	..
Motor lead boxes (2)	36	..	230	..
Motor lead box brackets	9	8	..	..
Bell mouths	25	..	..	..
MS switches (2)	29	..	..	..
MU 3 A switches (2)	14	..	..	..
MS 2 switches	4	..	..	..
MS 40 switches	6	..	..	..
MS 43 switches	3	8	..	..
Spare fuse box	5	8	..	..
Consol. fuse box (2)	7	2	..	..
Roof fuse, complete	11	..	..	..
Slate base and fuse (lights)	6	8	..	..
Contactor box	189	8	..	..
Contactor angle	40	8	..	..
Contactor angle	16	12	..	..
Contactor hanger	30	13	..	..
Resistance box (3)	216	..	..	..
Resistance hanger	35	2	..	..
Lightning arrester	20	0	..	..
Kicking coil core	6	12	..	..
M A 13 fuse box	16	8	..	..
Controller (2)	510	..	..	..
Bracket	1	9	..	..
Fiber block	1	12	..	..
Miscellaneous bolts	9	11	..	..
Arc headlights	11	..	..	..
Arc resistance	30	..	..	..
Arc plugs	..	14	..	..
Lamps	2	..	..	..
Sockets	7	..	..	..
Spare lamps and sockets	1	..	..	..
Trolley stand	121	8	..	..
Pole Harp Wheel	32	..	2,382	7
94-lb. trolley and light wire weighed with car body, and also included here (2,382·7 — 94)	..	..	2,288	7
Trucks (2)	6,305	..	12,610	..
Motors (4)	2,960	..	11,840	..

AIR BRAKE EQUIPMENT.

	lb.	oz.	Total lb.	Total oz.
Air compressor	625	..	..	..
Brake cylinder	170	8	..	..
Cylinder hanger	39	8	..	..
Cylinder con. rod	19	9	..	..
Cylinder levers	48	10	..	..
Compressor bracket	13	15	..	..
Comp. clamp	..	13	..	..
Com. angle	44	5	..	..
Comp. brace	2	8	..	..
Comp. hanger	55	0	..	..
Motorman's valve back	1	15	..	..
Motorman's valve	38	..	..	..
M. C. governor	29	..	..	..
Reservoirs (2)	94	8	..	..
Mufflers (2)	10	..	..	..
Intake strainers	6	8	..	..
Whistles (2)	7	8	..	..
Safety valve	2	5	..	..
Drain cocks (2)	1	8	..	..

AIR BRAKE EQUIPMENT (CONTINUED).

	lb.	oz.	Total lb.	Total oz.
Shut-off cock, air (2)	2	8	..	..
Whistle valves (2)	1	14	..	..
Air pipe	94	..	..	..
Pipe fittings	20	2	..	..
Pressure gages (2)	3	8	1,335	..

CAR BODY DETAILS.

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Window guards	12	..	6	4	8
Show case catch	4	..	1½	..	6
Cupboard catch	4	..	3	..	12
Sash springs	52	..	..	1	8
Deck sash opener	4	2	11	10	12
Brass butts, 2 in	8	..	..	..	6
Sash lock top	40	..	4	10	..
Finish above vest. windows, white-wood and ash	48	..	7	21	..
Side window stools, ash	2	42	..	84	..
Window stool irons	20	..	12	15	..
Wood battens on vestibule	8	..	..	..	..
Letter board returns	8	..	..	..	..
Stool returns	8	..	..	..	..
Window corners	8	..	..	12	..
Letter boards	2	50	..	100	..
Half-round, on letter board Window arches Side battens and plugs	..	..	..	10	8
Glass	..	..	..	438	4
Window screens, comp. with bracket	20	5	11	113	12
Vest. M. I. window bands	4	2	5	9	4
End sash without glass	4	4	1	16	4
Monitor without glass	20	1	..	20	..
Swing, without glass	4	3	8	14	..
Side vest, sash, without glass	4	3	7	13	12
Center vest, sash, without glass	2	5	2	10	4
Top casement sash, without glass	20	2	1	41	4
Bottom casement sash, without glass	20	3	2	62	8
Swing sash fasteners	8	..	3	1	8
Sash lift and leather	6	1	..	6	..
Sash lifts	40	..	1½	3	12
Sash lifts	4	3	12	..	..
Sash lifts	2	..	2	..	4
Vest. sash adjust plate	4	..	2	..	8
Window guard brackets	8	..	7	3	8
Strap hinges	12	..	13	9	12
Pocket cover bracket pivots	40	..	1½	3	12
Window bands	32	3	½	97	..
Anti-rattler brackets	8	..	3	1	8
Pocket covers	12	1	2	13	8
Pocket covers	8	1	..	8	..
				1,159	8

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Post anchor iron	8	..	8	4	..
Post anchor iron	4	..	8	2	..
Top queen post	4	4	..	16	..
Bottom queen post	4	3	..	12	..
Queen post	4	3	..	12	..
Center tee rod queen post	1	6	..	6	..
				52	..

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Shims on bolsters under angles	8	..	8	4	..
Bolster top plate	2	80	..	160	..
Bolster bottom plate	2	110	..	220	..
Bolster fillers	4	60	8	242	..
Bolster angle to side plate	4	14	..	56	..
Side bearing castings	8	4	2	33	..
Side bearing plates	4	5	12	23	..
Side bearing shims	8	..	4	2	..
				740	..

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
End door curtain brackets	8	..	½	..	4
End window curtain brackets	8	..	½	..	4
Curtain brackets	40	..	¾	2	8
Curtains, side	20	5	13	116	4
Curtains, door	4	4	3	14	8
Curtains, end	4	1	7	5	12
				139	8

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Safety treads	4	13	5	53	4
Step tread clamp plate, R	4	..	8	2	0
Step tread clamp plate, L	4	..	6½	1	10
Motorman's steps	6	1	13	10	14
Step tread, oak	4	3	3	12	12
Step risers	4	4	7	17	12
Step hangers, body	4	7	14	31	8
Step hanger vest. end sill	4	6	..	24	..
				153	12

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Seats, reversible	..	..	..	834	..
Seats, stationary	..	..	..	222	8
Corner seat angle clip	8	..	2½	1	4
Heel boards with perforated panels, long	4	7	4	29	4
Heel boards with perforated panels, short	4	2	8	10	..
Corner seat frames, ash	..	..	..	58	8
				1,147	8

CAR BODY DETAILS (CONTINUED)

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Gong shells, 12-in.	2	6	12	13	8
Gong bracket and Tapper	2	3	7½	6	15
Gong pin	2	..	6½	..	13
				21	4

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Draw head spring	2	13	..	26	..
Draw head castings	8	17	..	136	..
Draw head angles	4	83	..	332	..
Draw bar rest	2	19	2	38	4
Draw bar angle	4	1	8	6	..
				538	4

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Whitewood roofing	..	..	..	210	..
Roof tin	1	1	15	1	15
Trolley plank	2	55	4	110	8
Trolley plank	13	..	9½	6	7½
Roof racks	4	6	4	25	..
Duck	2	4	14	9	12
				364	6½

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Channel bumpers	2	71	..	142	..
Angle iron bolster to cross timber	4	23	8	94	..
Steel side sheets	6	17	10	107	..
Dashers	6	18	5	110	..
Long side battens	2	23	..	46	..
Dasher batten	6	..	..	11	..
Center timber support iron	2	..	8	1	..
Platform and bumpers support iron	4	1	..	4	..
Bumper clip	8	1	..	8	..
Cross timber clip	4	3	4	13	..
Iron under platform support	8	3	..	24	..
Bumper block brace	2	8	..	16	..
Bumper block plate	2	3	8	7	..
Iron on side ¼-in. floor timber	8	..	4	2	..
				585	

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
End frame with head board, whitewood panels, window arches, battens, whitewood, birch	60	..	..	139	..
Headlining battens	4	2	..	8	..
Monitor frames, hard pine and cherry	2	90	..	180	..
All wood rafters	..	..	..	70	..
Iron rafters	7	12	2¼	85	..
End carlines and monitors, cherry	10	1	1½	11	..
Side eaves rail	2	8	8	17	..
End eaves rail	2	2	..	4	..
Ash filling boards	..	..	..	64	..
Whitewood filling boards	..	..	..	59	..
Steel battens on roof	..	..	..	3	..
Steel corners on window stool	4	..	4	1	..
Steel corners on letter boards	4	1	..	4	..
Steel corner bottom corner posts	4	4	10	18	8
Side battens, steel	4	..	5	1	4
Side battens, steel	10	..	6¼	4	..
Iron side end corner	4	3	..	12	..
Side sign furring ash	..	..	..	7	..
B-C hanger, furring ash	..	..	..	5	..
Lamp rosette	..	..	..	19	..
Wire furring ash	..	..	..	47	..
Head line furring pine	..	..	..	48	..
Whitewood molding, roof	..	..	..	4	8
Lead corners	..	..	..	3	..
Cherry on posts and under windows	..	..	..	138	..
Maple matting	..	..	..	76	..
Agasote vest. panels with cherry	6	8	5	50	..
Headlining and wire molding	..	..	..	22	..
Panel over heater, cherry	..	..	..	2	6
Panel over heater, molding	..	..	..	..	12
Light wire covering	2	..	6½	..	13
Agasote upper body window	20	2	8	50	..
Agasote upper deck window	3	41	10	125	..
Agasote lower deck window	6	12	12	76	..
End body, cherry finish	..	..	..	96	..
Sheet iron clips hold panels under windows	80	..	1¾	9	..
End panel in bulkhead, cherry	4	1	4	5	..
Center plate furring	2	3	4	6	8
				1,471	15

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Register cord sheave	6	2	2	..	12
Pole sockets	4	..	2	..	8
Hand pole acorns	4	..	2	..	8
Register bracket	2	1	1	2	2
Pole strap pole	4	1	6	5	8
Pole straps	24	..	2½	3	12
R. & B. cords leather (4 cords)	..	..	..	4	3
Cord hooks	2	..	1½	..	3
Cord eyelets	16	..	1	..	16
Signal bells complete	2	2	3	4	6
Grab handles	8	..	13½	6	12
Pole brackets	12	..	14	10	8
B/C brackets	10	..	12	7	8
Grab brackets	16	..	10	10	..
				57	8

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Sign brackets	4	..	1½	..	6
Sign end casting	4	..	4½	1	2
Sign reflector	2	1	9	3	2
Front reflector	2	..	11	1	6
End sign bracket	4	2	4½	9	2

CAR BODY DETAILS (CONTINUED)

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Sign bracket	4	..	7	1	12
Sign light holder	4	1	14	7	8
End sign	2	7	6	14	12
				39	2

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Oil hole cover	2	..	¼	..	½
Nameplates	2	..	4	..	8
Trap lifts	8	..	5	2	8
Trap lifts	8	..	6	3	..
King pin	2	9	..	18	..
Trolley hooks	2	4	½	8	1
				32	1½

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
Vestibule door frame, ash	12	9	6	114	..
Vestibule posts front	8	10	4	82	..
Vestibule girts and stool, ash	18	2	11	48	6
Vestibule plate, ash	2	7	..	14	..
Bonnets—whitewood and ash	2	30	8	61	..
Vestibule finish ash and cherry	..	..	..	46	..
Vestibule angle irons	2	11	8	23	..
Vestibule angle castings	4	..	14	3	8
				391	14

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
⅞-in. hard pine floor	..	..	..	496	..
¾-in. hard pine floor	..	..	..	156	..
⅞-in. hard pine floor, vestibule	..	..	..	65	..
Vestibule floor furring	8	3	4	26	..
				743	..
Miscellaneous, screws, bolts, etc.	..	..	..	177	..

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total cz.
Wallace door hangers	2	30	..	60	..
End door bolt	12	..	2	1	8
End door bolt washer	8	..	½	..	4
End door strips	16	..	4	4	..
Vest. door latch	4	..	3	..	12
End door face strips	4	..	5	1	6
End door threshold	4	2	..	8	..
End door threshold	2	11	..	22	..
Vest. door butts, bronze	12	..	14¾	11	1
Door handles, outside	4	1	3	4	12
Door handles, inside	4	1	2	4	8
Door fastener, outside	2	..	5	..	10
Door fastener, inside	2	..	3	..	6
End door catch	2	..	4	..	8
End door casing	2	..	3	..	6
Vest. door latch plate	8	..	6	3	..
" " handles	4	..	7	1	12
" " keeper	4	..	2	..	8
" " striker	4	..	4	1	..
" " lock pieces	4	..	½	..	2
End doors, 2 prs., no glass	4	20	4	81	..
Vest. doors, 4 prs., no glass	4	36	4	145	..
				352	7

	No. per car.	Weight lb.	Weight oz.	Total lb.	Total oz.
End sills, oak	2	88	8	177	..
Bottom braces, oak	2	47	8	95	..
Center sills, oak	2	11	..	22	..
Cross sills, oak	2	36	..	72	..
Cap timbers, oak	16	7	4	116	..
End sills, furring oak	4	5	12	23	..
Queen post timber Floor timber, ¼ in. oak Floor timber, 1¼ in. oak	4	..	..	8	..
Sills with sash numbers, hard pine	20	4	..	80	..
Truss plank, cherry	20	5	8	111	..
Bumpers	2	5	8	11	..
Spring casting, furring oak	4	3	4	13	..
Wood platform, oak	2	60	..	120	..
Side and corner post, ash	22	15	8	343	..
End belts, ash	2	35	..	70	..
Body plates, hard pine	2	76	..	152	..
Truss rods	2	73	..	146	..
Trap tee irons	8	11	2	89	..
Platform supports	4	113	4	453	..
End sill plates	2	12	8	25	..
Long side plates with reinforcing bars riveted on top edge and angle riveted to bottom edge	..	..	..	1250	..
Truss rod anchors	4	15	..	60	..
				3,436	0

TABLE III.—SUMMARY OF CAR WEIGHTS, 1909 TYPE.

	Lb.	Oz.
Car body bare as weighed	11,170	4
Heaters	403	12
Sand boxes	117	8
Headlights (incandescent)	32	..
Seats, reversible	834	..
Seats, stationary	222	8
Scrapers	479	12
Fenders	164	4
Hand brakes	238	9
Draw bars	134	..
Registers, trolley catchers	76	..
Electrical equipment, excluding motors	2,382	7
Air brake equipment	1,335	..
Four GE-80 motors	11,840	..
Two Standard trucks	12,610	..
Total	42,040	10

being on the body and fittings, where the major saving occurred. A summary of these weights is given in Table III.

Great care was taken to determine the actual weights of the completed cars, trucks, etc. There was naturally some slight differences between different cars, but the following are some of the actual weights: Car body No. 1406, 1909 type, with both trucks, weighed 25,790 lb. With one end jacked up, the weight of a single truck in this equipment was 6305 lb. The weight of car No. 1721, of the 1907 type, was 48,700 lb. The weight of car No. 645, a 30-ft. straight side box car made by the Stephenson works in 1903, was 44,600 lb. The weight of car No. 1394, of the 1909 type, was 42,090 lb. The weight of one truck with motors was 12,250 lb. These figures show a clear gain of 3½ tons in each of the new cars compared with the 1907 type.

The engraving on page 574 shows a half section of the three types of cars described. No. 1 is a 34-ft. semi-convertible car of the 1906 type with large platform, pneumatic operating doors and folding steps. Section No. 2 is of the 1907 28-ft. semi-convertible cars, and No. 3 is the 1909 28-ft. standard car. The sections show the difference in the design of the cars, especially in the headroom in the lower deck. The dimensions from floor to roof of the car were kept the same and the total width of car of the 1907 and 1909 types over the side, just below the window sill, is the same.

The results of this saving are shown in the following summaries of tests made with recording wattmeters in actual service, counts having been taken of the passengers in addition to the precaution of changing around the motormen as outlined above. For conservative estimates, the cost of power was assumed to be 0.6 cent per kw-hour.

TESTS

Tests in urban service were made on the Stoughton-Campello line. The round trip required 1½ hours, and the distance run was 15.72 miles. The cars used were (1) 1907 semi-convertible "1717," with Brill 27-E-1 trucks, 6 ft. 4 in. wheelbase, and (2) the 1909 semi-convertible "1728," with standard O-50 trucks, 4 ft. 10 in. wheelbase. Three trips were run on Feb. 15, one being rejected on account of delay, and three trips on Feb. 16, 1910. One car ran 30 minutes later than the other. The equipment on both cars was practically the same.

Meters were checked before tests, and exchanged on the second day. The motormen were also exchanged on the second day in order to get average results. The rail was good on both days, although snow was on ground. The first day was cold, the second day warm, causing the motormen to run carefully on account of water on track.

The following is a summary of tests with the cars equipped with a 17-69 gear ratio:

	Trips.	Stops per car-mile.	Average watt-hours per trip.	Watt-hours per car-mile.	Difference, watt-hours per car-mile.
1728 car.....	5	5.3	41,200	2,621	581
1717 car.....	5	4.7	50,344	3,202	...

Assuming a car to run 210 miles per day, and a cost of 6 cents per kw-hour, the difference quoted above would mean a saving of $0.732 per day per car. The 44 1909 cars would then show a saving of $11,756 per year of 365 days over the same number of 1907 type of cars.

The following is a summary of the tests made in the interurban runs from Brockton to New Bedford with a 22-64 gear ratio:

Type.		Stops per car-mile.	Watt-hours per car-mile.	Difference, watt-hours per car-mile.
1907	1,710	2.68	3,320	539
1909	1,733	2.20	2,781	...

The Brussels Tramways Company is making extensive improvements in anticipation of handling the large crowds which are expected to attend the exposition to be held in that city during the coming summer. A 4000-kw turbo-generator is being installed in the power station and 100 new motor cars and 100 open trail cars have been purchased.

INSPECTION AND REPAIR OF ELECTRICAL EQUIPMENT

The following paragraphs will describe some electrical practices of a railway company whose methods of inspection, repair and manufacture are so thorough that its total equipment failures in the severe winter months cause an average loss of only 0.75 mile for every 1000 car-miles operated. This company's standard four-motor equipments are the GE-80 and GE-67 types geared 17:67, while the greater number of its two-motor equipments consist of GE-67 and GE-1000 types, also geared 17:67. The most common controller on double-truck cars is the K-16, but the single-truck cars carry K-10 controllers modified to the K-11 type by using No. 4 wire.

Cars are inspected every 24 hours at the division depots, but a more thorough inspection is made once a month. One unusual feature of this work is the attention given to the trolley-base connections, which are soldered on special terminals and further secured with set-screws bolted down solid. Passenger cars are thoroughly overhauled every 55,000 miles to 60,000 miles. Since a car is not permitted to stay out of service for more than a day, it is necessary to use spare trucks, motors, controllers and other parts. This substitution of equipment makes it possible to repair individual parts of cars more thoroughly than would be possible on the car itself. Upon receiving a car for the general overhaul, the braking and electrical connections are immediately unfastened, the car body raised on a trestle and the trucks shunted to the truck shop. The brake cylinders and the electrical apparatus, including resistances and trolley stands, are then taken off and replaced at once with new or overhauled material. The cable ducts on the car body are opened, cleaned and repainted, renewals being made where necessary.

ELECTRICAL EQUIPMENT OVERHAULING

In overhauling the electrical equipment, the motors are first stripped of their armatures, field coils and brush-holders, which are sent to the proper department. The oil cups are cleaned and the motor frame is scraped inside and out. After the interior of the motor casing has been painted with black insulating compound, oiled canvas liners are placed around the permanent pole pieces and the frames are ready for assembling. The cleaned or repaired field coils are next put in place and the magnet plates bolted home with finished steel bolts and hexagon nuts having spring-lock washers. After the motor frames have been bolted together, a gage is inserted between the pole pieces to test for proper spacing. If the distances are found correct, the armature is inserted and another gage used to determine the distance from the pole pieces. When the brush-holder yokes, brush-holder bearings and lubricating equipment have been installed the motor is subjected to a running test for three hours at 40 amp. During the course of this test, the motor is coated with a quick-drying mineral black paint. Finally, the overhauled gearing is lubricated, encased and put on the trucks with the motors ready for service. The motors and gearing are always overhauled in sets of two or four.

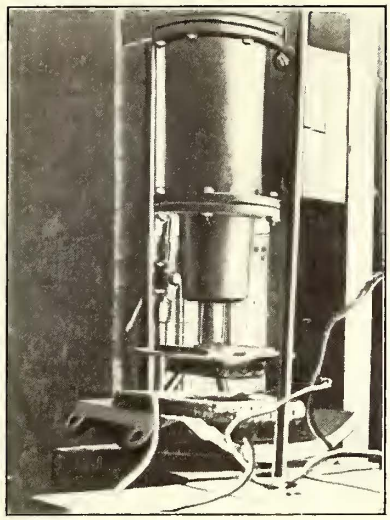
The armatures taken out of the motors are first inspected for bearings and, where necessary, renewals are made with cast-steel sleeves lined with babbitt. Next the entire armature is carefully cleaned, the commutator turned and polished, and the string band inspected or renewed. The commutator is then subjected to the millivolt test from bar to bar. Finally, the armature is given a 1000-volt ground test and, after shellacking, is available for service.

The field coils removed from the motors are placed in a section of a motor frame and undergo a millivolt reading without a magnet. Then a second reading is taken, after a magnet attached to an air-cylinder has been lowered on the coil as shown in one of the illustrations. If the meter reads up to standard and shows no variation when the coil is under pressure, the outside tape is repaired and the coil is dipped in air-drying compound. In this connection it may be added that in the case of outside-hung motors a great reduction in motor-lead trouble has been attained by boring the motor

frames on the axle side and bringing the leads out as near the king bolts as possible.

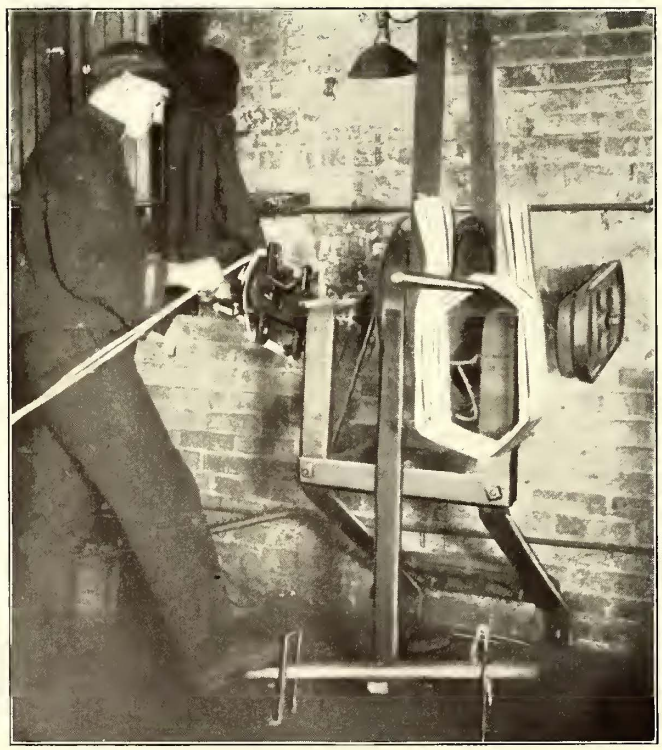
MANUFACTURE OF ARMATURE COILS

The following description of the manufacture of a GE-67 armature coil will give a fair idea of the company's practice in coil work generally.



Commutator Repair and Air Magnet for Field Testing

The GE-67 coils are made three at a time, as the coil-former has a triple groove. Before they are taken off the former they are kept to shape by binding them with soft lead straps. Fish-paper strips are then inserted by hand between the coils, after which the coil is tied up and the lead straps removed for re-use. The coil is next dipped in Standard varnish and left to air-dry. After drying, the insulation is removed from the ends for a length of 2½ in. The ends are then tinned and covered with web-sleeving. After this the strings are taken off and the sides of the coils are surrounded by fish paper, which is hot-glued on by a small air press. Only the sides are treated in this manner, as they form the part which goes into the slots. The coils are then taped by machine with linen taping, which is applied so that half the next turn always overlaps the preceding one. The coil is then dipped in air-drying Voltalac and treated with soapstone to make it enter easily into the armature slot. The completed coils are stored in closets, according to type, and are marked with the date of manufacture so that the oldest will be taken out first.



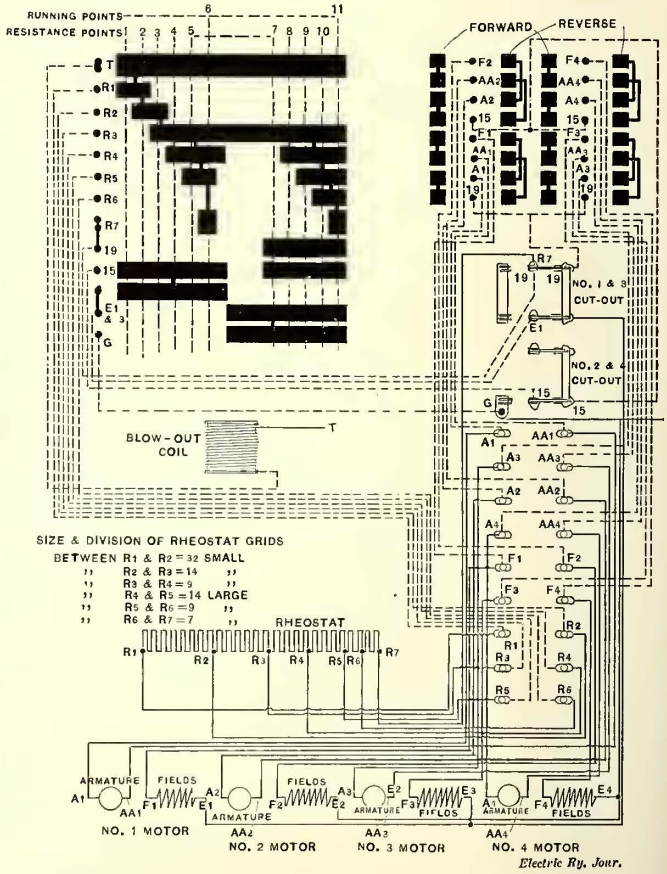
Coil Formers for GE and Westinghouse Armatures on One Shaft

The same shaft which carries the GE-67 former shown in the illustration has two treadles, as it is arranged to receive either a Westinghouse No. 3 or No. 12 coil former at the opposite end. The Westinghouse formers permit the winding of single coils only.

The different car depots are supplied with armature tags, on which the foremen indicate why a given armature has been removed and replaced. This tag accompanies the defective armature to the shops, where the stub is torn off and returned to the carhouse as a receipt. The other side of the tag is used for the shop foreman's report on the repaired armature and its destination. A history of every armature is kept in the master mechanic's office in a loose-leaf record, which shows when the armature was purchased, repaired electrically or mechanically, turned, painted, rewound or furnished with new bearings. At the end of every month the different classes of repairs are totalized.

FIELD COIL MANUFACTURE

Field coils, after winding, are heated for the removal of moisture and then dipped in Standard yellow varnish until the absence of bubbles shows that all air has been expelled. Next the coil is baked over night and then supplied with flexible leads made up of 245 strands of untinned No. 30 rubber-covered wire. One lead is 24 in. and the other 6 in. long. When the leads are soldered on, insulation is begun. The leads, however, are not tied down parallel to the coil until some mica has been inserted between them and the coil. The insulation consists of two double-overlaps (four thicknesses) of glace belting and one layer of insulating tape. The field is then re-dipped and baked all night. After the second baking, the corners of the coil are reinforced with No. 8 oil duck. The entire coil is then taped with black Competition rubber tape and air dried in Voltalac to complete the operation.

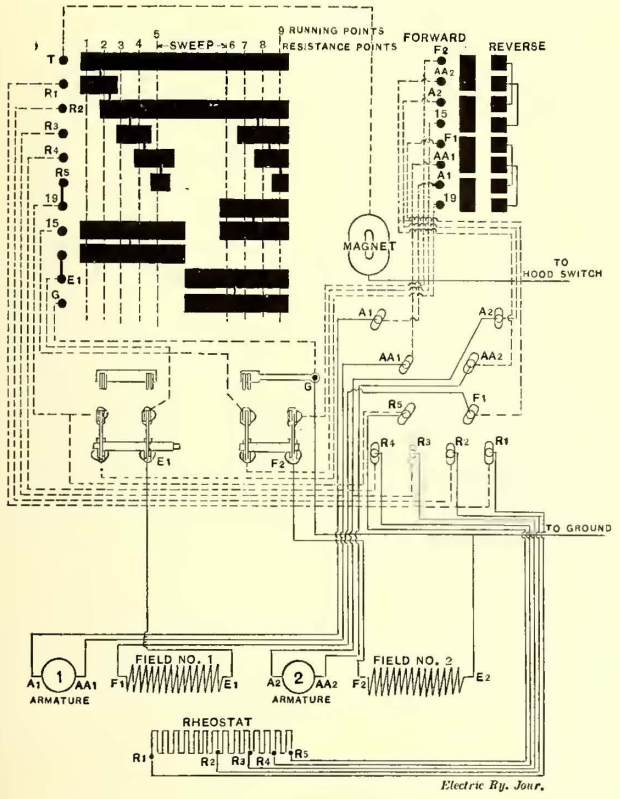


Connections for S.P. K-6 Controller and Rheostat for Four GE-1000 or GE-67 Motors

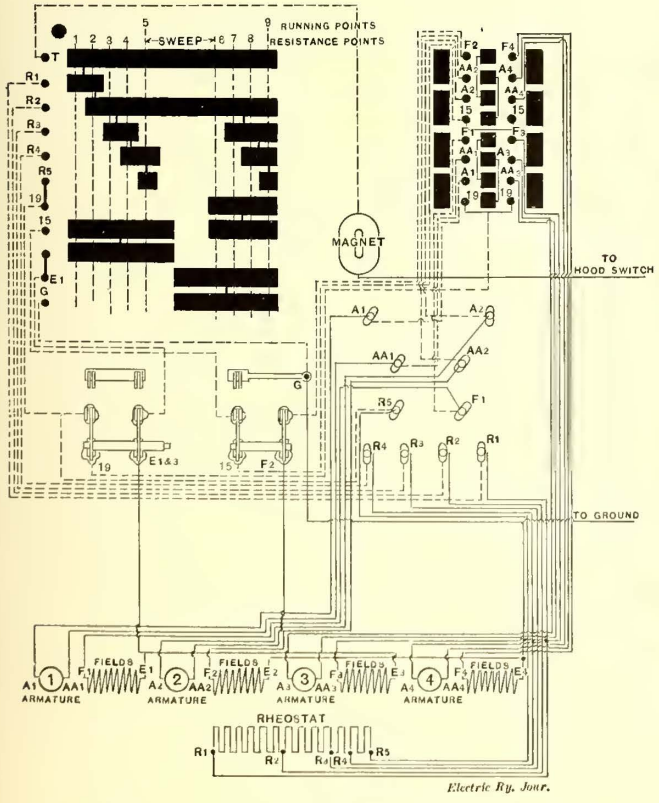
CONTROLLER WORK

Particular attention has been given to controller troubles, and, as a result, several changes have been made in construc-

tion. That portion of the controller case opposite the space between the main and reversing cylinders is covered with No. 16 fiber screwed down on wooden blocks and the cylinders are separated by a fiber barrier. In the K-6 controller, insulating



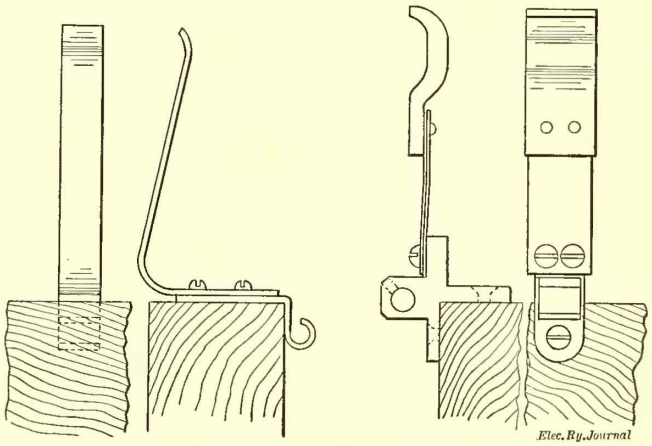
Connections for S.P. K-10 Controller



Connections for S.P. K-12 Controller and Four Motors

barriers have been placed between fingers 15 and E, in addition to those between 19 and R-6 and 19 and 15, which were installed by the manufacturer. The controller board is also insulated with mica from finger 19 to ground. Instead of carrying the ground wire from the ground terminal on the main board to F2, a wire is sweated to F2 and connected to ground on the main cylinder block. In all controllers the motor cut-outs are plainly marked "1" and "2" to avoid errors.

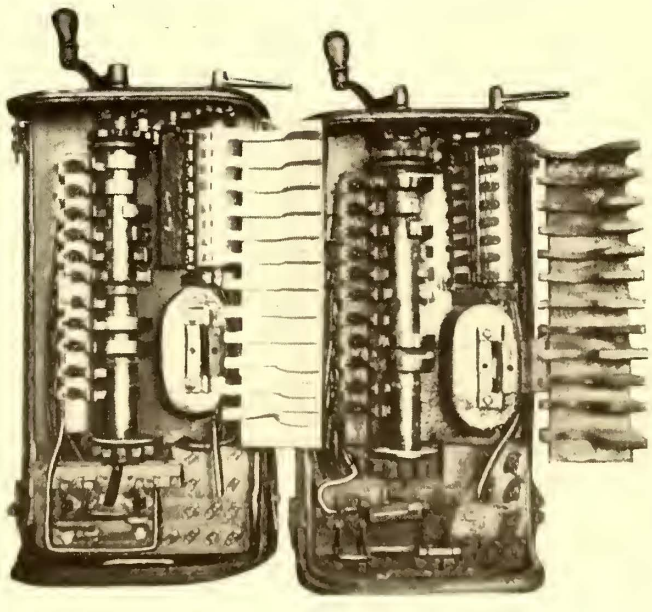
Nearly all parts of the K-6 and K-10 controllers are interchangeable. Old segments and fingers are cut down for use again wherever possible. Every division is supplied with a



Two Types of Reverse Fingers in Controllers

bar bender to make segments from bars supplied by the shop storeroom. Phosphor bronze fingers are used on the reverse cylinder at one-third the cost of the usual drop forgings. All heavy filing or sand-papering is avoided in cleaning fingers, segments and cover plates, as such parts are simply dipped in lye and acid, then chamfered with a rough file and buffed.

One feature of the controllers is that they are not grounded, but are insulated on a wooden block, yet very little trouble has arisen from blow-outs and there have been no instances of shocks to the motorman. When the controllers go through the daily inspection they are blown out with compressed air, which results in keeping them so clean that there are no leaks or bad short circuits. In overhauling controllers the case is stripped down to the back, pointed with black insulating paint



New and Overhauled Controllers

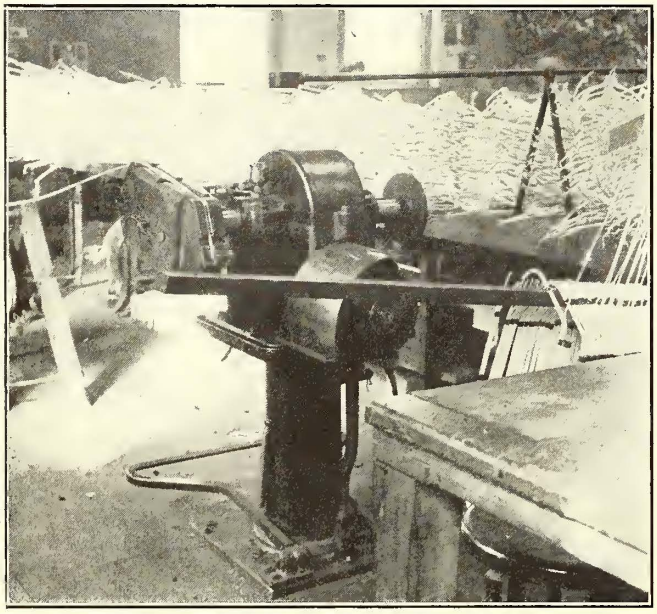
on both sides and lined inside with asbestos, after which the interior is rebuilt.

The Richmond Railway & Power Company, Richmond, Va., finding that its passengers have the usual tendency to place their feet on the corner rattan seats, protects the later by attaching along the edge a wooden strip 1½ in. high and ⅜ in. thick.

SHOPS OF THE CINCINNATI TRACTION COMPANY

Motor-Driven Tools, Armature Shop Methods and System of Card Records

THE shops of the Cincinnati Traction Company have an equipment of excellent tools, practically all of which are driven by individual electric motors. This article includes descriptions of the motor-driven tools, the armature shop methods and the system of card records used in shop accounting and supervision. It also mentions several interesting maintenance practices that are being followed on the Cincinnati property.



Cincinnati Shops—Armature Coil-Winding Machine

ELECTRICAL REPAIR SHOP

The Cincinnati Traction Company normally runs 700 cars which are equipped with 1700 motors. Heavy grades on many car routes make very severe demands on these motors, a large proportion of which are on single-truck cars. Many of the motors have been in service for a long time and a considerable number of them are of the GE-1000 and 800 types. The severe service conditions which the Cincinnati equipments have to meet are reflected in the armature repair room. At the present time new coils are made in this department at an average rate sufficient to wind about 75 armatures per month. No armatures are repaired in the car houses, but all such work is centralized in the main electrical repair shop where a complete installation of coil manufacturing apparatus has been made. Practically all the tools in this shop, some of which are illustrated herewith, have been designed and built in the nearby machine shop of this company.

The armature shop machinery is enclosed in a substantial building, one-story high, with large windows on all four sides. This building is subdivided into an armature coil-winding room and a general electrical repair room with one corner set off for testing purposes. The larger tools in both rooms are served by a chain-block hoist supported on an I-beam trolley runway.

WINDING ARMATURE COILS

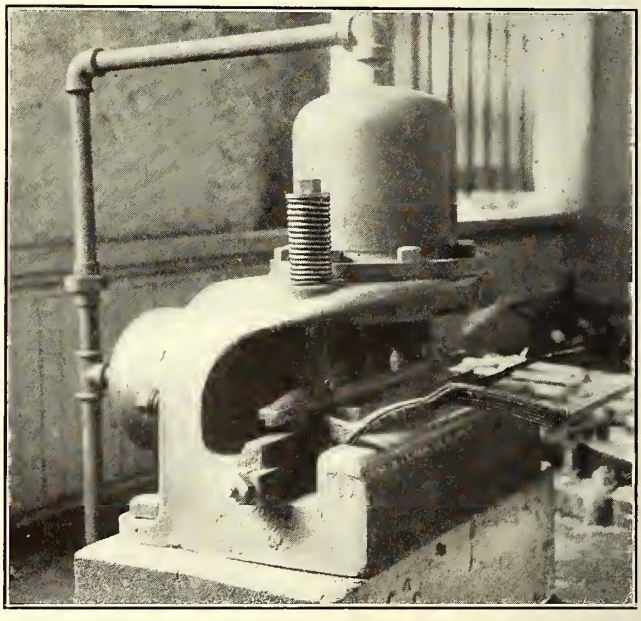
All the armature coils required for the maintenance of the 1700 car motors are made in the winding room at this shop. Power-driven forms are used in winding all but GE-58 coils. Winding and taping machines are arranged on opposite sides of a central table on which the unfinished coils are stacked. Steam-heated forming presses are mounted on a bench at one side and the curtain department is at the opposite end of the room.

Three forms are provided for winding GE-58 coils. These vary in size by the thickness of the wire used so that a set made up of one layer wound on each form will nest accurately. The middle of the three sections is wrapped with fish paper so that its wires are separated from the other two. When the three sections have been assembled a covering of fish paper is glued on and the set is pressed into shape.

One of the illustrations shows a home-made, air-operated press used in shaping coils. In this press, as well as in the older type toggle-joint presses also used, the forming blocks are hollowed out and provided with steam connections. After the application of the fish-paper jacket the coil is inserted in the press, pressure is applied, the coils and glue are heated by steam fed into the forming blocks, and then the coil is allowed to cool under pressure. During this process the attendant, who also applies the fish paper, busies himself with getting another coil ready for the press.

The air-operated coil press has two cylinders, at right angles to each other, and their pistons operate two forming pieces. Brass forms are used and sets are available for coils of several different shapes. The piston on the horizontal cylinder is fitted with a spring somewhat heavier than that on the upright piston, and therefore when equal air pressure is admitted to both cylinders, the upper forming piece comes into place a little ahead of the lower one. A small engineer's valve is used to control the air to the cylinders of the press.

After the straight part of the coils has been covered with paper the coils are passed along to the taping table which is in charge of two young women. Here the straight portions are wound with fish cloth. The final covering is made by winding white cotton web tape all the way around the coil and doubling it on those sections which are to lie within the slots. Before taping, the coils are dipped and allowed to dry, and after taping they are given a second dipping.



Cincinnati Shops—Two-Cylinder Armature Coil Press

The coil-taping machines and power-operated winding forms are driven from a shaft extending under a large table in the center of the room. This shaft is in turn driven by a 5-hp Westinghouse motor which stands on the floor under the table.

Field coils that have been burned out in service are utilized and the wire re-insulated if not too badly damaged. By means of home-made devices, as shown in the illustration on page 583, the wire is cleaned and retaped as it is wound onto a power-driven form. About $4.50 is saved on each coil by this process. The winding lathe used in this work is similar to that used in winding armature coils. It was designed and built in these shops. It is driven by a belt from a driving shaft in the winding room. All the power required for winding coils is furnished by a single 5-hp motor, and the current used is metered so that a proper charge may be made in determining the cost of coils.

A stock of sheet insulation cut into the shapes required in winding work is kept in a rack in the electrical shop. This insulation is punched out of large sheets by means of sets of dies used in a punch press, which is a part of the machine-shop equipment.

COIL TERMINAL ANCHORAGE

About 14 months ago a new terminal anchorage was designed and put into use on all field coils manufactured in this shop. Since then not one of these terminals has been destroyed. Provision for attaching a lead wire to either outside or inside terminals is afforded by a tapped and threaded boss against the top of which the lead-wire terminal lug is held securely by a cap screw with a lock washer. The terminal for the outside wire is about 3¾-in. long and L-shaped so that it will fit over the side of the coil. A hole is drilled in the angle of the L for insertion of the wire. The inside terminal also is formed to fit the contour of the coil and is provided with a strip of copper which reaches across the width of the coil and is bent around the end of the inside wire before soldering. The main part of each terminal is common brass.

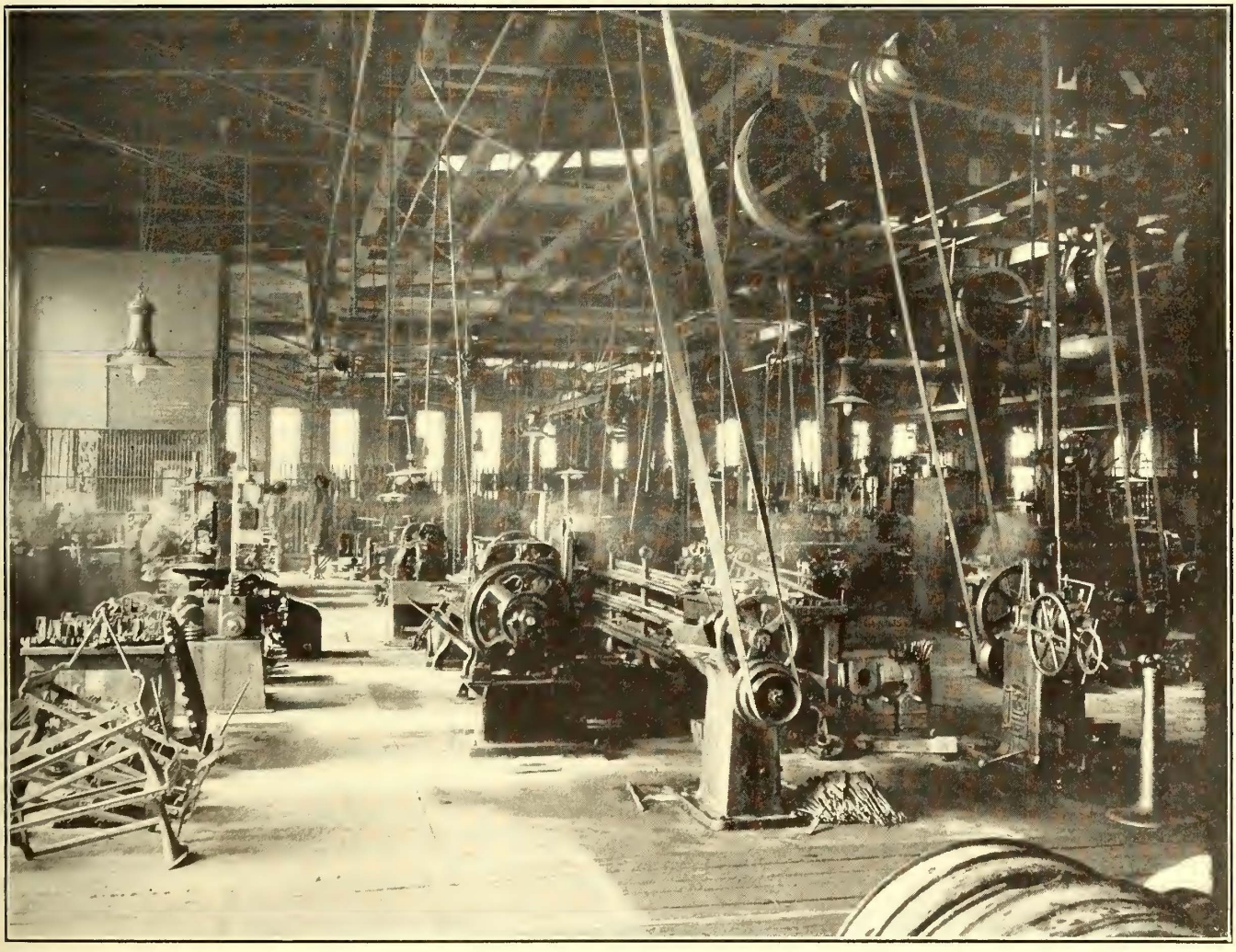
IMPREGNATING PLANT

The impregnating plant is shown on page 583. This equipment was built by the J. P. Devine Company and insulating compounds manufactured by the Standard Varnish Company are used. About 12 coils are treated each day and the plant is operated daily, because all of the coils in the 1700 motors are being put through this process. Vacuum is obtained with a motor-driven pump and the supply tank is operated by an independent motor. The raised platform about the two tanks and the substantial stairway thereto facilitate the work.

The compound in the supply tanks is kept hot all the time by means of steam fed from the shop steam supply system. During the daytime when coils are being treated the steam is reheated in a gas-fired superheater built inside the armature shop close to the impregnating plant. By means of this superheater the temperature of steam at 50 lb. pressure is raised to about 600 deg.

The pressure tank is emptied each afternoon and a set of coils put in to dry during the night. The ordinary shop steam supply is used to keep the pressure tank hot over night. In the morning a vacuum of about 27 in. is put on the pressure tank for 2½ hours. Meanwhile the compound is being heated by the superheated steam. Then the compound is allowed to flow into the tank and cover the coils. The supply valve is closed and the coils are kept under an 80-lb. pressure for 2½ hours. The results obtained by this process of coil treatment have been especially satisfactory.

Before a coil is put through the insulation process it is wound with strip muslin and special threaded plugs are inserted in the coil terminals to exclude the compound. After the coils are removed from the liquid the muslin is quickly torn off. This leaves the outer surface of the coils in a

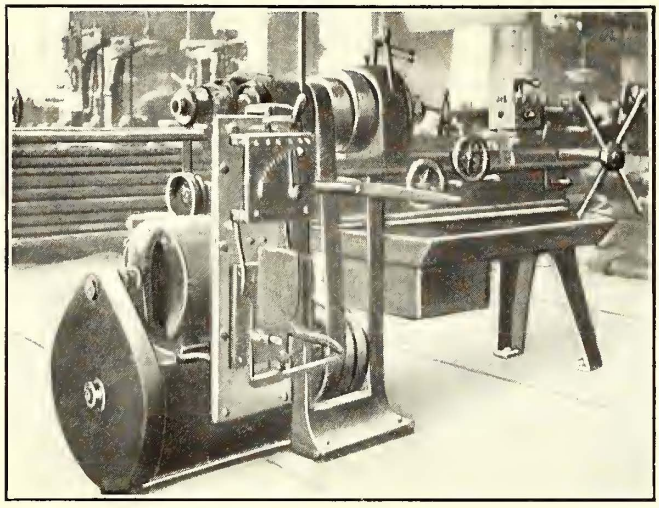


Cincinnati Shops—General View of One-Half of Machine Shop

smooth condition. The old muslin, which carries with it a great deal of compound, is saved and when a sufficient quantity has accumulated the compound is melted off by placing the refuse muslin in a kettle under which there is a hot fire.

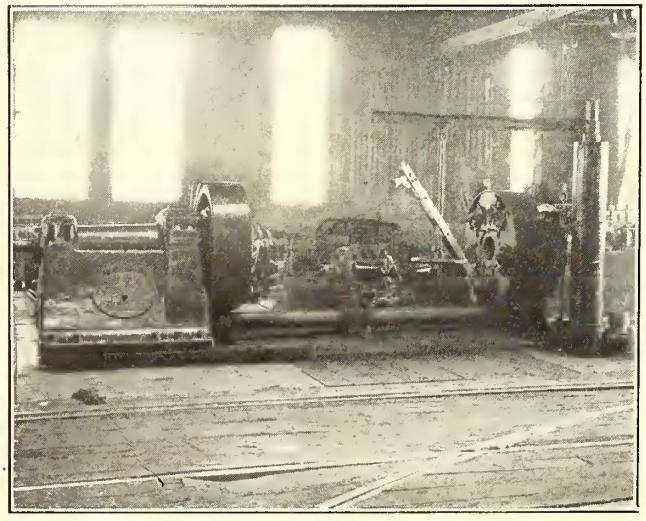
MISCELLANEOUS SHOP EQUIPMENT

The armature shop equipment includes two lathes, each of which is independently driven by an electric motor. One of



Cincinnati Shops—Small Turret Lathe with Independent Motor Drive

these lathes is used for turning commutators and the other for banding. The lathes stand at right angles to each other and close to a platform on which armatures are stored. A jib crane with a chain-block hoist serves the two lathes and the storage platform. By this arrangement of tools the course of an armature through the shop is made direct. The winding horses are located on the south side of the building. From here the armatures are taken into the baking oven at the southeast corner and thence to the storage platform nearby. The platform has on it at all times armatures in two conditions: at the south end are those which are ready for the turning lathe, and at the north end those which are ready for shipment to a car house. The single jib crane located near the



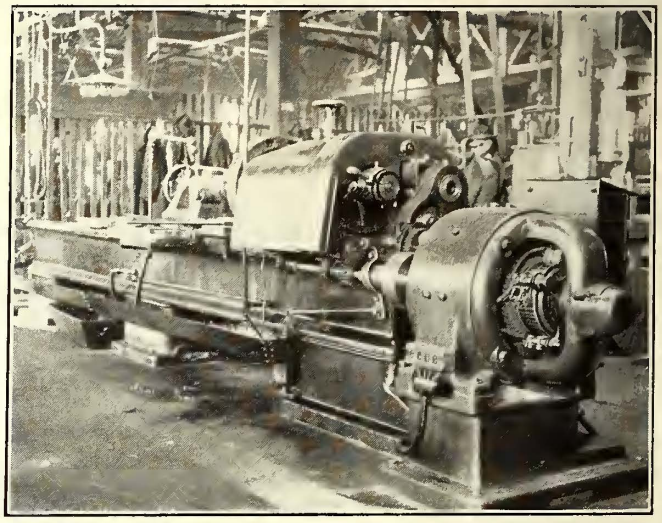
Cincinnati Shops—Motor-Driven Wheel Lathe Served by Air Crane

two lathes and the platform is thus available for doing practically all the heavy lifting required in moving the armatures about the shop.

Each armature shaft, just before the armature is approved for service, is fitted with new bearings. No special attempt has been made to standardize armature shafts and so bearings are fitted for each. The platform on which the finished armatures are stored is close to the door leading to the machine shop and the man from the machine shop who finishes the bearings can easily step across and caliper the shafts.

TESTING BOARD

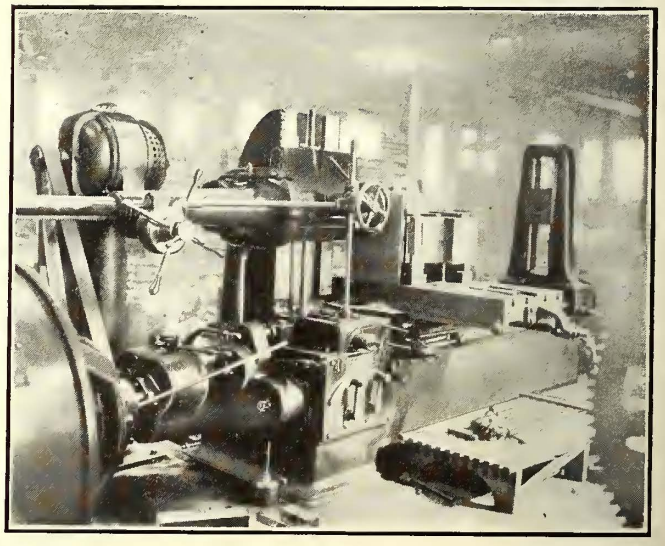
A testing board has been fitted up in one corner of the electrical shop. Controllers are repaired and resistances as-



Cincinnati Shops—24-in. Lathe and D.C. Variable-Speed Motor

sembled here. The testing board includes two panels with illuminated dial voltmeter and ammeter mounted on a swinging bracket. In testing circuit breakers they are mounted vertically. A series of seven knife switches connecting with resistance grids makes possible an adjustment of the load from 55 to 335 amp.

Alternating current for testing purposes is available in any part of the armature shop. Current is received into the shop at 110 volts and a system of wiring in conduit makes this voltage available at a number of sockets conveniently distributed. The 2500-volt testing transformer is mounted on a truck and is provided with a long connection cord. No mat-

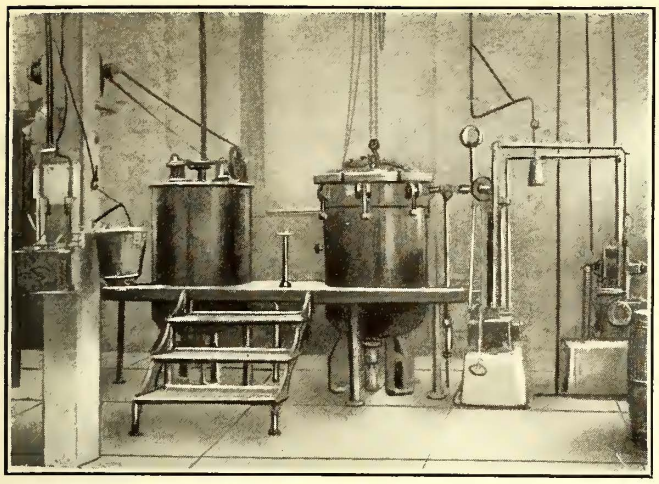


Cincinnati Shops—Horizontal Boring Machine with Independent Motor Drive

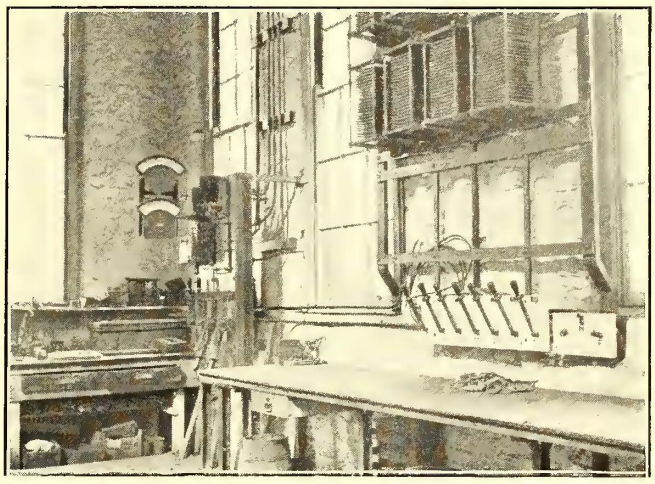
ter where the truck may be wheeled about the shop floor the cord will still reach one of the current supply sockets.

CURTAINS

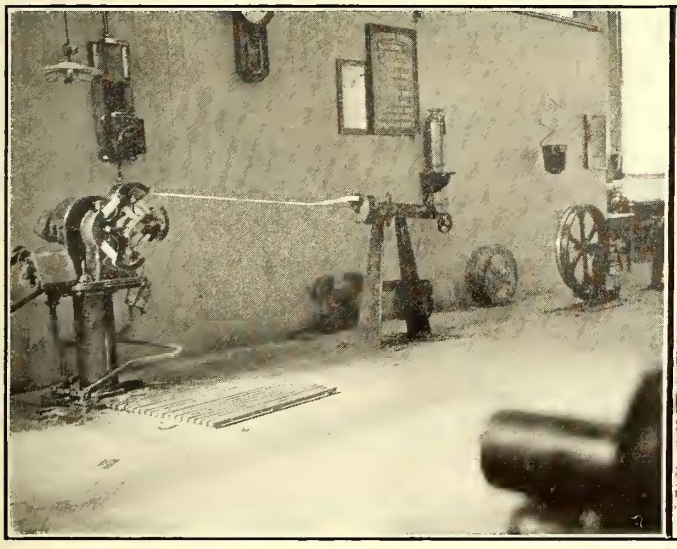
Two power-operated sewing machines have been installed at one side of the coil-winding room. These machines are operated by two girls, who repair and make all the curtains for the open cars. About 200 sets of summer car curtains are re-



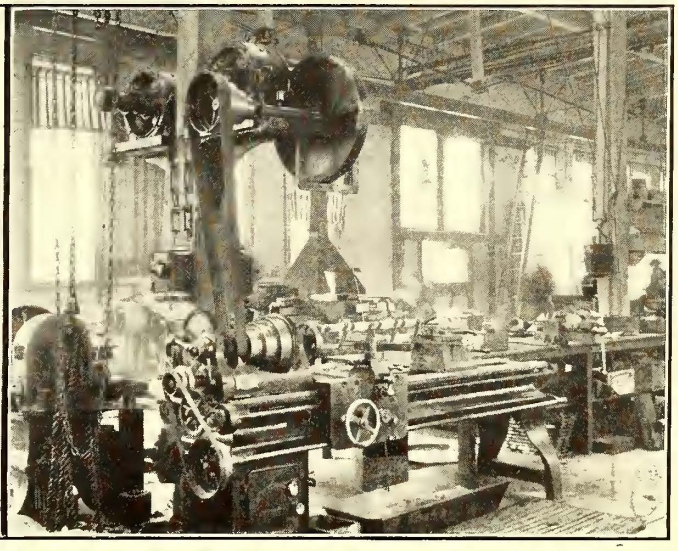
Cincinnati Shops—Vacuum Impregnating Plant in Armature Shop



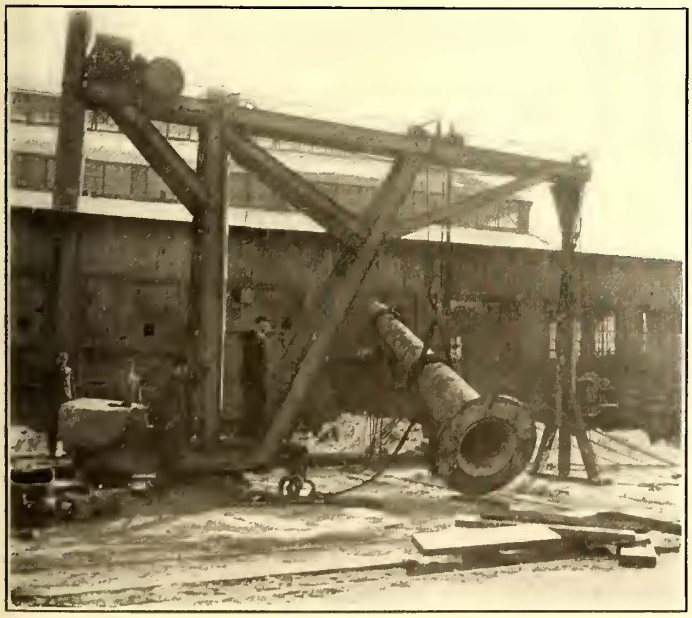
Cincinnati Shops—Corner of Electrical Shop Set Apart for Testing



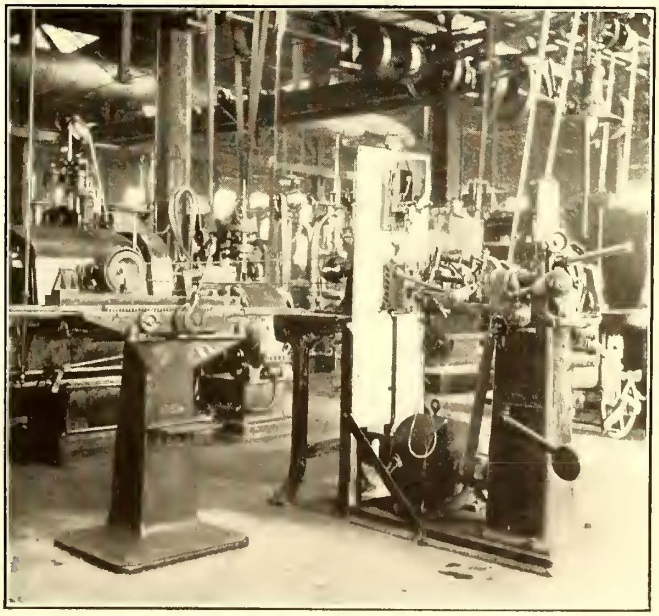
Cincinnati Shops—Field Winding Lathe and Wire-Retaping Device



Cincinnati Shops—Independent Motor Drive for Banding and Commutator Lathes



Cincinnati Shops—Home-Made Electric Crane in Shop Yard



Cincinnati Shops—Motor Installation Driving Two Grinding Tools

quired each year. A cheap canvas is used because it is thought more economical to replace them frequently than to repair more expensive curtains. All the curtains on every car that is put through the shop are inspected and overhauled by these two young women. The better class of curtains used on closed

ACCOUNT No. TITLE

JOB STARTED JOB FINISHED REPORTED CLOSED

	LABOR	MATERIAL	TOTAL		LABOR	MATERIAL	TOTAL
Amount Forward January				Amount Forward July			
February				August			
March				September			
April				October			
May				November			
June				December			
				TOTAL			

Cincinnati Shops—Cost Accounting Record Card

cars are rebound and the cloth is turned end for end, thus putting the faded part next to the roller and out of sight.

When this curtain shop was equipped with the power-driven sewing machines several attempts were made to build a satisfactory power clutch for driving the sewing machines off from the main shaft underneath the table. None of these was highly successful. Now the machines are under excellent control, obtained through the medium of a power transmission device manufactured by the sewing machine builder.

MACHINE SHOP

The machine shop of the Cincinnati Traction Company is of particular interest because of its excellent equipment of tools, nearly all of which are independently driven by 500-volt electric motors. In purchasing these tools special care was taken to choose those which would be suitable for removal at a later date to the new shop buildings which the company is planning to erect. The present machine shop building is shared jointly by the Cincinnati Traction Company and the Cincinnati Car Company. A high fence separates the work of the two companies. The car-building company's business has grown to such proportions that it is necessary for it to have more room and hence the traction company, which has ample land close by the present shops, will erect new buildings and the Cincinnati Car Company will occupy part of the space now used by the traction company.

Cincinnati Traction Company.

Barn Armature Record.

Car | OPEN / BOX Date, 190

Armature, Type,

Date in, Date out,

CAUSE FOR SENDING TO SHOP:

Barn Foreman.

B. P.

Person Receiving Armature.

NOTE—Both Barn Foreman and person receiving armature must write what in their opinion was the cause of the trouble.

Cincinnati Shops—Report Accompanying Defective Armature

MOTOR INSTALLATIONS

Several of the accompanying illustrations show various methods of motor installation for driving the tools in the machine shop. The electrical equipment has been installed in a very thorough manner. The 500-volt supply is brought to a main switchboard erected close to the shop foreman's office and from this board feed lines radiate to various groups of tools. Each line is protected by a circuit breaker on the board. All of the wiring inside the building is enclosed in tightly fitted iron conduit with porcelain condulets at all outlets. In laying out the conduit great care was taken to provide against accidental injury to the conducting wires. The thoroughness of this work was warranted because of the desire for protection against fire and assurance of continued current supply to each machine tool.

The feed lines from the control board pass through conduit carried on the roof rafters or under the concrete floor and terminate in small panel boards at the tools. One of these boards is illustrated in the view showing the group of tool grinders. At the board the feed lines emerge from the porcelain outlet and connect directly with a General Electric type C two-pole circuit breaker. From the opposite terminals of the circuit breakers the lines are again carried in conduit to a starting box and thence in conduit to the motor. In this way no wires are exposed, except the very short lengths necessary for attaching to the terminals of the different pieces of apparatus. The terminal board at each tool is of fireproof construction and is mounted in a substantial angle-iron frame bolted to the concrete floor or to the machine which is to be driven.

The motors are of the variable-speed commutating type and of both Westinghouse and General Electric manufacture. Special care was taken in the choice of motors for operating the various kinds of tools. Those motors which drive lathes have reversing controllers with a speed control handle directly on the lathe carriage. Thus it is possible for the machinist to start, stop or regulate the speed of his lathe through wide limits without leaving the position where he can best observe the working of the cutting tool. Some of the older tools in the shop are driven by GE-800 railway motors, which, at a cost of about $30 each, were rewound with shunt fields and now are said to give excellent service for driving constant speed tools.

HORIZONTAL BORING MACHINE

A great variety of railway shop work can be done with facility on the new Lucas horizontal boring machine shown on page 582. This machine is driven by a 5-hp semi-enclosed motor mounted on a cast-iron pedestal which supports it about 5 ft. above the floor and stands about 2 ft. away from the bed of the boring machine. The elevated position of the motor permits the use of a belt for transmitting power to the gear box of the machine. The table of the boring machine may be fed in either direction horizontally and the boring shaft has hand and automatic feeds for horizontal or vertical movement. With these combinations and a number of large cutting tools a considerable variety of work can be performed. The illustration shows the machine in the act of facing a casting.

REBORING MOTOR SHELLS

The horizontal boring machine just described is used for reboring motor shells. In this work a heavy jig and dummy shaft are used to support the shell on the machine table. Special clamps are provided for holding the jig to the table so that the holes bored will conform to uniform standards. When a shell is to be bored the bolt holes in the bearing housings are first rebored and increased in diameter from 1 in. to 1¼ in. Then the jig is set on the table of the horizontal boring mill and an arbor is put through the axle bearings. The shell and jig are held to the table by bolts passed through the holes in the bearing housings. By means of a boring bar with adjustable cutting tools the armature boxes are first rebored. Next an arbor is put through the armature bearings and the cutting tool adjusted to refinish or rebore the axle bearing housing. By the use of this combination of jig and bars uniformity in bearing housings is assured.

Four sizes of axles are used. New axles are finished 4½ in. in diameter and after they have been worn are taken out and turned down to 4¼ in., then, after a second wearing, they are turned to a diameter of 4 in. for use in another type of motor. In this way, with these three standard sizes, the purchase of one new axle and the machine work on two worn axles make

it possible to put three new axles in service on the road. In working over old axles they are carefully annealed in a blacksmith shop so that the metal may be under no undue stresses when it is returned to service.

LATHE EQUIPMENT

A 24-in. Lodge & Shipley lathe, direct driven by a 10-hp motor, is used for turning axles and for all kinds of general work. Two lathes of similar manufacture with swings of 20 in. and 16 in., driven by 7½-hp and 5-hp motors respectively, are used for smaller work. The 24-in. lathe showing the driving motor in the foreground is illustrated on page 582.

The Dreses turret lathe shown in one of the illustrations is driven by a 2-hp motor installed directly at one end of the machine. Power from the motor is transmitted through a single reduction gearing to a shaft close to the floor. This shaft extends under one end of the bed of the lathe and carries a set of cone pulleys which connect with the other set of cone pulleys by the usual leather belt. The switch, starting box and circuit-breaker for the motor are installed on a standard control panel within reach of the lathe operator from his position near the tool post.

WHEEL LATHE

The 42-in. Putnam wheel lathe illustrated is driven by a 25-hp variable-speed motor with a reversing speed controller. In turning steel wheels they are first roughed with a round-nosed tool and then finished with a shaping tool ground to the full contour of the tread and flange. A special air hoist for handling wheels and axles is mounted close to the driving end of the lathe. This hoist is made up of an air cylinder and a heavy piston extending upward. The top of the piston carries an I-beam jib reinforced with a heavy tension rod. A trolley carriage made of two small wheels yoked together travels on the lower lips of the I-beam and supports a balanced arm, which is used to lift the wheels. This lathe and crane are installed near the shop track on which wheels are received, and one man can easily lift a pair of wheels off the shop track with the crane and swing them onto the lathe centers. The lifting movement of the jib crane is controlled by an engineer's valve mounted on one side of the vertical cylinder.

MISCELLANEOUS TOOLS

The pair of grinding machines shown in one of the illustrations on page 583 is driven by a 4-hp motor, with a pulley on each end of the armature shaft. One of these machines is a Bullard surface grinder and the other is a Sellers universal twist-drill grinder. This installation stands close to the enclosed tool room adjoining the shop foreman's office.

In addition to the tools here described the equipment of this shop includes the following tools driven by motors of the capacities stated:

King 4-in. vertical boring mill, 10 hp.
Pond 21-in. chucking lathe, 7½ hp.
4-ft. radial drill, 5 hp.
Lodge & Shipley 36-in. lathe, 12 hp.
Emery tool grinder, 4 hp.
Two sensitive drills, 2 hp.
Small punch and shear, 3 hp.

Other tools not independently driven are as follows:

Niles wheel borer.
Niles 200-ton wheel press.
Horizontal planer, 36 in. x 36 in. x 12 ft.
24-in. back-geared shaper.
No. 3 Cincinnati milling machine.
Jones & Lampson 2-in. turret lathe.
Two punch presses.

Axle straightening press with Watson-Stillman hydraulic punch, having 8-in. ram.

Just outside the machine shop is a motor-operated crane which has done good service in unloading material from freight cars and placing it on the shop tracks. An illustration on page 583 shows this crane in the act of lifting a heavy cast-iron pillar, which is to form the center support of a more powerful crane that will replace the one shown in the illustration. On this crane, as well as on all the lifting apparatus used in the

CINCINNATI TRACTION CO. MECHANICAL DEPT.
Report of Armature Room. Month Ending 190

	ARMATURES RECEIVED											ARMATURES DELIVERED											FIELDS DELIVERED	
	34	67	68	87	88	87	93	800	1000	1200	Air Com	Total	34	87	88	87	93	800	1000	1200	Air Com	Total		
AVONDALE																								
EAST END																								
VINE ST.																								
W. HILLS																								
AVENUE																								
BRIGHTON																								
CLIFTON																								
EIGHTH ST.																								
INTERURBAN																								
TOTAL THIS MONTH																								
LAST MONTH																							ARMATURE COILS MADE	
LAST YEAR																							ARMATURE COILS ON HAND	
FOR COMP'T. REPAIRS																							FIELD COILS MADE	
PART REPAIRS																							FIELD COILS ON HAND	
COMMUTATORS ON HAND FOR REPAIRS																								

Cincinnati Shops—Monthly Comparative Statement of Armature Shop Work

THE CINCINNATI-TRACTION COMPANY
APPLICATION FOR EMPLOYMENT

Name in full _____ Date _____
Address _____
Trade _____
Nationality _____ U. S. Citizen _____ Married _____ Children _____
Age _____ Height _____ Weight _____

LAST EMPLOYED

Name _____ Address _____
" _____ "
" _____ "

EMPLOYED

Where _____ Date _____
As _____ Rate _____

Clerk. Foreman.

See Remarks and Change of Rate on back of card.

Cincinnati Shops—Record to be Filled Out by Applicant for Employment

Closed. Summer. Car No. _____ Live. Dead.
Received from _____ 19
For Complete Repairs _____ Slight Repairs _____ Repairs to Trucks _____
Repairs caused by Accident, as follows _____
Nature of Repairs. Carlines _____ Roof _____ Canvas _____ Hood _____ Vestibule _____
Platforms _____ Dash _____ Running Board _____ Floor _____ Sills _____ Seats _____
Panels _____ Windows _____ Inside Finish _____
Truck _____ Motor Repairs _____ Wiring _____
Painted Complete _____ Touched up _____ Varnished _____
Carpenter Shop _____ Completed _____ Transferred to _____
Paint Shop _____ Complete
All Work Complete _____ Stored
Sent to _____ 19

Cincinnati Shops—Shop Car Repair Records

THE CINCINNATI TRACTION COMPANY
RECORD OF EMPLOYEE LEAVING SERVICE

Name in full _____
Employed as _____ at _____
Has this day Resigned _____ Resigned by Request _____ Been Discharged _____
Cause of Leaving _____
While under my supervision I considered him _____
Date _____
Clerk. Foreman.
Clerk must sign and forward this card to Assistant General Manager

Cincinnati Shops—Record of Employee Leaving Service

shops and car houses which is operated by air, control is had by the use of engineers' brake valves. These valves are easier to maintain than the more usual type employed in this service and are freer from leakage.

SHOP CARD RECORDS

When a car is turned into the shop for repairs or general overhauling, a heavy brown manila tag, 8½ in. x 5 in. in size, provided with a protected eyelet, is tied on. The shop inspector notes on this repair tag or card just what work is to be done. After the car has been repaired and has been approved by the inspector the tag is visèd and returned to the master mechanic's office. When the repair tag is received at the office the information presented thereon is transferred to the duplicate card car record and filed vertically according to the car number. One of these cards is reproduced on page 585. Thus in a single file the master mechanic has at his disposal the complete shop record of each car that has been repaired.

A simple method of presenting the shop expense for various operating accounts of jobs, is had by the use of a card record made up of 8 in. x 5 in. cards ruled as shown in the reproduction on page 584. These cards are filed vertically and one card is used for each job or standing maintenance order. It will be noted that the record affords a ready means of presenting the labor and material and total costs for any one class of work or any single job, separated according to the months of the year. The cards are kept in drawers and are indexed and subdivided into three groups: (1) purchasing agent's orders; (2) job orders and (3) maintenance accounts.

The records of the electrical shop of the mechanical department present a complete history of each field and armature according to number. Each day the barn foreman sends to the foreman of the armature room detailed reports showing the cause for removing and sending to the shop each armature that needs repairing. The blank used in making such reports is reproduced on page 584. The use of this blank has a good effect in encouraging care and watchfulness on the part of the men handling the equipment in the barns. It will be noted that the barn foreman first is required to set down his opinion of the cause for requiring that the armature be sent to the shop. Later, when the armature and the foreman's report accompanying it are received in the armature shop, the person receiving the armature writes on the bottom of the blank his opinion of the cause of the trouble to the equipment. These reports, containing the opinions of the two men handling the armature are made in triplicate. One is kept by the barn man, one is sent to the armature room with the armature, and the third is sent to the master mechanic.

An independent record of each armature is kept in a loose-leaf book by the foreman of the armature room. The pages in this book are ruled to present the following information: Number of the armature, style, dates received, nature of repairs and dates delivered. The pages are 6 in. x 9 in. in size.

Each month a complete summary of the work of the armature shop is made up and inserted in the system of card records kept in the master mechanic's office. One of these reports is shown on page 585. It shows the number of armatures received and delivered to each of the car houses, the number of fields delivered, armature coils made, armature coils on hand, field coils made and field coils on hand. Totals for the armatures of various types of motors and air compressors are presented and similar totals for all classes of armatures for each barn and shop are shown. The report also presents detailed comparisons of the work done on armatures of the same type during the last month and the last year; it shows the number of armatures sent in for complete repairs and part repairs; commutator repairs, and the number in the armature shop awaiting repairs. A similar report is used for recording the repair work on fields and the number of trolley wheels returned and delivered. With these reports and detailed comparisons presented the master mechanic is able to keep a close line on the performance of the various classes of equipment, as well as note the amount of work done upon each car by the shop forces.

A rather complete record of the service of each shop employee is kept by the master mechanic, on a form illustrated on page 585. When application for employment is made the man is required to answer the questions shown on the blank and to give references. All references are investigated before a man is employed. Space is provided on the back of the application card for noting the date on which the man is employed and his hourly rate; also the date on which his work or his rate of pay may be changed. When an employee leaves the service a summary of his record is presented on a card which shows the date and cause of leaving, and gives the foreman's opinion of the man. After having been properly filled out at the shop, these cards are forwarded to the office of the assistant general manager.

SCHEME FOR PREVENTING BREAKAGE OF COAL-HANDLING GEAR

At the power plant of the St. Clair Tunnel Company, at Port Huron, Mich., a simple scheme has been adopted for preventing the breaking of important parts of the coal-conveying apparatus. Coal for this plant is received in steam cars and dropped into a crusher located beneath the track parallel with the boiler and bunker house. From the crusher a horizontal conveyor carries the coal to an elevator which in turn discharges into a belt conveyor above the coal bunkers in the roof of the boiler house. This train of coal conveying elevators and belts is driven by an electric motor through a sprocket wheel and chain. When the plant was first started the driving chain and sprocket frequently were broken by the excessive load put on when a miner's pick or some other piece of foreign metal got into the crusher. It was necessary at first to keep extra sprocket wheels on hand so that repairs could be made quickly if the crusher became clogged with foreign substances and broke the driving apparatus.

The sprocket wheel originally was keyed onto its shaft and thus any undue strain on the shaft showed its full effect in tending to break the teeth on the sprocket wheel or the links of the chain. To provide against such damage, the use of the sprocket wheel key was discontinued and the wheel so fastened to the shaft that an abnormal load would shear the fastening rather than break the teeth of the sprocket.

In mounting the sprocket wheel in the improved way the hub was bored out so that it had a slack fit on the shaft. Then a collar was set on the shaft on either side of the hub to hold the sprocket in its proper location. Next a hole was drilled clear through the two collars and the hub of the sprocket and a pin inserted. By the cut-and-try method a pin ⅜ in. in diameter was found to give sufficient shearing stress to carry the full load of the coal-handling machinery, and to give way and let the sprocket turn on the shaft whenever an undue load was thrown on the crushing or conveying machinery. This simple little scheme of mounting the sprocket wheel has done away with a troublesome detail of operation. Now when the pin shears and the motor revolves without driving the coal-handling apparatus the foreign substance causing the shut-down is removed from the crusher, a new pin is inserted quickly and the machinery soon placed in operating condition.

STEEL CAR PANELS OVER WOOD

Owing to the climatic conditions in Richmond, Va., the wooden panels on the cars are frequently cracked. Instead of replacing them with new wood panels the Virginia Railway & Power Company covers the old panels with steel of No. 18 gage. These steel sheets are screwed on under the old side moldings and when painted they cannot be distinguished from wood. In fact, there are many cars which have wood panels on one side and steel-covered panels on the other. When steel panels are applied, they are continued past the belt rail without a break and this prevents the rotting which occurs when water from the belt rail gets inside the car between the joints of the wooden half-panels. The plates are shaped in the company's shops and are applied whenever it is found that a considerable number of the wooden panels are split.

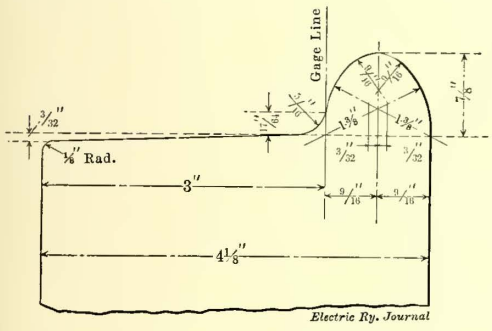
INTERESTING SHOP PRACTICES AT INDIANAPOLIS

Ingenious Methods of Caring for Wheels, Brakes and Motors on a Large Road

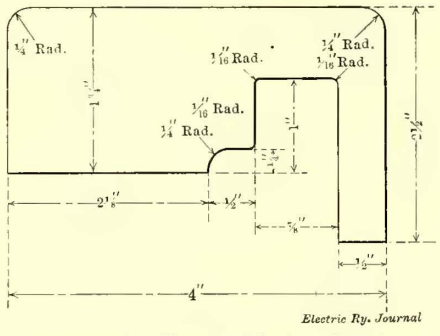
THE repair work for the city cars of the Indianapolis Traction & Terminal Company and for the interurban cars operated on one division of the Terre Haute, Indianapolis & Eastern Traction Company is done at the West Washington shops of the former company. Many interesting and thorough practices are followed here under the guidance of L. M. Clark, master mechanic. The detail system of record cards and monthly summaries of repair work are worthy of special attention because they are designed to give the management of the road very accurate and comprehensive statements of the condition of the various types of equipment. The buildings in which the repair work is done are not new, with the exception of the paint shop described elsewhere in this issue. The reconstruction of part of the shop group is contemplated. The present article describes the wheel practice, an air-brake testing department and motor testing, and presents a number of the blank forms used, together with a description of some of the more interesting shop kinks.

WHEEL PRACTICE

The Indianapolis companies were among the first electric roads to use steel wheels and steel-tired wheels, but now the steel-tired wheels are being dispensed with. About a year ago the two companies adopted a forged-steel wheel manufactured by the Forged Steel Wheel Company, Butler, Pa. None of these wheels has, as yet, been in the shop for re-turning, although some of them have run more than 40,000 miles. The wheels used under interurban cars are 34 in. and 38 in. in diameter and have rims 3¼ in. thick with a contour as shown in the accompanying engraving. The tread of this wheel is 3 in. wide and the flange 1⅛ in. thick from gage line to the back of the wheel. The flange is ⅞ in. deep. It is the practice to wear and turn the rims down to a thickness of ⅝ in.



Indianapolis Shops—Contour of Steel Wheel Flange and Tread



Indianapolis Shops—Limit of Wheel-wear Gage

The wheels in service are inspected with a limit gage made from case-hardened steel ¼ in. thick. It is so shaped that its position is fixed by the back of the wheel and the flat of the tread. It will fit over a flange that has a thickness no greater than ⅞ in. on a line ¼ in. above the projected line of the tread. When a wheel has reached this limit of wear it is taken out of service and about 5/16 in. of metal is turned off the tread in order to reshape the flange. The wheel inspectors pay especial attention to ordering wheels in for re-turning at the point in their life when the flange can be reshaped with the least practicable loss of metal on the tread.

WHEEL RECORDS

Detailed records of the performance of each wheel are carefully kept in the office of the master mechanic. When a pair of wheels is sent into the shop for any work a tag of the form illustrated is attached to the axle. On the face of this tag are entered the axle number and the tire number. The tire on the gear side is denoted by the letter "G." The face of the tag also bears the name of the inspector and the date on which the wheels are removed from service. The reverse side of the tag as illustrated shows a list of the eight common reasons for withdrawing wheels and axles from service and provides a space opposite for checking. The reverse side of the tag also has spaces for showing the car number, wheel number, name of inspector and date for each wheel removed and put on.

After the steel car-wheel record cards have served their purpose in the shop and the desired information has been entered thereon at the time the wheels are returned to service, the cards are turned into the master mechanic's office. Here a card-index system presents the history of each wheel. One of these cards, which are 6 in. x 4 in. in size, is reproduced in part. It will be noted that the various identifying characteristics of the wheel are exhibited at the top, including the size, material, date of purchase, name of manufacturer and notes regarding the fitting of the wheel. Lines are ruled for 14 entries to show the numbers of the cars under which this wheel has been placed, the date it was put under each car, the measurement at that time, the date, cause of, and measurement at the time of removal, and a tabulation of the number of miles and days, and loss of metal in service, also the shop number of the workmen who handled the wheel.

AIR BRAKE MAINTENANCE

A testing room for air brake parts has been fitted up with devices for making thorough inspections of the more important parts of the braking equipment. The shop forces have built here a complete testing rack arranged so that a series of service tests may be given triple, brake, feed and safety valves and various types of motor-compressor governors. The governors are set at known loads by feeding the test current through large banks of incandescent lamps used for resistance.

The most interesting feature of this air-brake test room is an installation of reservoirs equipped for accurately testing the pumping capacity of motor-driven air compressors. The principal parts of this testing set are two tanks, the capacities of which have been carefully calibrated by measuring with water. These tanks are mounted on the side wall of the room and connected by a short run of pipe with a valve inserted. Provision is made for closely observing the temperature of the air within the tanks, and in computing tests account is taken of the relation between temperature and pressure. These corrections are readily made by the use of a temperature table and they adjust the results for the correct pumping pressure exclusive of that caused by the heat of compression.

The upper of the two tanks is connected with the pump by a flexible metallic tube which is air tight. When the test set was first installed rubber hose was used, but it was found that the heat, during continued service, weakened this to a point where accidents might be expected.

The object of the pump test is to obtain an accurate record of the amount of free air pumped by the motor compressor while working against a back pressure of 100 lb. When being tested, the compressor is run for the full number of revolutions which it should make in a minute and not for a unit of time of one minute. This precaution is taken because of a possible

variation in voltage which might change the speed even though the pump was in good condition. The reason for using two tanks is to be able to maintain a constant back pressure of 100 lb. on the pump, meanwhile timing its revolutions and measuring the air exhausted into the lower tank.

In performing a test the pump is set to work and its exhaust led through the metallic tube to the upper tank, the pressure in which is allowed to reach 100 lb. The lower tank has a capacity of 5 cu. ft. and is connected with the upper tank through a valve. When the pressure in the upper tank has reached 100 lb. the operator starts counting the revolutions of the pump and his assistant tends the valve between the pressure and measuring tanks, keeping the pressure at 100 lb.

During the test the excess air above that required for maintaining a pressure of 100 lb. in the pressure tank, passes into the measuring tank, which, at the start, was under atmospheric pressure. At the end of the run, which extends for a definite number of revolutions of the pump, the pressure in the measuring tank is noted. Atmospheric pressure is added to the gage pressure and the sum is divided by the capacity (5 cu. ft.) of the reservoir to ascertain the number of feet of free air pumped during the run with the compressor operating against the 100 lb. back pressure. From a handy table the inspector is able to know what this pump should do, and if it does not meet the requirements the necessary repairs are made. No leeway is allowed and if a pump does not operate up to its full rated capacity under this test it is repaired before being put into service, otherwise it certainly would not operate at its rated output when installed under the car.

This method of testing a pump in a special room has the advantage that the test conditions can be maintained constant and any defect in the pump be located easily, while if the test were made on the car a poor pump might be excused on account of leaky pipes, incorrect gage or some other outside condition.

AIR-BRAKE RECORDS

A monthly report of the repairs made to air brake equipment is prepared. The blank used to make this report is reproduced. It presents a list of the types of compressors, governors and brake valves used and the defects and repairs more commonly experienced. In addition, the work on valves, cylinders, slack adjusters and air gages is noted, and a summary showing the number of cars on which the piping has been repaired and the brakes overhauled or standardized for the current month as compared with the previous month is presented.

Form 56

Indianapolis Traction & Terminal Company

STEEL CAR WHEEL RECORD CARD

AXLE NO._____ G TIRE NO._____
TIRE NO._____ _____

REPAIRS_____

_____

_____

BY_____

DATE_____

DEFECTS

X | Sharp Flange | Loose Tire | Broken Tire | Loose Wheel | Flat Wheel | Loose Gear | Broken Gear | Sprung Axle

REMOVED
CAR NO._____
WHEEL NO._____
BY_____
DATE_____

PUT IN
CAR NO._____
WHEEL NO._____
BY_____
DATE_____

Indianapolis Shops—Obverse and Reverse of Car Wheel Record Card

Form 239 5c 7-09

TERRE HAUTE, INDIANAPOLIS AND EASTERN TRACTION CO.

		Diam of Centre		Material		Wheel Fitted by		Pressed on by			
Wheel No		Made by		Purchased		Pd to Service		Tons Pressure			
		Diam	Material	Made by		Purchased	Put in Service	Fitted by			
Axle No											
Tire No.											
Put In				Removed			No.	No. Days	Tire		
Car No	Date	Measurement	Date	Cause	Measurements		Miles	in Ser.	Loss		Work Done By

Indianapolis Shops—Card Index Record of Wheel Performance

FORM 129

INDIANAPOLIS TRACTION AND TERMINAL COMPANY

Air Compressor Record

Make & Type_____ Pump No._____ Motor No._____

PUT IN		REMOVED		SERVICE		REPAIRS			TEST	
Car No.	Date	Cause	Date	Mileage	No. Days in Service	Nature	By	Date	Cu. Ft.	By

Indianapolis Shops—Air Compressor Record Cards

Form 110.

Indianapolis Traction and Terminal Company

MONTHLY REPORT OF AIR BRAKE REPAIRS.

W. WASHINGTON ST. SHOPS FOR MONTH OF 19

TYPE OF COMPRESSOR	DEFECTS: Disabled	Worn Cyl's	Worn Valves	Worn Bearings	Dirty Valves	Clogged Suction	Defective Lubrica	Motor Trouble	Air Leakage	REPAIRS: Cyl. Bored	Cyl. Overhauled	Re-paired	Tested	Total No.
West'g D-1-E-G.														
" " D-2-E-G														
Christ'sen AA1														

GOVERNORS	Disabled	Defective Packing	Defective Contacts	Burned Magnets	Grounds	Air Leakage				Over-hauled	Re-paired	Tested	Total No.
West'ghouse G													
" " J													
Christ'sen E													

BRAKE VALVES	Disabled	Air Leaky	Defective Latch	Overhauled	Re-paired	Tested	Total No.	MISC.	Disabled	Air Leakage	Defective Lubrica	Overhauled	Re-paired	Tested	Total No.
West'g O.V.P.								Triple Valves							
" Misc.								Feed " "							
Christ'sen Eng.								Brake Cyl.							
								Sla. Adjuster							
								Air Gauges.							

MISCELLANEOUS

No. of Cars. piping repaired, Current Month_____ Previous Month_____
" " " Brakes Overhauled " " " _____ " " " _____
" " " " Standardized " " " _____ " " " _____

REMARKS

_____

_____

_____

_____

_____

_____

_____

_____ Clerk _____ Foreman

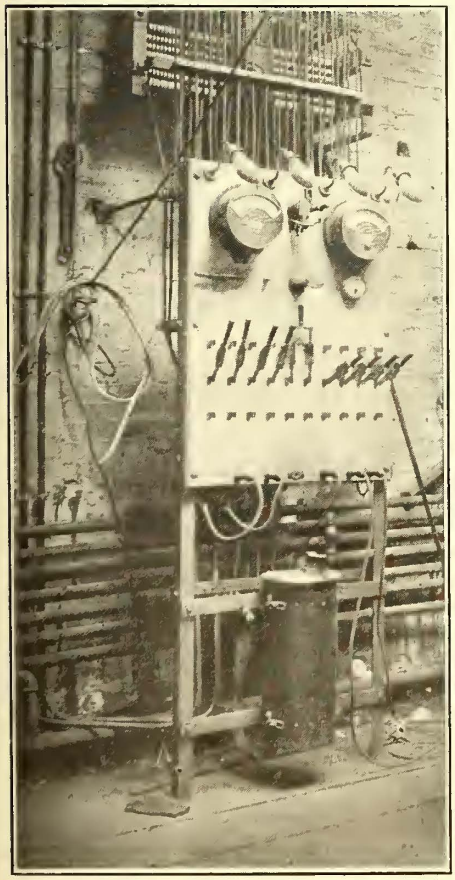
Indianapolis Shops—Monthly Summary of Airbrake Repairs

A set of card records for the use of the master mechanic's office is kept. These records, as reproduced, show the type and number of each air compressor and give the data regarding its service, the time of installation, time of removal and the repairs and tests made. Information for making this record is obtained from an air-compressor repair card tied to the compressor when it is taken out of service. The obverse and reverse of these tags, which are handled in a way similar to the wheel record tags, are shown.

MOTOR TESTING

Every car motor that is repaired in the Indianapolis shops is given a running test on the shop floor before it is put under a car. An illustration of the motor-testing board and a wiring diagram of that board are reproduced. A table of constants for the current and voltage readings for each type of motor has been prepared, so that when a motor is being given a test and the current and voltage values are noted it then is possible to determine fully whether or not the motor is running freely. If the bearings should not have been fitted properly the extra demand for current will indicate the fact. By the careful use of testing methods many causes for motor heating are learned in the shop where they can be easily corrected, and unnecessary pull-ins be prevented.

The testing board stands at one corner of the truck repair shop. An independent feed line direct from the power house furnishes current to this board. By means of this special connection the voltage regulation obtained at the testing board is equal to that of the power station busbars and is not affected by the shifting of cars in the shop yards, as it would be if the testing board were fed from the trolley wire. The board is equipped with a 100-amp ammeter and a 600-volt voltmeter and is protected by a 100-amp circuit-breaker. The lower part of the board carries eight single-pole, double-throw, 100-amp knife switches and a double-pole double throw switch, by means of which the various resistance grid connections are made to obtain a wide range of resistance values for comparative purposes. With these connections a range of resistance from 8.42 to 26.48 ohms in steps of 0.25 ohm and from 2.12 to 7.38 ohms in steps of 0.052 ohm may be obtained with facility. An R-28 controller serves for operating the floor tests given the motors. Testing current is distributed from the board to four different parts of the shops over cables carried in iron conduit. These cables terminte just below the test board and each is equipped with a feed connection plug. There is only one live socket to which these plugs can be connected; thus it is impossible for more than one of the distributing lines to be alive at one time. This precaution is taken to provide against accidents on the shop floor.

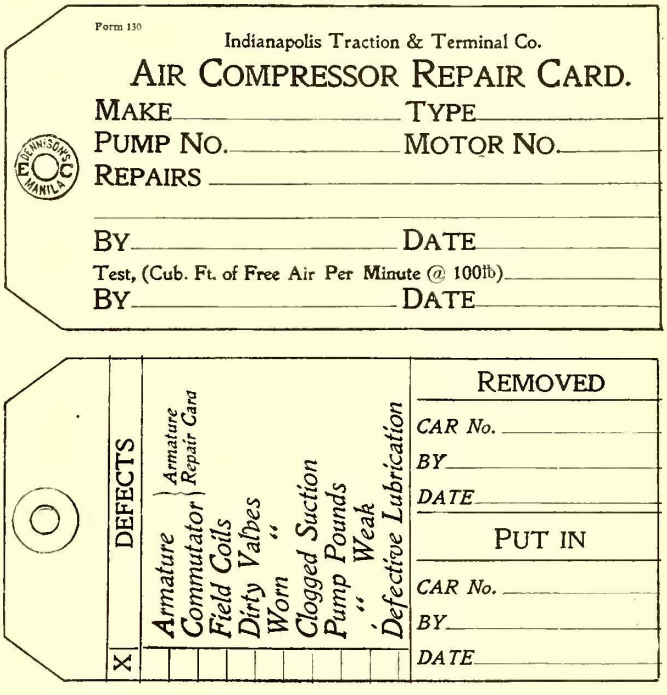


Indianapolis Shops—Test Board in Motor Repair Shop

ADJUSTING RESISTANCES

Resistance grids are repaired at a bench not far from the testing board. A lead from the board furnishes testing current at the repair bench and all resistance is checked before it is placed under a car. The method of checking requires that the proper resistance at each of the controller steps shall be obtained. The table used in adjusting resistance connections is given on page 591. As shown, the quantities quoted in this table for each resistance step are based on the use of a constant testing current of 10 amp, and thus the readings are in volts rather than in ohms. A current of 10 amp is not sufficient to heat the grids and therefore no correction for hot resistance is necessary. The use of constant current makes the calculation in voltage a simple matter because, with the testing current of 10 amp, the voltage reading at any step along the series of resistance connections equals 10 times the ohms resistance in the circuit, and it is only necessary to read the voltage and move the decimal point one place to the left to obtain the ohms resistance of the circuit.

In checking repaired resistance grids, measurements are first taken at the taps noted in the accompanying table. Then if the resistance at the various steps is not found to be correctly divided, adjustments are made by changing the taps until the voltage reading for the various steps closely approximates that shown in the table.



Indianapolis Shops—Obverse and Reverse of Air Compressor Repair Card

Alternating current for testing armatures is obtained from a small rotary converter installed in the armature shop. The a.c. output of the generator is fed to a step-up transformer from which current is taken to give voltage tests of the following values:

Late type armatures when new	2,400 volts
Late type armatures when old	1,800 volts
Old type armatures new or rewound	1,800 volts
Old type armatures repaired	1,200 volts

When an armature is sent into the shop for repairs a tag similar to that earlier described for checking the work done on wheels is attached. The printing on the two sides of one of these armature repair tags is reproduced. After the armature has been put through the shop the tag is turned in at the master mechanic's office and the information presented thereon is transferred to an armature record card illustrated on page 591. These cards are filed in an index and each presents the complete history of one armature, showing the time the armature has been in service, the reasons for renewal, the repairs made and the mileage and number of days in service.

Once a month a report of motor repairs is prepared by the shop office force. This report is similar in general form to that used in connection with the air brakes and indicates the repair work required on each of the various types of motors used. Space is provided for comparing with the record for the previous month, the number of repairs of different kinds happening during the current month.

SHOP KINKS

Babbitted bearings are finished on a lathe fitted with a special quick-clamping device for holding the bearing shell in line. An illustration of the carriage of this lathe with a bearing in place is shown. The bearings are finished with tools set in a Davis boring bar having a micrometer adjustment. The hinged clamping block is designed to hold the largest bearing shells. Liners are provided for shells of smaller sizes so that this lathe attachment serves for finishing all babbitted bearings.

A number of the small tools in the shop are operated by 110-volt motors. Current for this service is obtained from an old separately excited 500-volt motor run at slow speed.

To increase the speed in handling wheels in and out of a Niles lathe the tail stock of that lathe has been fitted with a 6-in. diameter 36-in. stroke air cylinder which serves to move the heavy tail stock quickly and without effort on the part of the lathe operator.

The thermit process of welding has been used in these shops for two years and its varied usefulness has been demonstrated many times. One of the interesting repair jobs made with thermit is that of welding truss rods. When a car has been in a collision and the truss rods damaged, the rods are straightened and rewelded in place without tearing down the car siding for removal.

Form 121-5m 11-09

Indianapolis Traction & Terminal Co.

ARMATURE REPAIR CARD

TYPE .....

SHOP NO. .....

REPAIRS .....

BY .....

DATE .....

X	DEFECTS
	Grounded
	Open Circuited
	Short Circuited
	Carbonized
	Worn Bearings
	Defective Bands
	Rough Commutator
	Defective Shaft
	Down on Pole Pieces

REMOVED

Car No. .....

Motor No. .....

By .....

Date .....

PUT IN

Car No. .....

Motor No. .....

By .....

Date .....

Indianapolis Shops—Obverse and Reverse of Armature Shop Tag

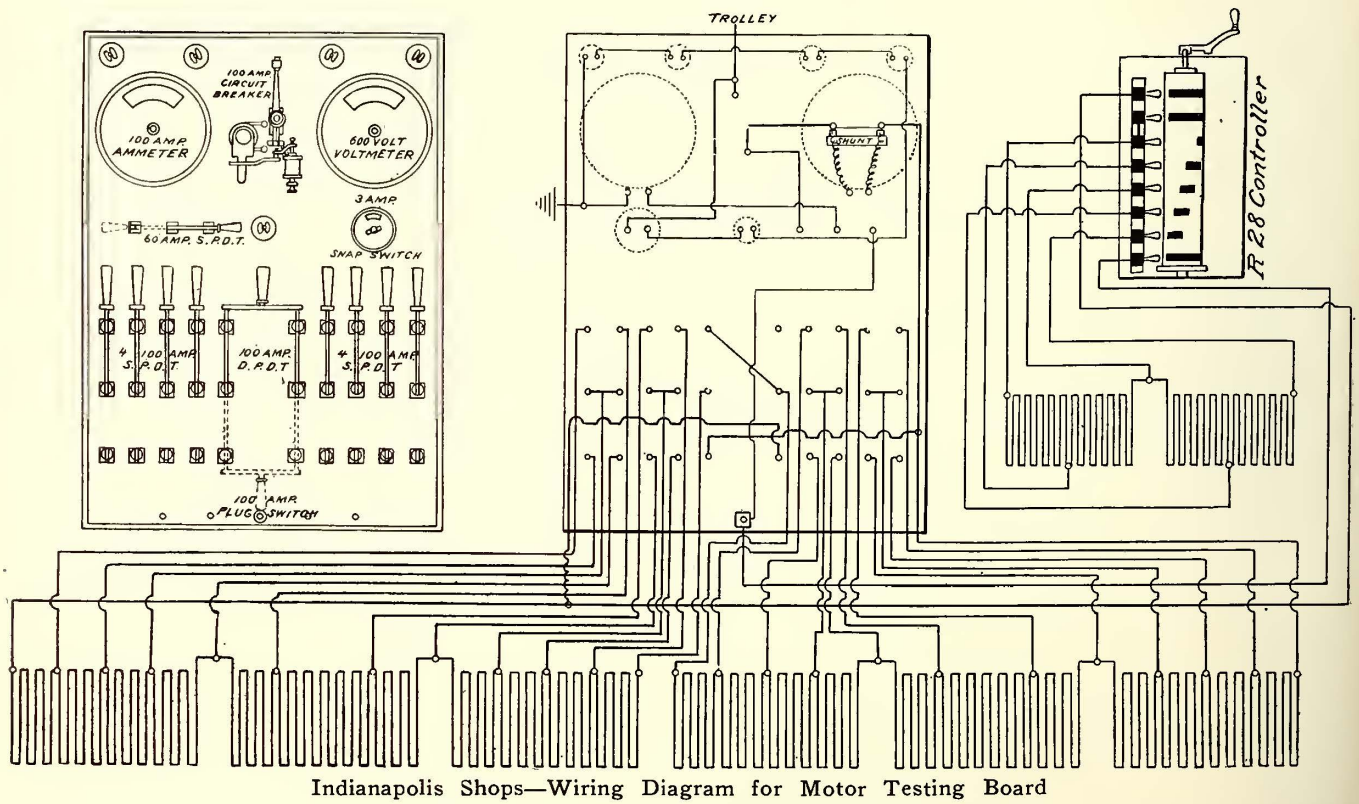
INDIANAPOLIS TRACTION AND TERMINAL COMPANY

COMPARATIVE REPORT OF PULL-OFF CARS

FOR MONTH OF .....

CAR BARN	Year	Car Body	Truck	Motor	Control	Cable	Air Brake	Trolley	Heater	Register	Lights	Sig. Bells	Brk. Glass	Air Frozen	Slack Brakes	Tight Brakes	Hot Brgs.	No Fire	No Water	No Defect	Relief Car	Wreck	Total	% of Cars Operated
ILLINOIS ST.																								

Indianapolis Shops—Comparative Report of Cars Pulled Out of Service



Indianapolis Shops—Wiring Diagram for Motor Testing Board

In the armature shop pure tin is used in place of solder for the purpose of fastening commutator leads so that they will not melt out at temperatures which would soften ordinary solder. The leads to Westinghouse 56 motor commutators are fastened in the slots without soldering and excellent results have been obtained by following this practice. The slots in the commutator bars are milled out to a width of 4/1000 in. less

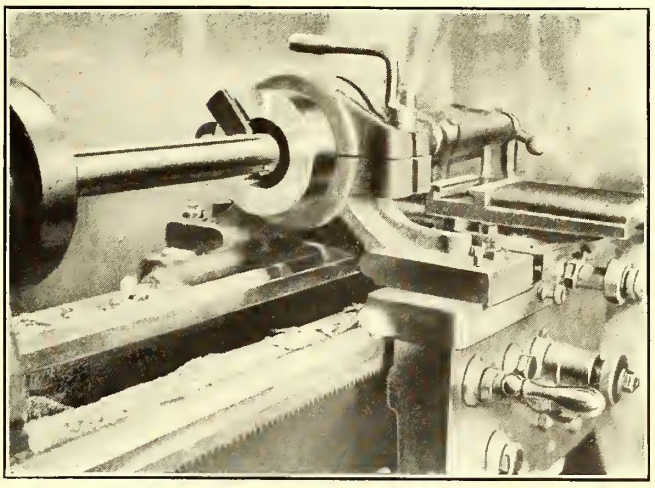
Motors.	Control	Weight of Car.	Dwg. No.	Connections	Volts.
2 GE-800 2 WH-3 2 WH-49	K2 K10	11 Tons	746	R1-R5 R1-R4 R1-R3 R1-R2	66½ 63 52½ 34
2 WH-56	K11	20 Tons	747	R1-R5 R1-R4 R1-R3 R1-R2	38 34½ 29 20
2 WH-93A2	K11	20 Tons	748	R1-R5 R1-R4 R1-R3 R1-R2	38 35 31 24

Indianapolis Shops—Table Used in Adjusting Resistances

than the diameter of the wires. The leads are driven into the narrow slots with a flat tool and the compression of the metal holds them securely in place without the use of solder or wedges.

BORING COMPRESSOR CYLINDERS

A special jig and reamer are used for finishing air compressor cylinders. The jig in which the compressor cylinder casting is held is made of cast iron about 1½ in. thick and is grooved on the under side to fit the lathe bed. This jig holds the cylinder in line with the center of the headstock, in which position it is adjusted by liners and clamped with bolts. The special reamer fits the headstock and has a cutting face about 6 in. long. Two of these reamers have been provided at a cost of about $40 each. A wide cutting face is obtained with a reamer and thus the walls of the cylinder are finished to a true cylindrical shape.



Indianapolis Shops—Method of Finishing Bearings with Boring Bar

BLANK FORMS

The form of card used by interurban motormen for reporting troubles found during operation is shown herewith. The original cards are 5 in. wide by 12 in. long printed on heavy manila stock. The arrangement of the listed car parts is such as to make it possible to find quickly the proper line on which the notation is to be made. The blank form carries a line for

Form 33

Terre Haute, Indianapolis and Eastern Traction Co.

Motorman's Report of Probable Defects in Car No. .....

..... DIVISION

TIME { On ..... M / Off ..... M DATE ..... 190...

LENGTH OF DETENTION ..... M.N'S TRAIN NO. .....

PLACE OF TROUBLE ..... TIME OF TROUBLE ..... M

CAR BODY.	AIR BRAKE.
Roof	Compressor
Body	Governor
Doors	Brake Valve
Windows	Feed Valve
Ventilators	Triple Valve
Steps	Guage
Grab Handles	Cylinder
Pilot	Slack Adjuster
Seats	Hose Coupling
Lights	Insulation Hose
Hand Brake	Leaks
Draw Bar	Brakes
TRUCK NO	Whistle
Wheels	Whistle Valve
Axles	Signal Whistle
Journals	Signal Whistle Valve
Center Bearing	**MISCELLANEOUS**
Side Bearings	Headlight No.
Brake Rigging	Headlight Screen
Loose Bolts	Trolley
MOTOR NO.	Extra Trolley
Armature	Retriever
Fields	Sander
Brush Holders	Heater
Leads	Toilet
Bearings	Water Cooler
CONTROL	Lightning Arrester
Controller No.	Gong
Contactor	Signal Bell
Reverser	Signal Bell Cord
Switch Group	Register
Line Switch	Fire Extinguisher
Limit Switch	Cla'n Lamps
Batteries	Tail Lamps
Rheostat	Flags
Circuit Breaker	Telephone No.
Fuses	Ventilator Stick
Switch Board	Broom
	Switch Iron

REMARKS .....

THE ABOVE DEFECTS REPAIRED 190

MOTORMAN

FOREMAN CONDUCTOR

NOTE.—Check B. O. opposite name of apparatus to be reported as defective. If apparent defects cannot be readily located, give in addition to check mark, particulars which may assist in locating same.

Reports of defective apparatus not included in the list can be noted under the heading of "Remarks."

Indianapolis Shops—Motorman's Report of Probable Defects

FORM 54 SCOTT-MILLER CO., INDPLS

INDIANAPOLIS TRACTION AND TERMINAL COMPANY

Armature Record

Type ..... Factory No. ..... Shop No. .....

PUT IN			REMOVED		SERVICE		REPAIRS		
Car No.	Motor No.	Date	Cause	Date	Mileage	No. Days in Service	Nature	By	Date

Indianapolis Shops—Individual Armature Record

Form 75 10m

INDIANAPOLIS TRACTION AND TERMINAL COMPANY

DEFECT CARD

CAR NO. ..... DATE 19

CAR BODY	Repairman's No.	CONTROL	Repairman's No.
Roof		Controller	
Body		Circuit Breaker	
Doors		Fuse Box	
Windows		Rheostats	
Ventilators		Cables	
Steps		**AIR BRAKE**	
Running Board		Compressor	
Grab Handles		Governor	
Tender		Brake Valve	
Seats		Brake Cylinder	
TRUCK NO		Air Gauge	
Wheel No.		Insulating Hose	
Axle No.		Piping	
Journal No.		Brakes	
Gear No.		**MISCELLANEOUS**	
Center Bearing		Trolley	
Side Bearing		" " Catcher	
Brake Rigging		Sander	
Loose Bolts		Heater	
MOTOR NO.		Lightning Arrester	
Armature		Gong	
Fields		Signal Bells	
Brush Holders		Register	
Leads		Lights	
Bearings		Hand Brake	
Pinion		Draw Bar	

REMARKS .....

CAR OUT OF SERVICE—TIME ..... A.M./P.M. ..... 19 ..... INSPECTOR

CAR DELIVERED SHOP " ..... A.M./P.M. ..... 19 ..... SHIFTER

REPAIRS COMPLETED " ..... A.M./P.M. ..... 19 ..... CLERK

Inspectors will mark "BO" opposite defects to be reported. If defects cannot be readily located, give, in addition to check-mark, particulars which will assist in locating trouble. Repairmen will mark their Clock No. opposite defect repaired.

MATERIAL USED.

Amt.	Type No.	MATERIAL	Repairman's No.
		Pinions	
		Gears	
		Carbons	
		Brush Holders	
		Field Coils	
		Trolley Wheels	
		" " Harps	
		" " Pins	
		" " Poles	
		Journal Brasses	
		Brake Shoes	
		Cast-iron Wheels	
		Steel Wheels	
		Axles	

Repairmen will note the amount of all material used as indicated above, and will mark their Clock No. opposite.

REPAIRS MADE

Repairman's No.

Repairmen will note the exact nature of all repairs made, and will mark their Clock No. opposite.

Indianapolis Shops—Shop Inspector's Defect Card, Obverse and Reverse

recording the date when the defects are repaired. Special notice is called to the insertion of the word "probable" in the title of this report. There is always a possibility that one of these cards may be used as evidence in law suits and so it is not thought wise to place too much responsibility on the motorman's opinion regarding a defect. Therefore they are called "probable defects."

The shop defect card used by inspectors for the city cars is also illustrated. This card is 4½ in. x 8 in. in size and carries a list of the principal car parts on the front side. Space is provided on the reverse side for noting the material used for repair work and indicating the repairman's number after each subject.

Monthly reports on motor repairs and on Westinghouse unit switch control repairs, similar in general form to those used for reporting the repairs to air-compressors, are also used. The report for motor repairs lists the different types of motors used. The following column headings are employed on the upper part of the blank: Armatures—open circuit, short circuit, grounded, down on pole pieces, worn bearings, defective shaft. Field coils—short circuit, grounded, damaged by armature. Commutators—grounded, rough, worn out. Miscellaneous—defective brush holders, defective leads, worn axle bearings, broken frames. Total. The lower half of the blank contains the following: Armatures rewound, armatures repaired, field coils rewound, field coils repaired, field coils impregnated, commutators new, commutators repaired, commutators grooved and turned, armature coils new, armature shaft new.

The monthly report for the unit switch control repairs is of uniform size with the other monthly reports. The left-hand vertical column contains a list of the switches, and the details for the types of repairs, the headings of the vertical columns, follow: disabled, dirty interlocks, defective interlocks, defective main contact, defective shunts, grounded, defective arcing box, loose connections, leaking piston, packing, leaking valves, overhauled, repaired tested. The divisions of storage battery repairs noted on the same blank are: disabled, grounded, short circuited, open circuited, electrolyte low, electrolyte weak, electrolyte dirty, defective jars, loose connections, overhauled, repaired, charged tested. In addition space is allowed for entering records of defective contact, loose connections, grounded, broken, repaired tested, for each of the parts of the miscellaneous equipment, like grid, resistance, control cable, motor cables, etc. At the bottom of the blank are lines for tabulating the total number of control failures in service, car miles and car miles per control failure, for the current and previous months.

Another blank form used at these shops is the daily report of car inspection which shows the car number and defects reported and indicates the repairs made and the shop numbers of the men doing the work, also the oiling done each day. A daily report of car repairs showing the car number, the time in and out of the shop, the defect repairs made, by whom, the date in the shop, is used, as is a monthly summary of car repairs which shows for each day the number of cars on which repair work falling under any 11 different subdivisions of the equipment has been done. A monthly report of the material disbursed shows for each day the number of gears and pinions of each type issued, the number of cast-iron and steel wheels, axles and pounds of babbitt issued.

A form of report used for presenting the number of pull-offs during one month and the reasons for taking the cars out of service is also used. These forms are 11 in. x 8½ in. in size and are so ruled that the monthly summary can be compared with the same monthly summaries for two years previous, subdivided according to each of the four car houses and summarized for the entire city system. These comparative reports of pull-offs when completed each month are posted on the bulletin boards in the various car houses so that the men may study the work of the different sections of the city and be encouraged to improve the record for the following month.

EXAMINATION OF TRAINMEN OF THE FT. WAYNE & WABASH VALLEY TRACTION COMPANY

Frank I. Hardy, superintendent of transportation, Fort Wayne & Wabash Valley Traction Company, has just held an examination for all the city and interurban trainmen of that company. Both the plan of conducting examinations and the knowledge of the men were put to test. As this was the first written examination which had been held by the Fort Wayne & Wabash Valley organization, it was not definitely known whether the plan would be successful. Special care was taken with the examination so that the officers would be able later to decide whether or not a periodical questioning of the men as carried out at this time is advisable. The examination just concluded has led to the opinion that similar, but shorter, written tests should be held about once a year, especially for the newer men. Probably future tests for the older men will not be so comprehensive, but it is thought that they will be of undoubted value in keeping the trainmen alive to the responsibilities of operation.

About six weeks before the examination was held the men were told of it in a general way and warned that they would be called upon to answer all manner of inquiries regarding the duties which they were employed to perform. This announcement was followed by a great many debates between the men. When it was not possible for a group of carmen to settle a debatable point to the satisfaction of all, the superintendent was called upon for a ruling. Thus for the six weeks prior to the holding of the examination practically every man in the train service of the Fort Wayne & Wabash Valley Traction Company was on the alert to clear his mind of every doubt regarding the correct interpretation of the operating rules. The good results of this study were clearly shown in the high average marking to which the examination papers were entitled.

The questions were kept secret until the men were called into the superintendent's office for examination. There were 367 questions for motormen and 272 for conductors. The answers were written on printed question blank forms. As the men sat in the superintendent's office while writing their answers, there was no opportunity for discussion with each other. If two interpretations could be put on a question, the men were free to ask the superintendent what was desired. Otherwise each man was instructed to give his own answer to all questions as he understood them.

Seventy-three of the questions were for both motormen and conductors. They had to do with standard time, time tables, signal rules, train signals, air-whistle signals, bell-cord signals, hand and lamp signals, fixed signals, rules governing the use of signals, train rules, rules for movement of trains by telephone orders and train orders. The questions for conductors only related principally to the proper method of making out reports and the answers to these questions were graded by a representative of the auditing department. The questions for motormen only were largely with regard to mechanical subjects, such as motor and car equipment, air brakes, reservoirs, triple valve, brake valve, etc.

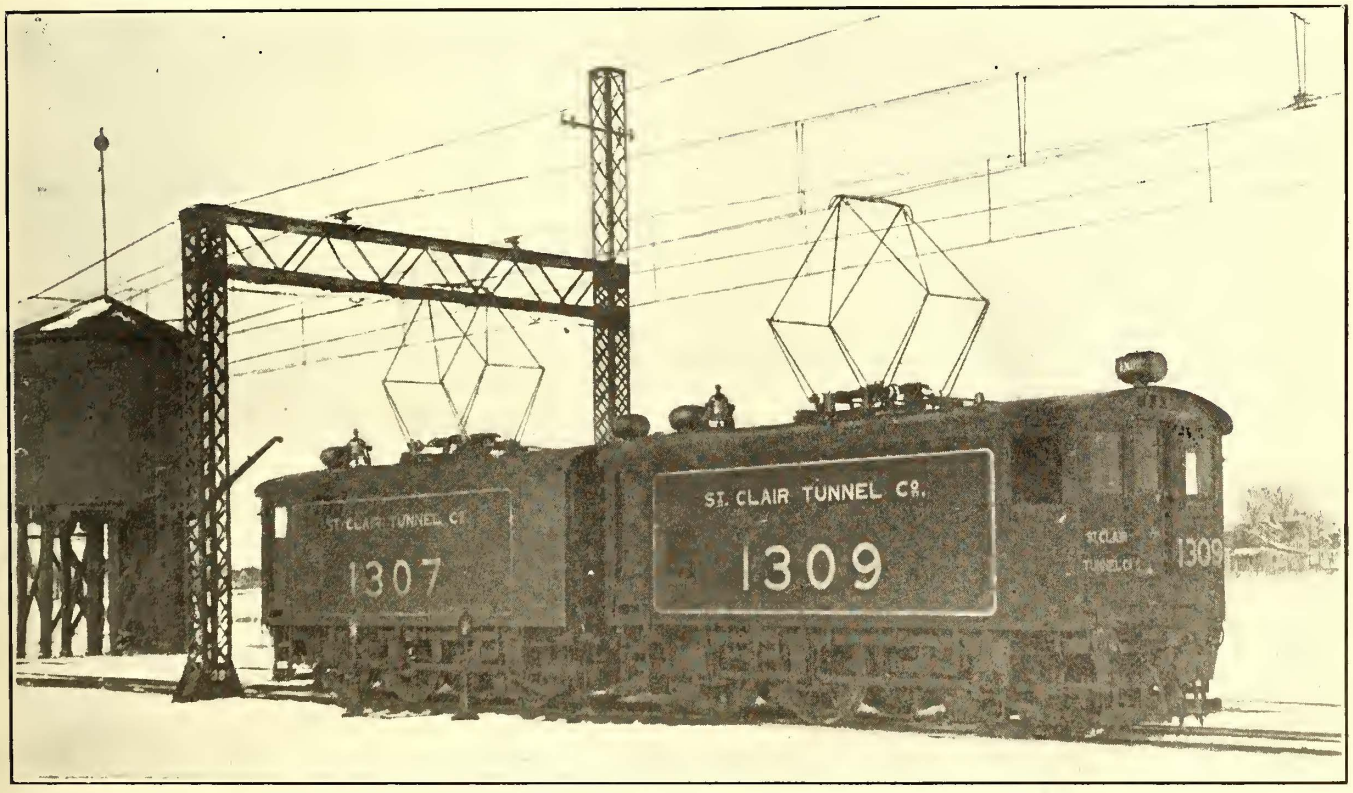
After the examination papers had been graded Mr. Hardy called the men into the office one by one and discussed with them all of the points on which the answers showed that they were not clear. It was interesting to learn that those men who had the best operating record stood among the highest in the examination. This showed that reasoning power more than knack was the most desirable qualification for a trainman.

One of the catch questions which the motormen were requested to answer was as follows: "If, when rapidly approaching a steam railroad crossing, it was found that the brakes would not work, that the trolley had left the wire and there was danger ahead, what would you do?" Without studying the question some of the men answered, "Jump." This, of course, was a catch question to see whether the men fully understood the method of reversing with the different classes of unit switch and platform control.

MAINTENANCE AND OPERATING FEATURES OF THE ELECTRIFIED ST. CLAIR TUNNEL

The First Extended Account of the Performance of This Line Since Operation Commenced

THE St. Clair tunnel of the Grand Trunk Railway System has been electrically equipped since May 18, 1908, and the severest requirements of the service are said to have been met very successfully by the single-phase system. The equipment was furnished by the Westinghouse Electric & Manufacturing Company and installed under the supervision of Bion J. Arnold, consulting engineer. The tunnel is a single track bore, lined with a cast-iron shell, and has an inside diameter of about 19 ft. The length of the tunnel from portal to portal is 6032 ft. The open tunnel approach on the Port Huron side is slightly over 2500 ft. in length, while that on the Sarnia side is nearly 3300 ft. in length. The total distance between the American and Canadian summits is 12,000 ft., or about 2¼ miles. The grade on the tunnel approaches and the shore sections of the tunnel is 2 per cent, while that in the flat middle section of the tunnel, about 1700 ft. in length, is of 0.1 per cent downward toward the east to provide for drainage.



St. Clair Tunnel—Side View of Double Unit Electric Locomotive

The specifications for the electrification of the tunnel service stipulated, in addition to various guarantees regarding efficiencies at different parts of the system and of the system as a whole, that the installation when completed should be capable of hauling a 1000-ton train through the tunnel from terminal to terminal in 15 minutes, that in doing so the maximum speed should not exceed 25 m.p.h. and that the minimum speed when ascending a 2 per cent grade should not be less than 10 m.p.h.

The single-phase system was chosen for this work on the score of economy in operation. Preliminary figures showed the first costs for the two systems to be about equal if no battery were installed. The estimates including batteries were slightly favorable to the d.c. system. However, the increased first cost with a battery would have been large in either case because of the nature of the load with frequent high peaks and short intervals during which charging could be done. The guaranteed efficiencies of the two systems without batteries indicated a considerable saving in the cost of power by the use of the a.c. system. The distribution losses and the use of current for rheostatic control lowered the relative efficiency of the d.c. system. Preliminary guaranteed figures for the power consumption for one locomotive trip hauling a 1000-ton train through the tunnel were 141 kw-hours for the single-phase system. In practice, considerably better figures of performance than those guaranteed have been obtained.

An illustrated article describing the electrical equipment of the St. Clair tunnel was presented in this paper in the issue of Nov. 14, 1908. The electrical equipment includes six three-motor locomotive units fed with 3300-volt, 25-cycle current generated in a steam turbine station and distributed by a catenary supported copper wire. This article will describe the more interesting features of maintenance and operation which have developed during the past two years of electrified service.

OPERATING STATISTICS

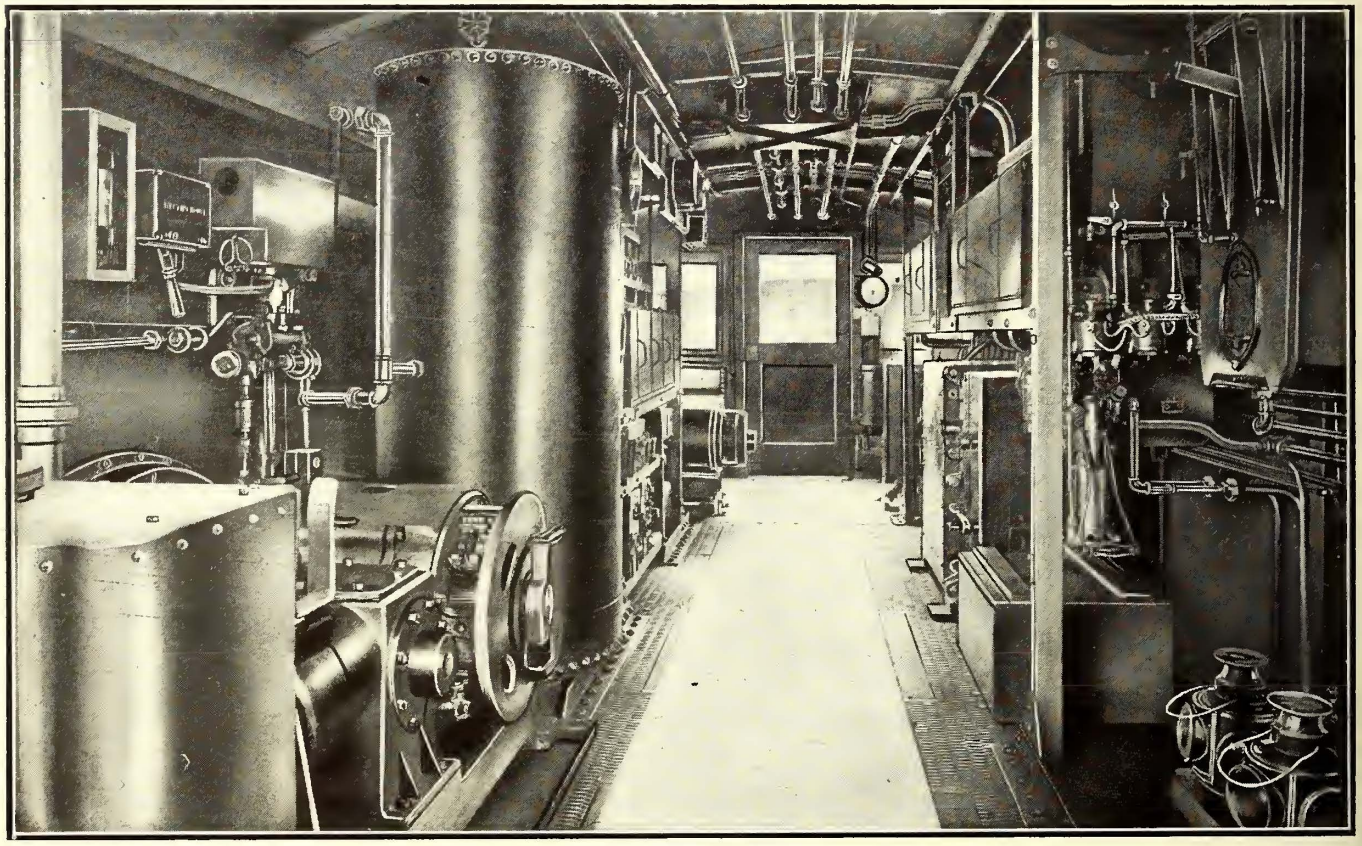
The St. Clair Tunnel Company has furnished some comparative figures for steam and electrical operation which are of interest, indicating as they do in a general way the relation between important items of operating costs. These data refer to two years' operation—one before and one after electrification. Although the amount of traffic handled during these two years was not identical, the service performed was sufficiently similar for purposes of approximate comparison of figures.

The cost of coal with electrical operation was 30 per cent

of the cost of coal under steam operation. A part of this saving is due to the greater economy of the electrical system so far as coal consumption is concerned, while another large part of the saving is due to the fact that it was necessary to burn anthracite coal in the steam locomotives that formerly operated through the tunnel, while ordinary run-of-mine or even slack coal is used for power plant operation.

The total service charges, including all items that are charged by the railway company against locomotive service, but not including fixed charges, indicate that this charge under the electrical operation is about 60 per cent of the charge under steam operation. If, however, the fixed charges, including both interest and depreciation on equipment, are added in each case, it is found that the total charge for locomotive service under electrical operation is approximately 84½ per cent of the charge under steam operation.

If a comparison be made of fuel costs under steam operation with the cost of electrical energy delivered at trolley under electrical operation, it is found that, disregarding fixed charges, the cost of power delivered to the locomotives under electrical operation is 69 per cent of the cost of the fuel under steam operation. If, however, the fixed charge (and depreciation) due to the initial investment for the electrical generating plant and distributing system be added to the charge for electricity delivered at the locomotive, this charge then practically equals fuel cost under steam operation. This indicates that the saving is effected in other items than that of cost of power delivered to the two locomotives in the form of electrical energy in one case and of fuel in the other. One of the large items in this saving is in the maintenance and repairs to locomotives, which for the years under comparison indicates the electrical cost to be about 55 per cent of the steam cost. Other items chargeable to steam operation, such as the coaling of locomotives, water supply, etc., do not appear at all in the charges for electric locomotives.



St. Clair Tunnel—Interior View of Locomotive

LOCOMOTIVE MAINTENANCE

Three locomotives are available for use in the tunnel and switching service. At present the entire traffic is handled by two locomotives, each of which consists of two half-units. The half-units are duplicates in every respect and are equipped with the multiple-unit system of control. Each half-unit is mounted on three axles driven through gears by three single-phase motors with a normal rating of 250 hp. Inasmuch as the motors have a very liberal overload rating it is possible to develop 2000 hp with two half-units. The locomotives are powerful enough easily to start a 1000-ton train on a 2 per cent grade. In a test made on a half-unit using a dynamometer car it was found that a single half-unit would develop a 43,000-lb. drawbar pull before slipping the wheels. The locomotives have a maximum speed of 35 m.p.h., but they are never called upon to operate faster than 25 m.p.h. to handle the full number of trains.

The general dimensions of a locomotive half-unit are as follows:

Length over all	23 ft. 6 in.
Height from top of rail to top of pantograph bow when lowered	14 ft. 11 in.
Width of cab over all	9 ft. 8 in.
Total weight of half-unit	67½ tons
Length of rigid wheel base	16 ft.
Diameter of driving wheel	5 ft. 2 in.
Normal speed with 100-ton train ascending 2 per cent grade	10 m.p.h.
Normal speed on level track	25 m.p.h.

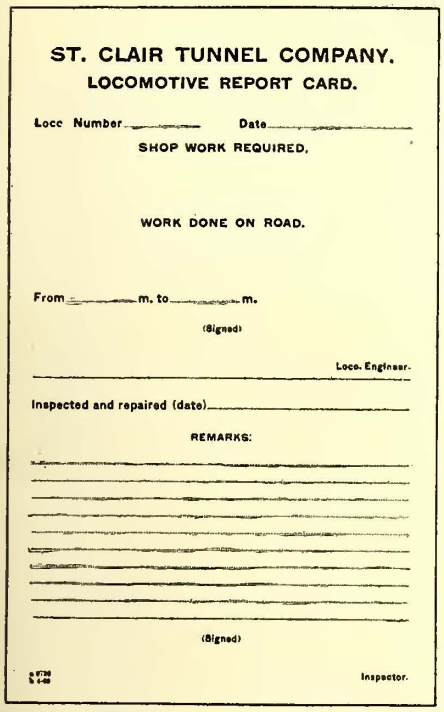
The electric locomotives have required very little change in design or unusual maintenance work. A two-track section of a roundhouse in the Sarnia yards has been equipped as an inspection shed for the electric units. The locomotives may be taken in or out of this shed at either end.

An annunciator system has been installed here in connection with the 3300-volt trolley wire to provide against accidents. Ordinarily the section of trolley wire inside of the inspection shed is disconnected from the trolley line outside. When current is desired to move or to test a car a hook switch installed about 10 ft. above the floor at one end of the building is thrown to connect the interior and exterior trolley wires. Within the box of this switch a ground connection is provided so that

when the knife of the switch is pulled open, to cut the shed trolley off from the line, the trolley wire within the car house automatically is grounded. An annunciator bell rings at 15-second intervals to warn the men while the 3300-volt trolley is alive.

LOCOMOTIVE INSPECTION

A regular program of inspection is followed and each half-unit is held in the inspection shed for 12 hours every three days. In addition to this short inspection each half-unit is held in for more thorough care for 24 hours once every 24 days. Thus the units are in service 80 per cent of the time, which is considerably more than is possible with steam locomotives. The roundhouse force includes a foreman, two day and one night inspectors, one wiper and one overhead lineman whose services are available either here or in trolley work. In making one of the regular 24-day half-unit inspections the various parts of the unit are inspected and checked off according to the program laid down on the inspection card reproduced herewith. The inspection, which is made every three days, includes the following: Back of switch groups; intake strainers; fan and main motor nettings; jumper pins (these are spread to insure good contact); foot buttons which include bell and two sanders; poppet valves (main and emergency reservoirs); reducing valves; overload trip relay; hand air pump; hand brake (this is well lubricated and kept in good operating condition); pantograph tension and operating mechanism. The inspectors keep a log of all the work done and make daily reports to the superintendent.


ST. CLAIR TUNNEL COMPANY.
LOCOMOTIVE REPORT CARD.

Loco Number_____ Date_____

SHOP WORK REQUIRED.

WORK DONE ON ROAD.

From_____m. to_____m.

(Signed)

Loco. Engineer.

Inspected and repaired (date)_____

REMARKS:

(Signed)

Inspector.

St. Clair Tunnel—Locomotive Report Card

The change from steam to electric service was made without any undue delay. In the article earlier referred to mention was made of how steam and electric service was alternated until all the employees became accustomed to their duties, and then the steam locomotives were relieved from tunnel duty. At the beginning of electric operation when the alternate steam and electric service was operated, the electric locomotives were taken into the shop after each 18-hour run and thoroughly inspected. After the first few weeks of service, when it was quite certain that all parts of the equipment were operating smoothly, the regular inspection period of once every three days was adopted.

TIRES AND GEARS

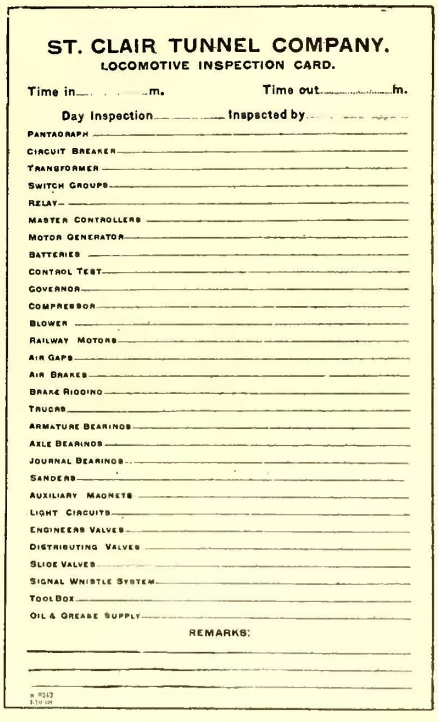
It has been found necessary to turn the locomotive tires once every 12 months. This is on account of flange wear rather than hollowing of the tread. The flange wear is attributed to the low center of gravity of the unit. Once every 30 days each locomotive is turned around so that the flange wear may be evenly distributed. The motor or journal bearings have given no trouble. The armature of each of the three motors drives its axle through a pinion with 16 teeth and a gear with 85 teeth. The life of these pinions is from 50,000 miles to 60,000 miles and some have run 64,000 miles. None of the gears has yet been renewed after two years' service. Whenever a pinion has run more than 30,000 miles and the wheels are removed for any purpose, a new pinion is put on so that the wheels may not have to be removed unnecessarily.

LOCOMOTIVE PANTOGRAPHS

The standard Westinghouse galvanized sheet-steel pantograph shoe is used, one on each half-unit. The average life of these shoes is about 3000 miles. The shoe is adjusted to have a pressure against the wire of 7½ lb. in the winter and 5 lb. in the summer. These low contact pressures are made possible by the limited speed of 25 miles an hour at which the trains operate. Shoes with copper wearing surfaces were tried with the idea that they would not wear the wire, but as no apparent advantage was realized and as their life was much shorter than that of the galvanized steel shoes, the trial was abandoned. The steel shoes apparently do not wear the wire so much as the copper shoes. This is attributed to the reduction in friction when dissimilar metals are used. A spring balance is used when adjusting the pantograph tension. Such adjustments are needed very infrequently, but if any undue flashing is noted during operation the tension is inspected and usually it is found that the pantograph spring has become weak or that the joints in the pantograph are stiff.

LOCOMOTIVE CREWS

When the electric locomotives were first put into service classes of instruction were held every afternoon for two months. The men who had been operating the steam locomotives attended these classes when off duty. Later when the school work was concluded the steam locomotive engineers were put in charge of the new electric locomotives and instructors rode with them. The men who formerly operated the steam locomotives and now run the electric locomotives are enthusiastic over the change, even though their rate of pay is slightly reduced by their being required to work longer hours. The locomotive crews are made up of two men, an engineer and an assistant. The assistant spends his time in looking over the electrical apparatus in the cabs of the two half-units while they are in operation, and when not thus engaged he rides in the rear half-unit. Formerly two brakemen were required for each train passing through the tunnel. The smoothness with which the trains are handled has made it safe to operate with but one brakeman.


ST. CLAIR TUNNEL COMPANY.
LOCOMOTIVE INSPECTION CARD.

Time in_____m. Time out_____m.

Day Inspection_____ Inspected by_____

PANTAGRAPH
CIRCUIT BREAKER
TRANSFORMER
SWITCH GROUPS
RELAY
MASTER CONTROLLERS
MOTOR GENERATOR
BATTERIES
CONTROL TEST
GOVERNOR
COMPRESSOR
BLOWER
RAILWAY MOTORS
AIR GAPS
AIR BRAKES
BRAKE RIGGING
TRUCKS
ARMATURE BEARINGS
AXLE BEARINGS
JOURNAL BEARINGS
SANDERS
AUXILIARY MAGNETS
LIGHT CIRCUITS
ENGINEERS VALVES
DISTRIBUTING VALVES
SLIDE VALVES
SIGNAL WHISTLE SYSTEM
TOOL BOX
OIL & GREASE SUPPLY

REMARKS:

St. Clair Tunnel—Locomotive Inspection Card

TRAIN OPERATION

A round trip through the tunnel, including the terminal switching when a train is handled in either direction, requires a run of about 10 miles. The freight trains are made up so as not to exceed 1000 tons each and all cars are inspected before passage through the tunnel. This is necessary for the preven-

tion of accidents and because the tunnel is the dividing section between two main divisions of the Grand Trunk Railway system, one in Canada and one in the United States. While the freight trains stand in the yards for inspection the air-brake piping system is charged from a yard air service pipe line which extends through the tunnel and is fed by an electrically operated air pump at Sarnia. The charging, which is done before the electric locomotive couples onto the train, requires no additional layover because the train must stand in the yard to be inspected, and use is made of the yard air supply system so that the air-compressor equipment on the locomotive may be relieved of the unnecessary duty of charging a long freight train just prior to starting through the tunnel.

Under normal conditions passenger trains are hauled through the tunnel with two-unit locomotives, but one-half unit would be ample so far as pulling capacity is concerned. However, 1000-ton freight trains are handled most frequently and as these require full locomotives, the locomotive pairs already coupled for freight service are used also to handle the passenger trains. Otherwise, if the half-units were separated, one-half would be idle on one side of the river while the other was pulling a passenger train through the tunnel. At the end of the run the halves would be available for hauling only passenger trains or freight trains below the maximum rating. Thus to simplify operation the two half-units are always operated as one locomotive. The average mileage for each locomotive is in the neighborhood of 2700 miles per month. The maximum monthly mileage was 3540 miles. Looking at it in another way each locomotive made an average of 10 round trips of the electric zone per day.

An indicating ammeter in each locomotive cab serves to assist in keeping the demand on the power station within a safe maximum. The locomotive engineers are required not to let the motors of one-half unit exceed a maximum of 3500 amp. There are 17 running positions on the controllers. The first, second and third notches are only for switching, coupling up a train and other purposes where slow speeds are desired. The fourth to the twentieth notches, inclusive, are running notches and the controller can be left on any of these, according to the speed that is desired. The engineers become very adept at gaging the amount of power required when starting trains of various loads. When using the ammeter it becomes possible to accelerate the train and to notch up the controller as the current tends to drop. If a train will not start on 3000 amp or less per half-unit the crew is instructed to look for trouble in the air-brake system.

INSTRUCTIONS FOR ENGINEERS

Some extracts from the instruction book for the government of engineers in the operation of locomotives follow:

"When the locomotives are in the terminal or lying idle at the end of the run the condition of the apparatus should be as follows:

"1. Trolley locked down.

"2. Compressor switch and blower switch left in off position.

"3. Battery switches open.

"4. Heater switches left open.

"5. Controller lever in the off position and reverse lever and plug removed.

"On leaving the locomotive the engineer should in all cases set the hand brake so that the locomotive cannot run away when unattended.

TO PREPARE TO OPERATE

"1. Inspect all motor, axle and main journal bearings to ascertain if sufficient oil is in the cellars.

"2. See that the safety chain is unhooked from trolley.

"3. Insert plug and reverse lever in controller.

"4. Close battery switches up on even days and down on odd days of the month.

"5. Press (trolley lock) button on the controller which will cause the trolley to rise if there is air pressure in the main reservoir; if not then turn the three-way valve on top of the emergency control reservoir 90 deg. to the right and if there is air pressure in this reservoir the trolley will rise when the unlock button on the controller is pressed. If there is no air in the emergency reservoir, the hand pump can be used as described later.

"6. Press the reset button on the controller, which will cause the line switch or circuit-breaker to close.

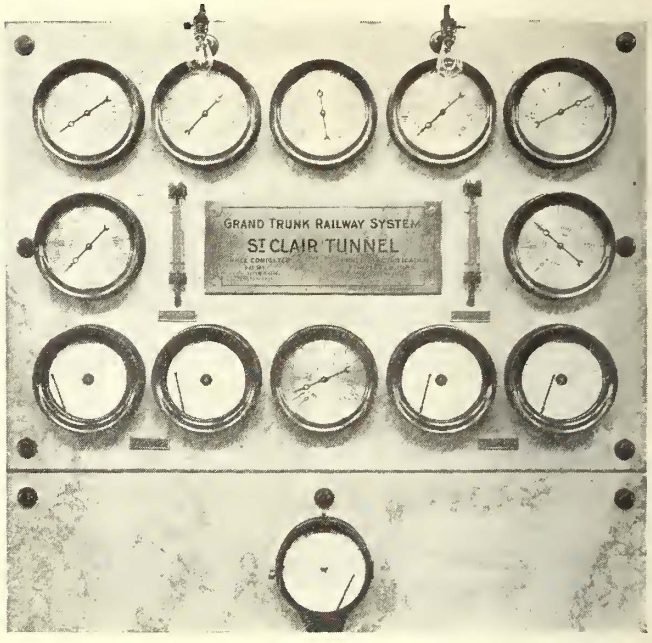
"7. Close air compressor switch. If there is no air pressure in the main or emergency reservoir, close the air compressor switch and pull in the line switch by hand, holding it in until sufficient air pressure is obtained to hold it in.

"8. Start motor-generator set by closing switches.

"9. Test bell, sanders and lights.

"10. Test out control as described in pages (of instruction book) following.

"11. Start blower motor. The blower must be kept in constant operation while the locomotive is running.



The gages on the top line, reading from the left, are: Turbine No. 2 condenser, turbine No. 2 steam, auxiliary steam, turbine No. 1 steam, turbine No. 1 condenser. Those on the bottom line, reading from the left are: Recording vacuum No. 2, recording steam No. 2, auxiliary exhaust, recording steam at boilers, recording vacuum No. 1. The round gages on each side of the nameplate are: Power house compressed air system, the power house heating system. The vertical gages are for the two draft fans. The single gage at the bottom of the board is a recording thermometer to indicate the superheat of the steam.

St. Clair Tunnel—View of Gage Board at Power Station

"12. See that the sand boxes are filled; and if the sand is not perfectly dry, close the switches for the sand heaters.

"13. Be sure that the main reservoir pressure is normal.

MULTIPLE OPERATION

"When two or more locomotives are to be operated in multiple, all locomotives should be operated from one controller of one locomotive, perferably the forward controller of the leading locomotive.

"1. Make the three jumper connections between locomotives by means of three cables provided for that purpose, taking care to see that the jumpers are placed in the proper sockets. The outside jumpers should be crossed between locomotives.

"2. Test control and make sure that its operation is correct in all locomotives.

"3. Remove reverse levers and control plugs from all controllers except the one from which the train is to be operated.

"4. Close all battery switches and battery charging switches in all of the locomotives.

"5. Be sure that all trolleys are up and that all circuit-breakers are in.

TROLLEY

"In case of any mechanical difficulty with the trolley, lower it by pressing the button on the master controller marked 'Trolley Down.' If air pressure is not available, pull down the trolley by means of the pole with hook on the end, which is supplied with each locomotive. If the locking mechanism

is out of order, hold the trolley down by air or with the pole until some person can climb to the roof and snap the safety chain which fastens the trolley down and at the same time grounds it. In case the locking mechanism is all right, the air cock on the trolley side of the magnet valve leading to the unlocking cylinder should be closed to prevent the trolley being raised before the safety chain has been snapped on. A thorough inspection should then be made.

"Never go on top of a locomotive under any circumstances when the trolley is in contact with the overhead wire. Immediately after going on top of the locomotive while the trolley is down, the safety chain should be snapped on so that there can be no possible chance of the trolley being raised while any person is working on the roof of the locomotive.

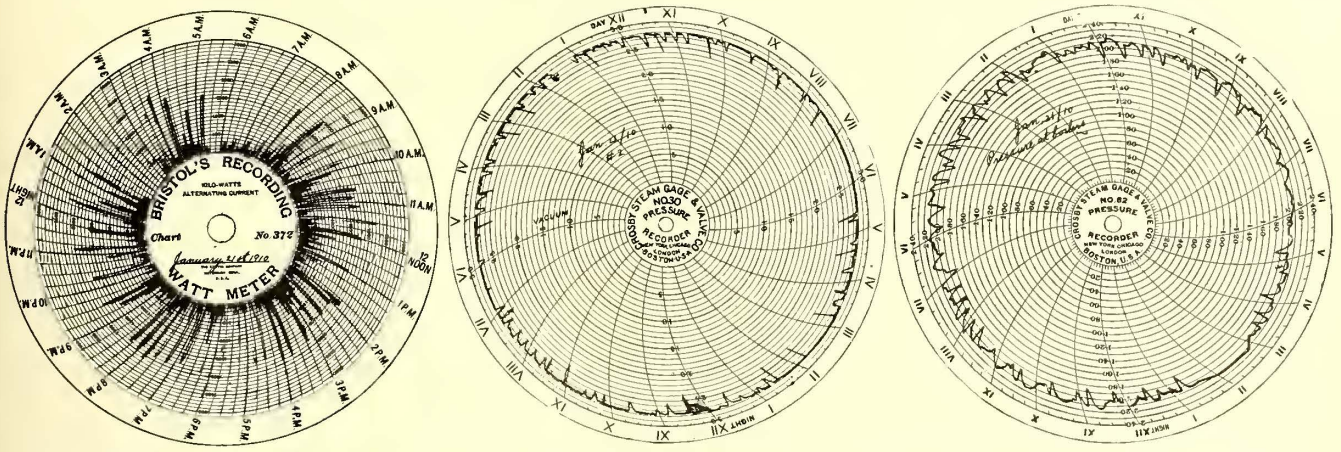
FIRE

"In case of fire in the locomotive lower the trolley immediately and use sand for extinguishing it. Never use water unless absolutely necessary, as it is liable to increase the fire by causing short-circuits if the trolley is up, and will in any case seriously damage the apparatus. Fire extinguishers are provided in the cab of the locomotive and should be used only in case of extreme emergencies where it is evident that sand will not put out the fire."

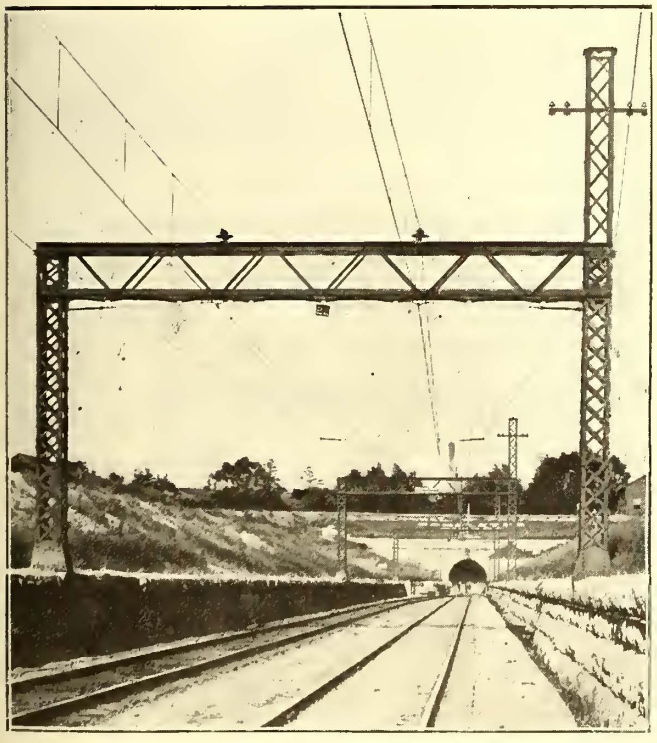
SPEED INDICATOR AND RECORDER

One of the pairs of locomotive units is equipped with a speed indicator and recorder of Hausshalter's design. This apparatus was manufactured by Seidel & Naumann of Dresden, and purchased through the Engineers Agency, 63 Chancery Lane, London, England. A short section of one of the records from this tachometer is reproduced. By means of the speed-measuring apparatus the traveling speed of the locomotive is, at all times, graphically recorded on a roll of paper. The rate of speed is also indicated on a dial within the view of the locomotive engineer. The chief use of this device is to provide a means for preventing the over-speeding of the locomotives. Operating rules require that at no time shall the speed exceed 25 m.p.h. and as every movement of the train is permanently recorded within the box as well as indicated by a pointer the use of the device is very effective.

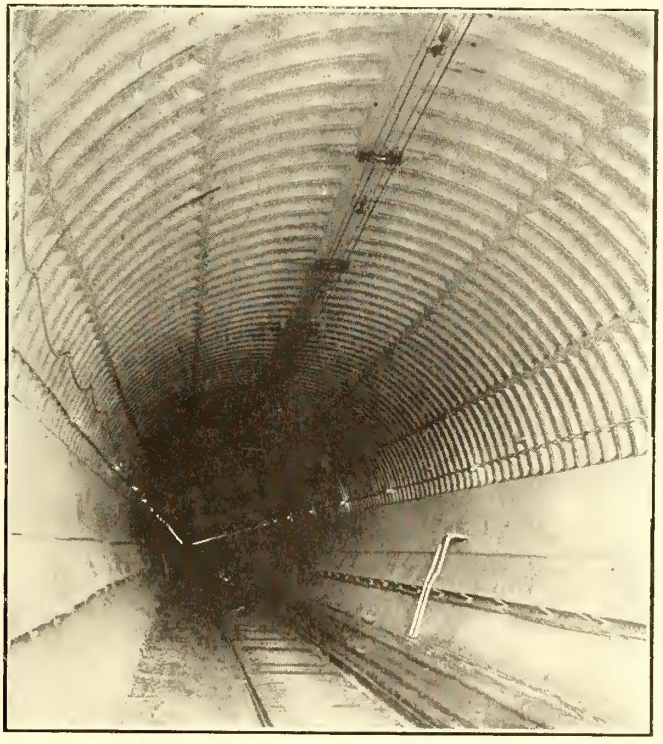
The principal mechanism of this speed-measuring apparatus is enclosed in a substantial iron box, the moving parts being driven from one of the main axles of the locomotive while



St. Clair Tunnel—Chart Records for Jan. 21, 1910, from Recording Wattmeter, Vacuum Gage and Steam-Pressure Gage



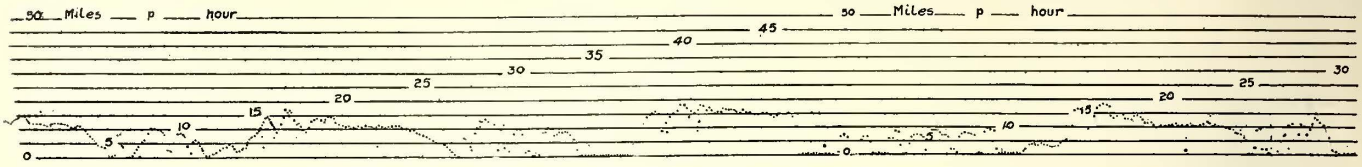
St. Clair Tunnel—View of Overhead Bridge and Single Catenary Construction



St. Clair Tunnel—Interior of Tunnel, Showing Overhead Construction and System of Lighting

the train is in motion, and by a clockwork for 20 minutes after the train has come to a stop. The clockwork spring is automatically wound during running by an eccentric and pitman feeder. The device which moves the paper on which the record is made automatically punches the three-minute intervals and in addition to this the record shows the rate of speed in the form of a curve. One roll of paper will last for about

Within the tunnel bore the messenger cables are insulated from the conductor wires. The messengers are carried on porcelain spools and the trolley wires are supported from the messengers by special wood-break hangers 3 in. square and 15 in. long. The effective insulating length of these hangers is about 5 in. If a porcelain insulator breaks down and allows the messenger cable to ground on the tunnel shell, then the



St. Clair Tunnel—Section of Record from Speed-Recording Device

375 hours of operation. During service the speed indicating and recording device requires no attention except when the train stops for longer than 20 minutes. Then the apparatus must be wound up by hand. In the instruction book of the St. Clair Tunnel Company suggestions are included for maintaining the speed-measuring apparatus in good condition. The suggestions conclude with the statement, "It is necessary in the engineer's own interest that the time of stoppage particularly should be registered exactly."

TROLLEY MAINTENANCE

The trolley circuits for the entire electrified zone normally are all in one electrical section. Switches are provided at each tunnel incline for cutting off the yards from the tunnel section, if such sectionalization should ever be needed. Since operation was started there have been practically no electrical troubles or mechanical defects in the trolley circuits. At one time a high brake wheel on an especially large car grounded the trolley wire in the tunnel and opened the breaker, but the trolley wire itself was not damaged enough to interfere with the continued operation of the same train after the brake staff had been bent out of the way. Aside from three of the porcelain spool insulators that were cracked when installed, the trolley wire insulation and suspension have given no trouble.

Connections between the power station switches and the conductors and the track return in the tunnel are made through lead-covered cables for the feed line and bare copper return cables. The cables pass from the power station in underground ducts for a distance of about 150 ft. to a shaft leading down to the tunnel bore. An extra lead-covered cable, with end bells ready for quick connection at both ends, is available in case the feeder cable gets damaged.

LIGHTNING ARRESTERS

Westinghouse gravity type lightning arresters with metal

THE ST. CLAIR TUNNEL COMPANY

Record of Operation of Power House for Date _____ 19

TIME	TURBINE PANEL K. W.		LOCOMOTIVE PANEL		PUMP PANEL				POWER AND LIGHT PANEL					ARC LIGHT PANEL	ENGINE DRIVEN EXCITERS				MOTOR DRIVEN EXCITERS			HOUSE PANEL	Coal Plant Started and Stopped	VACUUM		TEMPERATURES.									
						Ft. Huron	Sarnia			Ft. Huron	Sarnia	Tunnel		In. Out	1		2		D. C.		A. C.				Circulating Water				Steam at Turbin		Steam at Superheater		Boiler Feed	
	1	2	Amps	K W Hours	K W Hours	Av Amps	Av Amps	K W Hours	Av Amps	Av Amps	Av Amps	TIME	Amps	Volts	Amps	Volts	A	V	A	K W Hours	TIME	1	2	1 In	1 Out	2 In	2 Out	1	2	In	Out	1	2
12 Md. N																																		
1																																		
2																																		
3																																		
9 P. M																																		
10																																		
11																																		
Totals,																																		
Average,																																		

TURBO — GENERATORS	STARTED	IN PARALLEL	STOPPED	EMERGENCIES TESTED	BOILERS IN USE	1	2	3	4	WATER METERS No. 1	WATER METERS No. 2
No. 1					Blown Down					6 A. M.	6 A. M.
No. 2					Cleaned					6 P. M.	6 P. M.

Materials Used, Waste, Oil, Grease, Coal

Other Materials

Power off, Time and Cause

Engineers Report, Day Shift, from A. M. to P. M.

Day Engineer

Engineers Report, Night Shift, from P. M. to A. M.

Night Engineer

St. Clair Tunnel—Record Card of Operation of Power House

arcing points are used for protection of the trolley and messenger in the electrical zone outside of the tunnel. The metal arcing points of these arresters, which are mounted on the steel catenary bridges, afforded a convenient perch for birds and until precautionary measures were taken the breakers not infrequently were opened by short-circuits caused by the birds alighting on the arcing points. The bodies of the birds would carbonize and afford a path to ground for the current and so the fuse stick would not fall and disconnect the arrester. The passage of current to ground would thus open the circuit breaker at the power house, but sometimes the arc would be so severe before the breaker opened that the metal support of the lightning arrester would weaken and let the heavy insulator fall. The possibility of the recurrence of such lightning arrester troubles has been effectively provided against by adding a perch for the birds directly above the metal arcing points. An ordinary two-wire porcelain cleat is supported from one end only by a small metal bracket. Thus the bird uses the cleat rather than the arcing points as a perch and protection from a short-circuit is afforded.

TELEPHONES

In installing the power telephone circuit cable was used throughout and no part of the line is carried on poles. The object in this special construction was to avoid any mechanical interference with the service. The telephone service on such installations has its greatest value in times of trouble and so the circuits were installed to avoid any probability of mechanical interference. So far the telephone has given uninterrupted service. The telephone circuit used by the motive power department has instruments connected with it at the following points: One on the power station switchboard, one in the power station office, two in the tunnel, one at the top of the tunnel cut on the power house side, one in each of the two tunnel pumping stations and one each at the dispatcher's office in Sarnia and the roundhouse in Sarnia. All of these instruments are bridged on the line and a ringing code is used for calling the different stations.

POWER PLANT

The generating station which supplies 3300-volt alternating current for the electric zone is located in Port Huron on the St. Clair River front, about 150 ft. distant from the line of the tunnel. The boiler house equipment includes four 400-hp B. & W. sectional water-tube boilers, each having three drums 42 in. in diameter by 23 ft. 4 in. long. The tubes are arranged 21 wide in order to secure quick steaming, and the three drums provide a large hot-water storage capacity to assist in maintaining steam pressure under excessive demands. Each battery of boilers is fed by six Jones underfeed stokers controlled by a Cole automatic regulator. On account of the great variations in the load on this plant an American Blower Company steel-plate fan 11 ft. deep by 3 ft. 5 in. wide, driven by an enclosed vertical engine, is used to accelerate quickly the fires of each group of boilers. The speed of the fan engines, through the control of a Kitts regulating valve, is varied according to the steam pressure at the turbines. This forced draft apparatus, like all other parts of the plant, is in duplicate to provide for continuity of service.

AUTOMATIC BOILER PLANT MACHINERY

It may be of interest to describe the operation of the train of automatic apparatus which serves under severe overload to keep the steam pressure high enough to prevent a slowing down of the turbine unit. While no trains are in the tunnel the load on the station is about 400 kw; but when a freight train passes into the tunnel and starts to climb the incline a peak load amounting to about 2000 kw is thrown onto the turbine suddenly and unannounced. This electrical overload makes a heavy demand for steam in the turbine and it is necessary for the boilers to be forced immediately or their reserve capacity will be exhausted and the pressure fall below a good operating point.

The interaction of the various parts of the steam supply when excessive load comes into the turbine is as follows: Attached to the supply line is a pressure line extending to the Kitts valve which is located in the boiler room. The diaphragm in this valve is under two pressures. On one side is the 200-lb. pressure of the live steam main and on the other side is the 125-lb. pressure of the auxiliary main. A balance lever serves to keep the valve in equilibrium. When the heavy demand comes on the steam line to the turbine and the pressure in that line falls, the Kitts valve is thrown out of balance and the movement of it in turn opens the throttle of the engine which drives the forced draft fan. Normally a difference in pressure of 4 lb. will operate this valve. As the load on the turbine continues to draw heavily on the boilers the steam pressure lowers and the Kitts valve feeds more steam into the fan engine until the fan is driven at full speed. The increase in air fed to the boilers forces more rapid combustion.

With the coming on of the load the fuel is fed more rapidly. The Cole stoker-control valves are driven through a system of belts operating off from the flywheel of the fan engine. As the fan speeds up the wheel which drives the Cole regulating valve is accelerated and the Jones stokers operate faster. Thus the auxiliary apparatus furnishes more air and more fuel to the firebox very quickly after the load comes on the steam turbine.

When the control valve for the fan engine was first installed the high-pressure tap was made from the main steam header in the boiler house. The valve then lacked sensitiveness and so to improve the service the live steam tap was made at a point in the steam line close to the turbine throttle. Thus the valve is affected by the additional drop in pressure caused by the increased load and the resistance of the header and turbine connections. In addition to making the valve more sensitive this change in location of the pressure tap has reduced the temperature in the Kitts valve. Formerly the value diaphragms lasted only two or three weeks, but since the longer pressure line has been used the life of the diaphragms has been increased to three or four months.

SUPERHEATER

A separately fired Foster superheater is installed between the two batteries of boilers. This superheater has the capacity for heating 36,000 lb. of steam per hour at 200 lb. per sq. in. to a final temperature of 587 deg. Fahr., which corresponds to a superheat of 200 deg. The grates are hand-fired and the temperature of the steam is controlled automatically by means of the thermo-couple in the steam outlet of the superheater. This thermo-couple is connected to a relay with a large solenoid which opens and closes the valves to a hydraulic piston. These valves move dampers in the air ducts and thus regulate the draft.

In practical operation the regulating devices have been found to control the temperature very closely, notwithstanding the great variation in load to which the power plant is subjected. The superheater is of especial value because on periods of normal and low load the piping and turbine are kept highly heated by it, and thus initial condensation is greatly reduced at the time of the sudden demands.

GENERATORS

The two Westinghouse-Parsons turbo-generators which comprise the main units of this plant are designed to operate at a normal voltage of 3300 volts with a frequency of 25 cycles per second. They are three-phase machines and by the specifications are required to furnish their full rated load of 1250 kw from a single phase. Each of the turbine units is capable of handling the entire load and so one machine always is held in reserve. Either turbine regularly handles peaks of from 2000 kw to 2300 kw, single phase, which last for four or five minutes at intervals of about 15 minutes. This phase also carries the lighting load. The other phases carry the load of the pumping and auxiliary apparatus, amounting to 250 kw.

With normal traffic through the tunnel the daily output of the plant is about 10,000 kw-hours. The maximum output for one day was 12,000 kw-hours and the highest peak load, 2750 kw. This plant has been in continuous service without any interruption in the delivery of current since starting in April, 1908. After nearly two years of operation the turbines were opened and it was hardly possible to detect any erosion, even on the low-pressure vanes; the tool marks were still plainly visible in the main bearings.

The turbine glands have a water seal and because of the necessity for maintaining the water supply continuously an emergency connection has been made with the city water service. The city water line connects with the discharge line from the house pump. The house service is under 75 lb. pressure and the city pressure varies from 35 lb. to 60 lb. A check valve in the city water connection provides against the use of city water except when the house supply pressure falls below that of the city pressure. Because of this emergency connection, the house pump can safely be stopped without endangering the water glands at the main turbine bearings.

The main generators are cooled by means of air drawn through the coils by vanes mounted on the rotor. The supply of air for this cooling service as originally installed was all taken from out of doors. An independent supply duct serves each turbine. The ducts are short and so air is taken into the turbine generator at practically the outdoor temperature. Formerly difficulty was experienced in severe weather because of frost accumulating on the air intake screens and cutting down the circulation. To provide against this condition an opening was cut through the side of each duct. Now in cold weather the turbine cooling air is taken from the basement. The circulation of this air through the turbine generator also serves to warm the building.

When the plant was first started each turbo-generator set was used on alternate days. Now the load is shifted from one machine to the other twice a week. It is stated that the daily change was made at the beginning of operation so that the men would become familiar with the program of starting and stopping the units. After the service was well under way, however, it was not thought desirable to shift the load so frequently because of the stresses set up in a turbine when it is warming or cooling.

REGULATION OF VOLTAGE

A Tirrill voltage regulator set is a very essential part of the regulating equipment of this plant. This set is connected with the locomotive phase of the generator only and maintains it practically constant at 3300 volts, even though the load swings from 250 kw to 2500 kw. When a heavy train goes through the tunnel and a maximum load comes on the railway phase, the other two phases get considerably out of balance and so, to keep the voltage on the lighting supply constant. all the lighting transformers are connected with the locomotive phase. The smaller pump motors, machine shop and other motors are all of the three-phase induction type operating directly across the 3300-volt line, and so they are not unduly affected by the locomotive phase being out of balance with the two unloaded phases.

On account of the widely variable nature of the load it is necessary to keep an especially careful watch over the turbine governors and emergency valves. A systematic method of testing these safety devices is followed. Whenever a turbine unit is shut down, and the load is changed from one to the other twice a week, the emergency valve tripping device is given a service test. The engineer moves the governor rod so that the speed of the turbine is increased, meanwhile watching the frequency indicator and noting at what frequency the emergency valve closes. The valve is set to open at 10 per cent above normal speed and it is thus put to an actual test twice each week.

All the circuit breakers on the station switchboard are now equipped with contact points which complete a circuit and ring an annunciator bell whenever a breaker opens. This system of announcing the opening of a breaker has made it possible for the turbine engineer also to act as switchboard attendant. If the engineer needs assistance at any time he has a push-button available on the board so that he can ring gongs located in the boiler house and in the basement where the auxiliaries are located, and call either the boiler tender or the oiler. There also is a speaking tube from the engine room to the boiler room. At night the fireman reports to the engineer every 15 minutes. If he fails to report regularly the engineer blows a whistle or sends the oiler to see whether the fireman needs assistance. A telephone instrument, connected with the electrical department line, is mounted on the power station switchboard so that the turbine engineer can quickly answer emergency calls coming from the tunnel or the yards.

DRIP TANK

A barometric jet condenser with a 30-in. inlet manufactured by the H. L. Worthington Company serves each steam turbine. A 36-in. exhaust pipe connects the exhaust outlet for the turbine with a reducing fitting attached to the condenser head. There are two bends in the connection and on low loads when the plant was first operated it was found that water accumulated in the bottom bend. This accumulation of water, unless withdrawn, would cause water-hammer as well as offer a resistance to the passage of steam from the turbine to the condenser head. To provide against this undesirable feature a drip tank has been installed in the basement. This tank has a capacity of about 20 gal. A pipe leads directly to the tank from the bottom of the U-shaped condenser connection. Any water forming in the condenser connection during low load drains into the storage tank in the basement. A water gage is provided on the tank and the hot water is drawn off from the tank once an hour. Valves are placed in the drip connection so that the vacuum will not be lost while the tank is being emptied. Reference to the vacuum chart will show, however, that when the water has been drawn from the tank and it is again connected with the turbine exhaust connection, there is about 3½ in. drop in the vacuum. This accounts for the loops and straight lines in the vacuum chart, which appear at hourly intervals.

The power station is illuminated by eight Nernst lamps in the turbine room and two in the boiler room, in addition to nearly 200 incandescent lamps located suitably for special illumination. Lighting current is taken from the main a.c. generator. Normally the exciter unit, which is controlled by a Tirrill regulator, is below voltage and so its current would not be suitable for lighting. Four oil lamps are kept burning every night for emergency use but as yet have never been needed. The lighting circuit switch is of the double-throw type and so connected that in emergency it can be thrown over and lighting current taken from a steam-driven exciter which, though not normally used, can be started quickly.

OPERATION OF POWER PLANT

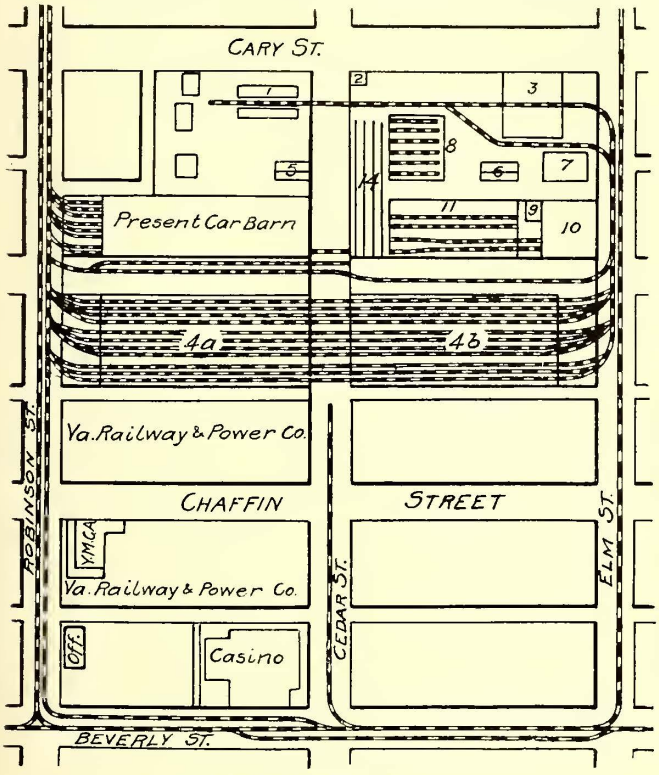
The power station staff includes the following: First engineer, turbine engineer, oiler, fireman (and water tender), machinist, ash handler, janitor, and laborer. The night staff includes turbine engineer, oiler and water tender. The turbine engineer acts as switchboard operator. Only one of the two turbine units is ever required to carry the entire load and as the switchboard is within a few feet of the steam end of the turbine and requires practically no attention, one man can easily attend to both the turbine and the switchboard.

OPERATING STAFF

The operation and motive power features of the St. Clair tunnel are in charge of W. D. Hall, superintendent of power plant and electrical equipment and superintendent of tunnel, who reports to W. D. Robb, superintendent of motive power, Grand Trunk Railway System. Reporting to Mr. Hall are four subdivisions of the force: A first engineer in charge of the power house, four pumping plant attendants, roundhouse foreman and the line crew of two men who take care of the electric lighting and trolley maintenance.

FIREPROOF CAR STRUCTURES FOR RICHMOND, VIRGINIA

The Virginia Railway & Power Company, Richmond, Va., was in the hands of a receiver up to July 1, 1909. During the receivership period, which lasted 5 years, no large amounts were disbursed for new work and practically all money spent was purely for the maintenance of the property. It has now been decided, however, to replace the old-time wooden car houses with structures of brick, concrete and steel. These are being planned and built to conform as closely as practicable to the fireproof standards of the local underwriters. In each case, the insurance association has figured out a base rate for what it considers a good risk and has afterward increased the premium in accordance with the number and character of the fire hazards. The combined capacity of the new buildings will be ample to house the 300 and odd cars now in service. The company has decided to make the double-truck semi-convertible car its standard, so that the new car house capacity will be ample to cover the estimated growth in traffic for 10 years.



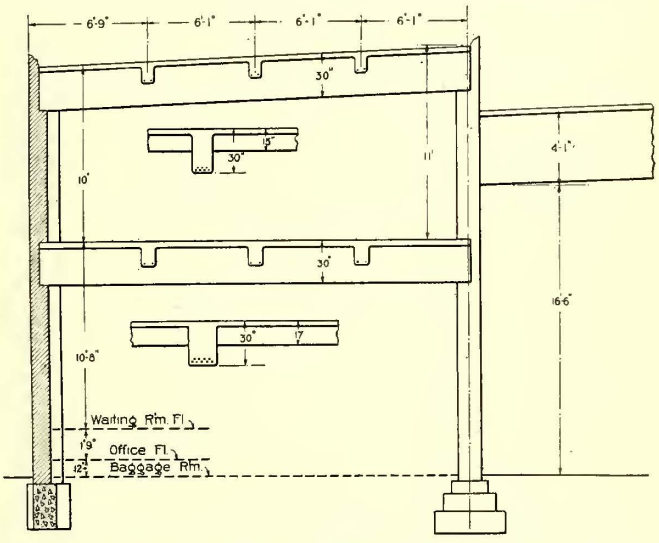
KEY TO BUILDINGS.

No. 1, Sand house.
No. 2, New oil room.
No. 3, Storeroom.
No. 4a and 4b, Car houses.
Nos. 5 and 6, Men's toilets and lockers.
No. 7, Blacksmith shop.
No. 8, New paint shop.
No. 9, Boiler room.
No. 10, Paint shop to be proposed new machine shop.
No. 11, Machine shop to be proposed new carpenter shop.
Nos. 12 and 13, Proposed car houses.
No. 14, Transfer table.

Richmond Car Structures—Plan of New Main Shops and Car Houses

The main installation will involve the erection of a $600,000 car storage and repair plant made up chiefly of two car houses and general repair shops arranged as shown in the accompanying plan. The company will also build a combined passenger and freight terminal and car house at Twenty-ninth and P Streets in Richmond and also one at Manchester, Va. Other plans are in mind for extensive renewals and rehabilitation of track, but these are dependent on the Richmond Council granting the company a new blanket franchise. The latter would include provisions for rerouting of certain lines which were built by the original competing companies and which are still unprofitably operated owing to the necessity of complying with the old franchise conditions.

The combined car house and shops will be in the west end of Richmond, 1¾ miles from the center of the city, on property which is now used in part for the same purposes. Both the old and new conditions are indicated on the plan previously mentioned. The building marked "Casino" is to be replaced eventually by a passenger terminal, as the property in this vicinity is directly in line with the prevailing westward movement of the Richmond population and this point is already the terminus of three other city lines. Aside from the general rearrangement of the shops, the storage facilities will be enlarged by the construction of the two car houses which will have a total capacity of 165 single-truck or 110 double-truck cars. The old car house has already been improved by the installation of a granolithic floor and concrete pits.



Richmond Car Structures—Section of Manchester Car House Through Waiting Room and Men's Quarters

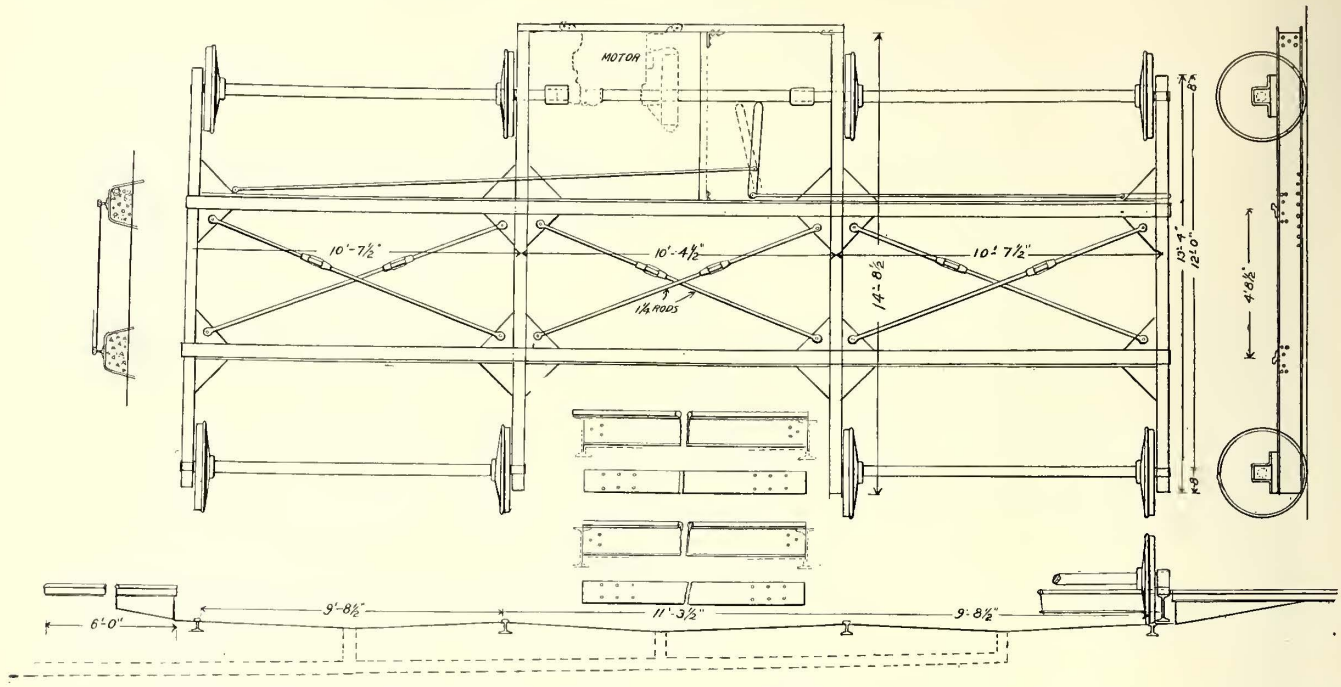
The new paint and machine shops will receive rolling stock from the car house by means of a transfer table, which will be 32 ft. 3 in. overall to accommodate the longest cars used by the company. The greater part of the table is being built up of second-hand girder rails, I-beams, wheels, etc., which were lying around the shops. The 90-lb. girder rails of the transfer table will be cut and fitted into the 10-in. I-beam framing as shown so that only the head of the rail will project above the I-beam. The table will be operated by an old GE-62 motor. Locking levers manipulated from the operator's cab will be provided to lock the table at any given track. The transfer pit will be of concrete and will have a slope on each side for the convenience of the men in passing from one shop to another.

Richmond Car Structures—Elevation of Car House and Passenger Terminal at Manchester, Va

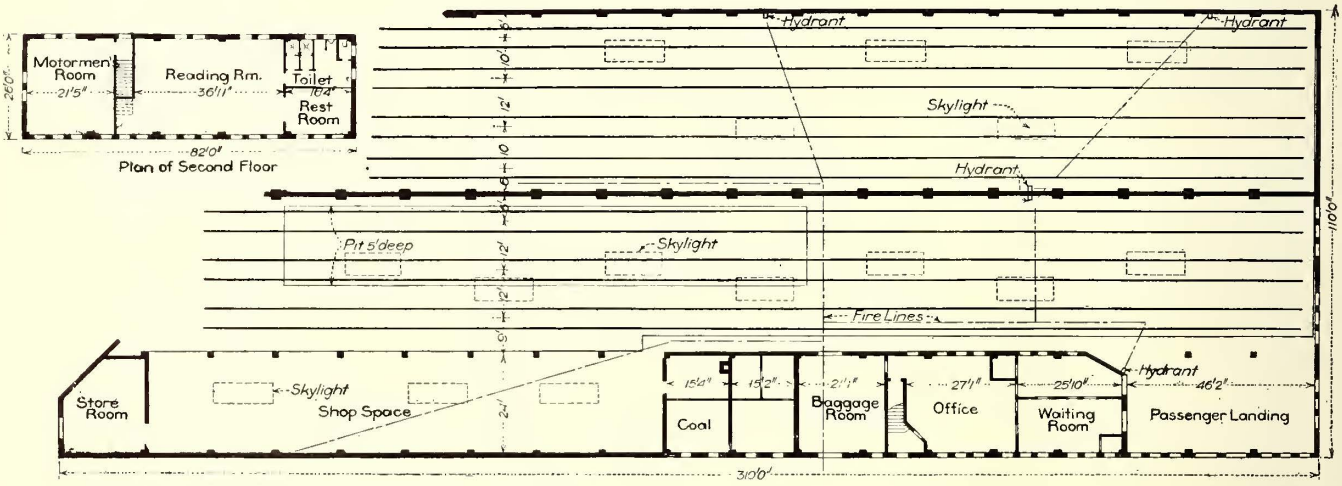
THE MANCHESTER CAR HOUSE

The Manchester building is to serve for the storage and light repairs of the interurban cars of the Richmond-Petersburg line. The first floor will be divided into two car bays and a group of

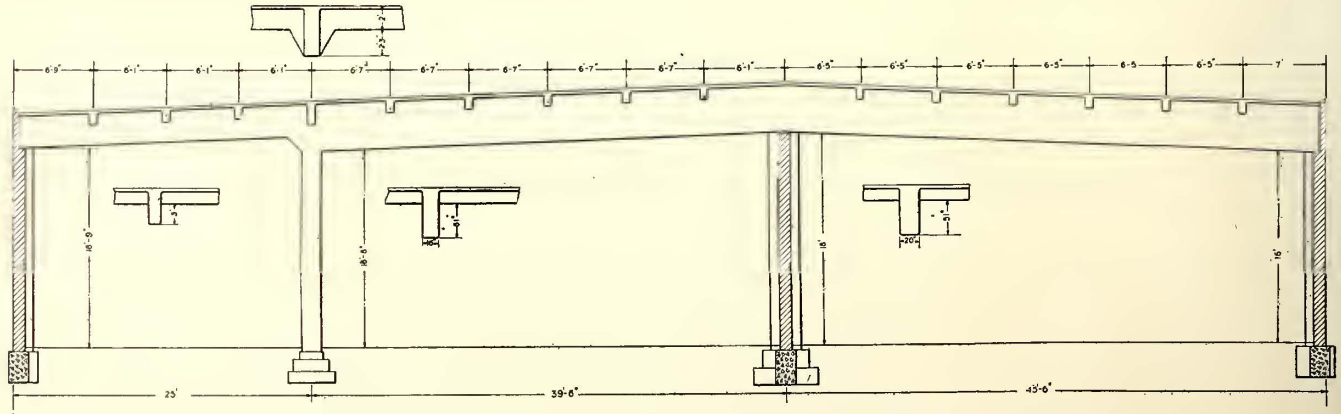
utilities structures, including a shop-heating plant, dispatcher's and ticket office, baggage-room, passengers' waiting-rooms and platform. It will be observed that the passengers are to board or leave the cars on the inside of the building. Separate waiting-rooms will be provided for the white and colored passengers with separate exits to the platform and separate ticket windows. Above this portion of the building is a second story which is reached by a stairway in the dispatcher's office. The



Richmond Car Structures—Transfer Table Between New Shop and Present Car House



Richmond Car Structures—Plan of Car House and Passenger Terminal at Manchester, Va.

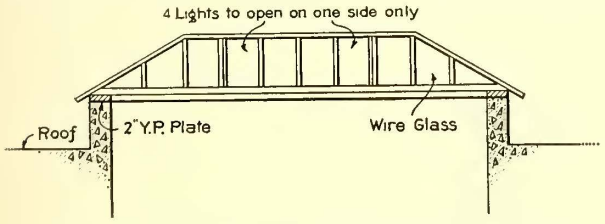


Richmond Car Structures—Section of Manchester Car House

upper floor is to be devoted exclusively to the Y. M. C. A. recreation room of the conductors and motormen. It will be observed that the arrangement is such that the men can proceed directly to their quarters after depositing their trip reports at the window in the vestibule.

The greatest length of the structure will be 310 ft. along the northern line of the utilities division. This length will gradually diminish to about 217 ft. along the southern wall, as shown. This diagonal entrance was adopted for convenience in moving long cars in and out of the building. The width of the structure will be 110 ft., of which about 25 ft. will be taken up by the utilities section and the balance by seven tracks divided into bays of three and four tracks. The brick wall between these bays has no openings whatever. The four-track section will be used exclusively for storage and will have no entrance doors, but in the three-track section, where overhauling pits are to be provided, rolling doors will be provided to close the entrances. The last of the three tracks, which is marked No. 7 on the plan, will be used for passenger and baggage loading only, while the other two will be supplied with an open pit, 128 ft. long. The floors of both bays will be built to a grade of 1 per cent.

The walls and most of the partitions of the Manchester building will be of brick. The piers will be of brick with the exception of a line of 16-in. and 20-in. concrete columns with plain rod reinforcement forming the dividing line between the car house proper and the utilities section. Partitions of terra cotta are to be used to some extent in the utilities rooms, as indicated on the drawing. The roof will be of 3-in. concrete slabs reinforced with wire mesh to be carried on reinforced-concrete roof girders. This roof has been designed to carry a live load of 30 lb. per square foot in addition to the dead load. About one-fifteenth of the roof area has been reserved for skylights of wired glass. These skylights will be furnished on one side with four movable ventilating sash operated by chains from below. The front of the car house will be carried on double I-beams supported on double channel columns filled with concrete. These columns will have footings of reinforced concrete. The partition wall between the utilities section and the car house proper is carried 5 ft. above the roof. A granolithic floor will be used in all of the rooms of the shop except in the office, where a yellow-pine floor is to be laid. The floor of the upper story will be of reinforced concrete with granolithic finish. The stairway to the upper floor is to be of reinforced concrete with wire mesh and will be supported by an 8-in. brick wall. The windows and doors will have row-lock arches. The window sills and copings and the chimney cap will be of stone and the door sills of granite. It will be seen from these particulars that every endeavor has been made to secure as fire-



Richmond Car Structures—Detail of Skylight

proof a structure as practicable for an operating car house. Fire-fighting means will be provided by a city main connection to fire lines and hydrants distributed as shown on the plan. Fire extinguishers will also be installed in the offices.

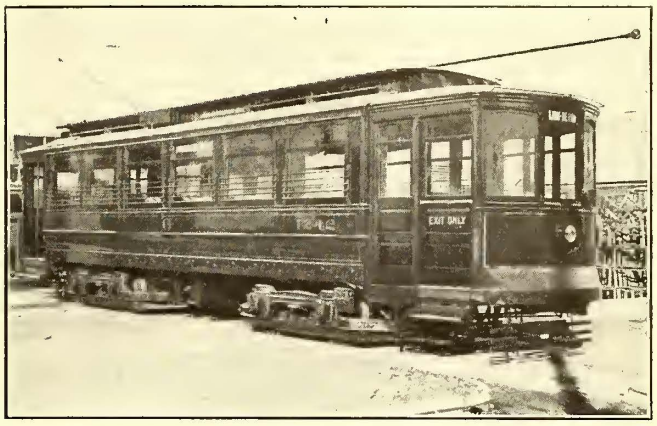
GENERAL

The new structures are being built under the direction of C. B. Buchanan, general superintendent of railways, and Calvin Whiteley, Jr., chief engineer of railways.

During a recent meeting of the South African Electric Power Commission, A. Beaton, acting chief engineer of the Central South African Railways, approved of the general principle of electrifying the lines in the low country, and also the Springs-Randfontein line.

COST OF CONVERTING AND STANDARDIZING CHICAGO RAILWAYS CARS

The detail methods followed by the Chicago Railways Company in reconstructing 328 double-end vestibuled closed cars into pay-as-you-enter equipments were described and illustrated in the Electric Railway Journal for Nov. 27, 1909, page 1092. Figures for the cost of converting one car are now available. In studying these figures it should be remembered



Chicago Railways Company—Reconstructed Pay-As-You-Enter Car

that the cars converted, which were of the St. Louis double-truck box type with four motors, had undergone a period of six years' severe service in Chicago. These cars have been thoroughly rebuilt and converted for pay-as-you-enter service under license from the Pay-As-You-Enter Car Corporation.

Quantity. Description.	Material.	Labor.	Totals.
WOOD MILL			
672 ft. 1½-in. cherry, at $0.12	$80.64	....	....
24 ft. 1½-in. yellow pine, at $0.04	.96	....	....
152 ft. 3½-in. ash, at $0.07½	11.40	....	....
40 ft. 1½-in. ash, at $0.06½	2.60	....	....
56 ft. 1½-in. ash, at $0.05	2.80	....	....
35 ft. ⅝-in. poplar, at $0.06½	2.28	....	....
72 ft. 1-in. birch, at $0.06½	4.68	....	....
		....	$105.36
LABOR			
60 hrs. wood machinist, at $0.29	....	$17.40	....
90 hrs. wood machinist, at $0.28	....	25.20	....
15 hrs. wood machinist, at $0.39	....	5.85	....
65 hrs. wood machinist's helper, at $0.21	....	13.65	....
18 hrs. wood machinist's helper, at $0.25	....	4.50	....
			66.60
CARPENTER SHOP			
196 lbs. malleable castings, at $0.03	$5.88	....	....
60 lbs. brass castings, at $0.18	10.80	....	....
120 lbs. 16x36x120 steel, at $2.20	2.64	....	....
2 register rods, complete with springs, pedals and levers	5.00	....	....
1 register back	1.50	....	....
2 Duner door tracks, at $6.25	12.50	....	....
2 Duner door track pins, at $1.00	2.00	....	....
2 brass door handles, No. 2, at $0.20	.40	....	....
6 brass door handles, No. 3, at $0.25	1.50	....	....
2 brass door handles, No. 1, at $0.15	.30	....	....
2 catches, brass, at $0.25	.50	....	....
2 catches, with plates complete, at $0.35	.70	....	....
12 rubber rollers, with brass bushings and holders, at $0.15	1.80	....	....
12 door rollers for st drs., at $0.35	4.20	....	....
12 special hinges, 2¼ in. x 5 in., at $0.017	.21	....	....
3 pair brass butts, 2¼ in. x 4 in., at $0.728	2.19	....	....
12 brass door roller strips, at $0.25	3.00	....	....
4 air sander traps, at $1.85	7.40	....	....
288 ft. ¼-in. black pipe, at $5.10	14.69	....	....
40 ft. 1-in. black pipe, at $4.45	1.78	....	....
2 ft. tees, at $0.10	.20	....	....
120 lb. mild steel, at $1.90	2.28	....	....
2 hand brakes, at $12.50	25.00	....	....
2 bascule fenders, at $16.50	33.00	....	....
228 ft. rattan (sq. ft.), at $0.21	47.88	....	....
8 lts. glass, 20 in. x 36 in., at $0.262	2.10	....	....
6 lts. glass, 14 in. x 34 in., at $0.16	.96	....	....
6 lts. glass, 20 in. x 28 in., at $0.18	1.08	....	....
12 lts. glass, 42 in. x 24 in., at $0.38	4.56	....	....
12 lts. glass, 10 in. x 42 in., at $0.15	1.80	....	....
12 brass storm sash catches, at $0.15	1.80	....	....
Bolts and screws	5.00	....	....
		....	204.65
719 hrs. carpenter, at $0.30	....	$215.70	....
50 hrs. carpenter, at $0.26	....	13.00	....
10 hrs. plumber, at $0.28	....	2.80	....
75 hrs. blacksmith and helper, at $0.56	....	42.00	....
15 hrs. machinist, at $0.31	....	4.65	....
25 hrs. machinist, at $0.23	....	5.75	....

ELECTRICAL DEPARTMENT

Quantity. Description.	Material.	Labor.	Totals.
1 set cables, at $60.00	60.00	....	....
2 Pullman fuse boxes, at $8.10	16.20	....	....
2 headlights, at $5.50	11.00	....	....
2 platform heaters, at $3.00	6.00	....	....
2 trolley catchers, at $6.00	12.00	....	....
2 Pullman trolley bases, at $19.00	38.00	....	....
475 ft. No. 18 wire, at $0.636	3.02	....	....
400 ft. No. 14 wire, at $0.935	3.74	....	....
23 light sockets, at $0.22¼	5.12	....	....
2 wall sockets, at $0.12	.24	....	....
18 16-cp frosted side lamps, at $0.209	3.77	....	....
2 16-cp clear market lamps, at $0.19	.38	....	....
3 32-cp frosted center lamps, at $0.3686	1.11	....	....
2 32-cp clear platform lamps, at $0.3420	.69	....	....
1 heater switch, at $5.00	5.00	....	....
2 32-cp headlight lamps, at $0.35	.70	....	....
1 switch, at $0.404	.41	....	....
2 3-way switches, at $0.44½	.89	....	....
		....	$168.27

LABOR

40 hrs. electrician, at $0.28	....	$11.20	....
			11.20

TRUCK DEPARTMENT

48 ¾-in. x 2½-in. machine bolts, at $1.85.	$0.89	....	....
16 ¾-in. x 6½-in. machine bolts, at $2.76.	.45	....	....
8 ¾-in. x 4½-in. machine bolts, at $2.30.	.19	....	....
16 ¾-in. x 3½-in. machine bolts, at $2.08.	.34	....	....
8 ⅝-in. x 2-in. machine bolts, at $1.83...	.15	....	....
8 ⅝-in. x 2½-in. machine bolts, at $1.48.	.12	....	....
4 ⅝-in. x 1½-in. machine bolts, at $1.17.	.05	....	....
16 ⅝-in. x 3-in. machine bolts, at $1.46...	.24	....	....
24 ¾-in. x 3-in. C. H. bolts, at $2.37.....	.57	....	....
48 ⅝-in. x 2½-in. C. S. bolts, at $1.47....	.71	....	....
8 ¾-in. x 10-in. G. S. bolts, at $0.21.....	.08	$1.60	....
8 ¾-in. x 3½-in. G. S. bolts, at $3.90....	.32	....	....
16 ⅝-in. x 2-in. rivets, at $0.15	.16	2.24	....
2 ¾-in. x 3-in. brake lever pins, at $0.05.	.01	.09	....
2 ¾-in. x 3½-in. brake lever pins, at $0.05	.01	.09	....
4 ⅞-in. x 5½-in. machine bolts, at $3.98.	.16	....	....
4 ⅞-in. x 3½-in. machine bolts, at $3.21.	.13	....	....
16 ½-in. x 4-in. cotter keys, at $0.966.....	.02	....	....
16 3/16-in. x 1-in. cotter keys, at $0.45....	.01	....	....
8 ½-in. x 5½-in. C. S. bolts, at $2.15....	.18	....	....
8 ⅝-in. x 2½-in. C. C. bolts, at $1.47....	.12	....	....
80 ¾-in. spring washers, at $0.625.....	.50	....	....
84 ⅝-in. spring washers, at $0.525.....	.45	....	....
4 brake beam supports, ⅜ in. x 2 in. x 16 in., at $0.16	.40	.24	....
4 brake beam supports, ⅜ in. x 2 in. x 12 in., at $0.14	.32	.24	....
4 brake beam guards, at $0.95	1.20	2.60	....
4 brake levers, at $0.50	1.60	.40	....
4 axles, at $11.70	42.00	4.80	....
8 wheels, at $8.12	60.80	4.16	....
8 journal boxes, at $2.56	20.64	....	....
8 journal brasses, at $2.15	16.40	.80	....
4 2¾-in. x 6-in. x 7/16-in. coil springs, at $0.09	.36	....	....
2 1½-in. turn buckles, at $1.50	3.00	....	....
8 1¾-in. x 5-in. x 6-in. coil springs, at $0.315	2.52	....	....
8 journal box wear plates, ⅜-in. x 4 in. x 12 in., at $0.25	.80	1.20	....
16 journal box clamps, at $0.15	1.60	.80	....
2 brake lever guards, at $0.73	.24	1.22	....
8 bolster hangers, at $0.46	1.76	1.92	....
8 brake shoe keys, at $0.16	.16	1.12	....
4 St. L. side frames, at $19.15	71.40	5.20	....
4 end bars, at $5.16	13.12	7.52	....
4 center cross bars, at $3.44	11.28	2.48	....
2 center bearings, at $0.48	.96	....	....
4 side clamps, at $0.56	2.24	....	....
4 elliptical springs, at $6.00	24.00	....	....
2 channel irons, at $1.69	3.00	.38	....
4 btm. bolster pins, 1½ in. x 12 in., at $0.27	.88	.20	....
4 top bolster pins, 1¼ in. x 2 in. x 15 in., at $0.27	.88	.20	....
8 brake beams, at $2.14	11.84	5.28	....
8 brake shoe heads, at $0.48	3.84	....	....
8 brake shoes, at $0.36	2.88	....	....
16 brake hangers, at $0.15	2.40	....	....
8 brake hanger castings, at $0.15	1.20	....	....
4 brake beam center castings, at $0.51	2.04	....	....
8 release springs, at $0.29	.80	1.52	....
2 cast clips for brake beam supports, at $0.06	....	....	....
4 forged clips for brake beam supports, at $0.50	2.00	....	....
38 hrs. truckmen, at $0.23	....	8.74	....
		....	56.04
	....	....	314.48

PAINT DEPARTMENT

Material	$27.00	....	....
		$27.00	....
Labor	....	43.00	....
	....		70.00
Air door operating device	....	....	55.00
Grand total			$1,335.50

CREDITS

BODY AND ELECTRICAL.

4 car body doors, at $4.00	$16.00	....	....
4 vestibule folding doors, at $6.00	24.00	....	....
1 United States trolley base, at $3.80	3.80	....	....
1 Standard trolley base, at $18.00	18.00	....	....
90 lbs. scrap copper cables, at $0.12	10.80	....	....
175 lbs. ½-mild steel, at $1.90	3.32	....	....
2 ULTL fenders, at $4.00	8.00	....	....
15 16-cp lamps, at $0.15	2.25	....	....
3 3-light clusters, at $9.60	1.80	....	....
3 enameled shades, at $0.72	2.16	....	....
14 lbs. scrap brass, at $0.10	1.40	....	....
		$91.53	....

TRUCKS

Quantity. Description.	Material.	Labor.	Totals.
8,200 lbs. scrap iron, at $9.00	$32.95	....	....
4,000 lbs. scrap wheels, at $16.80	30.00	....	....
48 lbs. scrap brass, at $0.10	4.80	....	....
		67.75	...
			159.28
Net cost			$1,176.22

The work of conversion also included rewiring of the cars in conduit, installing new light fixtures and cables, adding large electric heaters on the platforms, installing new headlights, hand brakes, air door-operating devices, air gongs and life guards, thoroughly rebuilding the trucks, and painting and varnishing the entire car.. One of the reasons for so thoroughly overhauling these cars was to standardize largely all the minor details which require frequent attention and repair. It was believed that an interchangeability of parts would greatly reduce future maintenance charges. An illustration of one of the reconstructed cars is presented.

The accompanying detail cost figures apply to the conversion of one typical St. Louis double-truck box-type motor car into a standard pay-as-you-enter equipment.

POLE AND TIE PRESERVATION IN THE SOUTH

Although most of the electric railways in the Southern States are conveniently situated with regard to lumber shipments, they have given considerable attention to the problem of securing the maximum life from their ties and poles by the use of preservatives. It may, therefore, be of interest to describe the conditions and practices in several Southern cities, which were visited recently by a representative of the Electric Railway Journal. A summary of tie preservation practice throughout the United States appears elsewhere in this number.

NORFOLK, VA.

The Norfolk & Portsmouth Traction Company is now creosoting 1000 to 1200 poles a year and at this time has about 12,000 treated poles in use. The costs of the treated pine poles of different lengths are as follows: 30 ft. to 35 ft. poles, 20 cents per ft.; 40 ft. to 50 ft. poles, 22 cents per ft.; 55 ft. to 60 ft. poles, 24 cents per ft. In connection with this price, it should be remembered, that Norfolk, Va., has some of the largest creosoting plants in the United States. Although this company itself began with 50 treated poles only about seven years ago, creosoted poles have been in use in Norfolk for over 32 years and they are still in good condition. Throughout the latter period, the same poles were used successively by the fire alarm, gas and telephone companies. The Norfolk & Portsmouth Traction Company also had left over from the Jamestown Exposition work about 30,000 untreated 8-ft. ties, which have since been creosoted. The prevailing price of creosoted pine or gum ties 8 ft. long is 85 cents in Norfolk. This company has also used the superficial method of preservation on a 1500-ft. trestle at Tanner's Creek, the preservative being Avenarius Carbolineum which was imported direct from Germany.

DURHAM, N. C.

The Durham Traction Company is using white oak and chestnut ties. So far it has not treated any as it is found that these woods give a long life when they are well buried. All poles, however, are treated with C. A. wood preserver on the butts and up to 18 in. above ground. The same preservative is applied to fences, posts and other ground work. The principal pole wood is cypress, but juniper is used occasionally.

WILMINGTON, N. C.

The Tidewater Power Company uses both cresote and dead oil of coal tar, but the former is consedered better. The company has had long experience with creosote. For example, on July 16, 1907, it removed a light tie of short-leaf pine which had been creosoted and laid in 1888. This tie was found in perfect condition when taken out, not showing the least signs of rot. The company has followed the practice of buying

for 25 cents apiece sap long-leaf ties which have been rejected by the steam railroads, and then treating them with creosote at a cost of 20 to 25 cents each additional. Some of these ties were laid down three years ago and were taken up in January of this year. They were found in perfect shape, whereas similar untreated ties in the damp soil of Wilmington would have been useless by that time. The creosoting process of the Wilmington company differs from the ordinary method with vacuum and high temperature in which the wood is subjected to as much as 350 deg. F. It is believed that such a high temperature tends to make the wood brittle and affects the life injuriously. The process used is one in which the temperature does not exceed 240 deg. F. A closed tank is employed with means for taking care of the saps as they evaporate. When the ties are put in the retort, the latter is closed to prevent the escape of explosive vapors. By means of steam pipes, the retort is then heated to about 240 deg. F. in six hours. After this, the hot oil is pumped out and the cold oil is pumped in. The hot oil heats the ties and drives out the moisture and saps, whereas the cold oil following contracts the pores and draws in the preservative. The Wilmington retort is used for any pieces up to 16 ft. in length, including ties, crossarms and paving blocks. The poles are of juniper or so-called white cedar. They are treated at their lower ends and for a short distance above the ground with creosote applied with a brush and are then coated with tar.

CHARLESTON, S. C.

The Charleston Consolidated Railway, Gas & Electric Company has determined to use black cypress principally for ties. During this year, for example, it will buy 4000 black cypress and 1000 yellow-pine ties. The cypress ties are 7 in. x 9 in. by 8 ft. long and cost 41 cents, against 35 cents in 1905. This wood is obtained from Southern swamps and has a great partiality for moisture. It is said to last indefinitely under the ground and rots only if exposed to the air. Black cypress ties have been in service in Charleston for 13 years under 7-in. and 9-in. rails in paved streets and are good to-day. Cypress ties are good for about 10 years in open track, whereas untreated pine ties last only 4 years under the same conditions. Poles are treated with creosote at the butts for a distance of 1 ft. above the surface. The treatment is made in three applications with a brush, one coat being applied each day. The cost is about 40 cents and the estimated increase in the life of a black cypress pole is 3 to 4 years. The prices of black cypress poles in Charleston are as follows: Thirty-ft. poles with 8½-in. top, $2.50; 35-ft. poles, $3; 40-ft. poles, $4. An untreated pole, if cut in winter when the sap is down, will last 10 to 12 years, but if cut when the sap is up, will last only 4 years. White cypress is not good for more than 4 to 5 years in any event. Black cypress is very much superior to juniper where heavy loading is required and is also better than pine, because it is a swamp wood which thrives on moisture even after it has been cut, whereas juniper dry rots.

SAVANNAH, GA.

The Savannah Electric Company uses untreated Georgia black cypress ties, of which it intends to lay about 6000 during the present year. These ties are 6 in. x 8 in. x 8 ft. long and cost slightly less than 38 cents each. The company expects that in the sandy soil of Savannah this wood will be good for 15 years in paved and 10 years in open track. This estimate is based on the experience with a former steam dummy line, which is now an interurban extension, where similar ties have been in use for 30 years. In fact, this wood is considered ideal for a moist soil. Experiments were made at one time with long-leaf pine ties, but they had to be taken out in less than 5 years. The poles are also of untreated cypress and cost about $4.50 each for 30-ft. lengths. Recently this company has been treating its poles to the extent of a coating of carbolineum over that portion placed in the ground and a coating of dead oil of coal tar has been used over the balance of the pole, both treatments being applied with a brush. The company has not been treating poles this way long enough to have gained any reliable data as to the results accomplished but feels that the expense undoubtedly is entirely warranted by the increased life it will get from the poles.

AUGUSTA, GA.

The Augusta-Aiken Railway & Electric Company has for its standard untreated ties either black cypress or hard pine, 7 in. x 9 in. by 8 ft. long. In paved streets, however, the company uses a short-leaf, sap pine creosoted tie, 6 in. x 8 in. x 7 ft. long. These sap pines are bought for 20 cents apiece raw and when treated cost 60 cents. In 1908, the city of Augusta paved a street which had been macadamized about 7 years before when the railway company had put in creosoted ties under a 7-in. T-rail. When the ties were examined before the repaving of the street, it was found that they were to all appearances in exactly the same condition as when installed. The poles used are of untreated black cypress. A 35-ft. pole with 10-in. top cost $3.50 or 10 cents per ft., other lengths up to 65 ft. with 7-in. top have been purchased at about the same rate.

ATLANTA, GA.

The Georgia Railway & Electric Company probably has the most elaborate railway creosoting plant in the Southern States. This company began creosoting ties in 1895, and an idea of the extent of this work may be obtained when it is stated that 43,000 ties were creosoted in 1909, 26,000 in 1908 and a total of 163,000 in the last 7 years. At this time, about 50 per cent of the entire trackage is supplied with creosoted ties and no other kind is being used either for renewals or extensions. In 1910, 40,000 ties will be treated for new construction and 12,000 ties for maintenance. Creosoted ties which were installed on Peachtree Street in 1895 were taken out in 1908 on account of the necessity of installing heavier ties for the increased traffic. It was found possible to use fully 50 per cent of them elsewhere. Few of the others were decayed, but quite a number were useless because of the rail wear. It is quite possible that some of the ties which were found decayed really had dry-rot before they were ever placed in the creosoting tank. The original investment for the creosoting plant was about $5,000, but a total of $7,000 to $8,000 will have been expended when the present work of increasing the daily capacity of the plant from 160 to 240 ties is completed. The treated long-leaf sap pine and oak ties, 6 in. x 8 in. x 8 ft. in size, cost about 80 cents and 90 cents each respectively. A sap pine tie requires 4 gal. and an oak tie 3 gal. of creosote. It is figured that the creosote treatment lengthens the life of the ties to a total of 15 years in paved track and 12 years in open track as against 7 and 5 years with untreated ties.

The Atlanta company does not preserve poles. The principal pole wood is chestnut, but some juniper is used. Further particulars of the pole and tie standards of this company will be given in a later article on track standards.

The danger of using untreated ties will be understood from the fact that about 50 per cent of the hewn oak ties which were installed on the Atlanta Northern Railway in 1904 and 1905 are now gone, showing that this wood when not treated is serviceable only for 5 or 6 years in interurban railway work.

MOBILE, ALA.

The Mobile Light & Railroad Company, which operates 50 miles of track, has now creosoted all but 17 miles of track and this trackage will be creosoted as fast as the maintenance goes on. The company has been creosoting on a large scale only for the last 5 years, but the first creosoted ties were placed in service about 10 years ago and are still in service in the sandy soil of Mobile without showing the least deterioration. Untreated pine ties are good only for 6 years in paved and 4 years in unpaved tracks. Short-leaf sap pine and loblolly ties 7 in. x 8 in. x 8 ft. long, are purchased for 30 cents each, and are treated at an additional cost of 47 cents each. The treatment requires about 12 lb. of creosote per cubic foot. In Mobile, which is a great lumber center, untreated heart yellow pine ties now cost 45 cents, whereas they could be bought in

1905 for fully 10 cents less. Treated creosoted poles are purchased for 20 cents per foot for lengths up to 55 ft. They have been in use for about 7 years and are still in good condition.

ASHEVILLE, N. C.

The Asheville Electric Company installed about a year and a half ago a C. A. wood-preserver plant. The company uses white oak, chestnut and red oak ties, which come from within 10 to 15 miles from Asheville, and cost about 35 cents each for the 6-in. x 8-in. x 7-ft. sizes. The cost of treating a tie, including the labor, is 18 to 25 cents. Untreated ties of the same woods have been found to give 7 to 10 years' service in this territory. While it is too soon to make any estimates on the life of the ties subjected to the superficial treatment mentioned, it has been found that treated ties which were put in last year show none of the signs of wear evident in similar untreated ties alongside. The plant installed for this method of preservation is very simple, consisting principally of an 8-ft. x 9-ft. iron tank 17 in. deep. The grate and ash pit are made up of old rails with another row of rails at right angles to the grate to act as a baffler for the first so that the heat will be transmitted equally to both ends of the tank. An iron stack completes the outfit. Ties are kept in the tank for about 20 minutes, during which period about one-third gallon is absorbed per tie. The cross-arms receive double treatment. A six-pin arm costs 7 cents per dipping, or a total of 14 cents. The poles are given two butt treatments with a brush.

LYNCHBURG, VA.

The Lynchburg Traction & Light Company uses chestnut and oak ties, which cost 45 to 50 cents each. These woods have been found to give a life of 8 to 9 years, and the company, therefore, has not considered that it would pay to use a preservative for them.

DATA ON TIE CONSUMPTION AND PRESERVATIVE TREATMENT

In order to present to the readers of this paper some general data on cross tie consumption by the electric railways in the United States a letter of inquiry containing 24 questions was sent out to 95 representative city and interurban companies. Replies to this inquiry were returned by 51 companies. The questions were framed to elicit information regarding the extent to which steel ties and preservative treatments for wooden ties are being used, the cost of ties and the cost of treatment. The 51 roads which answered expected to use a total of 1,307,000 ties in 1910. Based on their mileage, the total demand of all the electric railways of the country for ties may be estimated for the year at 7,100,000. Practically all of the wooden ties purchased by electric railways are of small size, 6 in. x 8 in. x 8 ft. or smaller. Oak, chestnut, yellow pine and cedar are the predominating varieties, oak and chestnut being preferred by companies near the hard wood forests. In the South, yellow pine and cypress are almost universally used. The prices paid for these ties vary from 30 cents to 87 cents delivered; the average price is between 50 and 60 cents. Prices of ties have advanced in nearly all parts of the country during the past five years, although a few companies report no change or even a reduction in cost. An average advance of 25 per cent in five years is a conservative estimate. One company in Massachusetts which bought chestnut ties in 1905 for 45 cents each is now paying 60 cents. The price of cypress ties in Florida has increased from 65 cents in 1905 to 87 cents in 1910.

The life of untreated wooden ties is variously estimated at from 5 to 12 years in open track and from 8 to 28 years in paved track. The kind of ballast used in open track affects the life of ties, the longest life being obtained where broken stone is used.

Sixteen of the 51 companies reporting are using some form of preservative treatment on all or part of the ties laid. A majority of the ties treated are pine, but some companies are also treating white, red and black oak, fir and beech. Many different methods are represented in the replies. The vacuum-pressure straight creosote method is being used by nine of the 16 companies while the open tank creosote method is used by three companies and the open tank method using some one of the many trade preparations of antiseptic dead oils is employed by four companies. One company is using both the vacuum-pressure creosote treatment and the zinc chloride treatment. The quantity of preservative injected into the ties varies with the process used and the kind of wood being treated. For yellow pine ties from 10 lb. to 12 lb. of preservative per cubic foot of timber is injected by the vacuum-pressure process. This is equivalent to about 25 lb. or 2½ gal. per tie. One company uses only 6 lb. per cubic foot for Norway pine and tamarack ties. With the open tank processes much smaller quantities of preservative are injected. From ¼ gal. to ½ gal. is absorbed per tie. The penetration of course is not so deep, but the higher grade of antiseptic oils commonly used with this process affords satisfactory protection against decay, which always begins on the surface.

The cost of treated ties delivered is given at from 67 cents to $1.20, the latter being the cost of a creosoted white oak tie. At the plant of the Indianapolis, Columbus & Southern Traction Company, where the open tank process with low pressure added is used, the cost per tie for 25 lb. of creosote and the necessary labor is given as 32 cents. One company which uses the open tank dipping process states the cost to be from 15 cents upward, depending on the preservative used.

The lowest estimate given of the life of treated ties in open track is 15 years, and one company says 24 years is conservative. A life of from 18 to 20 years can reasonably be expected in almost any kind of ballast and climatic conditions, provided the tie is not disintegrated mechanically by rail cutting or constant respiking. A number of companies are now using tie plates on all wooden ties to prevent rail cutting on tangents as well as to relieve the strain on the spikes on curves. In paved track the life of treated ties is estimated at from 25 to 35 years. They will undoubtedly outlast the rails which are laid on them. The use of steel ties in paved track is making progress although only nine companies reported that they were using them. The cost per tie is more than double that of wooden ties preserved by the most expensive processes but the spacing used is also more than double that used with wooden ties. Four feet is the common spacing but one company reports spacings of 5 ft. to 7 ft. The life of steel ties is estimated by all companies replying to be at least 30 years when embedded in concrete.

THE PHILADELPHIA STRIKE

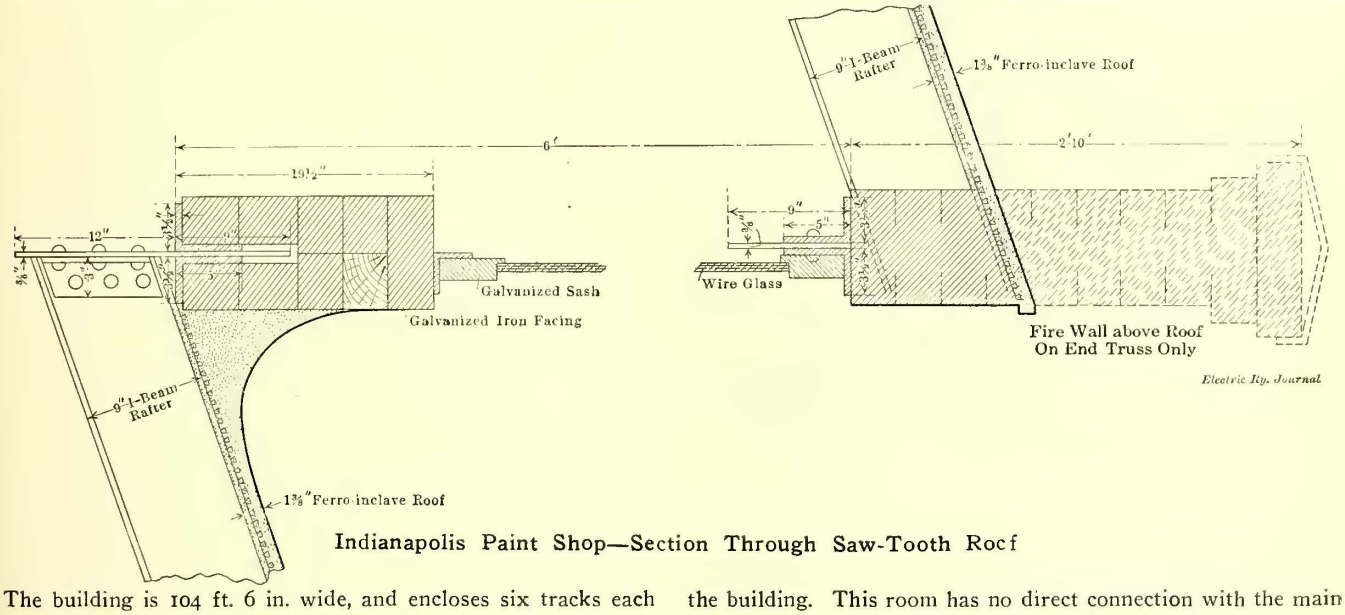
The return to work on March 23 of all the mill and factory operatives in Philadelphia who were on strike in sympathy with the employees of the Philadelphia Rapid Transit Company and the deflections from the ranks of the strikers in the building and other trades virtually forced the committee of 10 in charge of the sympathetic strike to recommend on March 27 that the general strike end at once, and this recommendation was adopted. The sympathetic strikers, however, pledged themselves to support the car men financially. The company reports conditions to be virtually normal on all its lines.

OFFICIAL TICKET PAPER

The Central Electric Traffic Association has officially adopted a safety-ticket paper on which tickets of the members of that association will be printed in the future. This is said to be the first use of a paper of this kind by any single electric line or association of electric railways. The paper is manufactured in 10 different shades to cover the five standard forms of single-trip tickets and five standard forms of round-trip tickets, and carries as a water mark the badge of the association with the words "electric" and "safety" above and below it. The paper is furnished by A. A. Pugh Printing Company, Cincinnati, Ohio, which has agreed to supply it only to members of the Central Electric Traffic Association.

NEW PAINT SHOP OF THE INDIANAPOLIS TRACTION & TERMINAL COMPANY

A paint shop of interesting fireproof construction, occupying the site of one destroyed by fire, has just been completed by the Indianapolis Traction & Terminal Company. The new building has a saw-tooth roof which is supported by brick side walls and a single row of steel-concrete center columns.



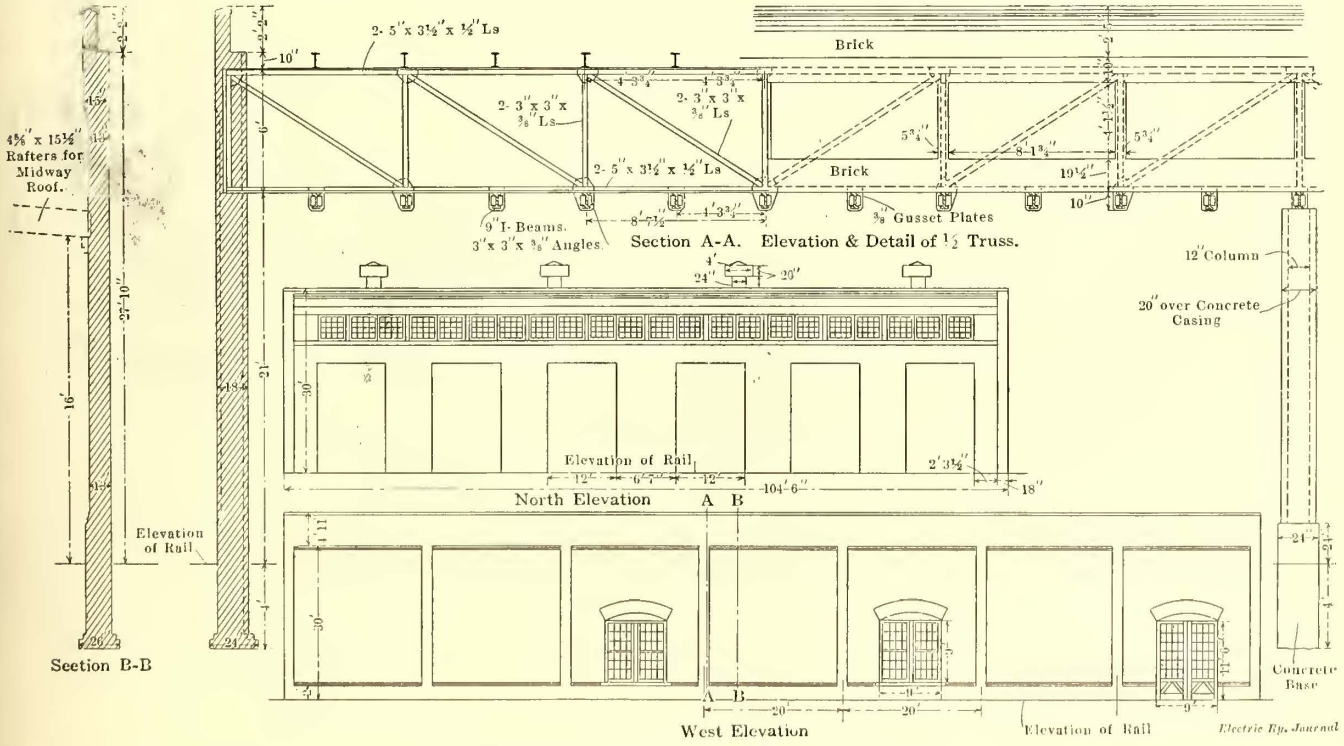
Indianapolis Paint Shop—Section Through Saw-Tooth Roof

The building is 104 ft. 6 in. wide, and encloses six tracks each 140 ft. long. All the tracks lead to the shop transfer table which shortly is to be rebuilt so that large interurban cars may be handled with greater facility. The new shop building is 20 ft. longer than the one which it replaces and is built according to a type of design which it is thought will be adopted when other buildings are reconstructed. The present new building, in event of the erection of other new structures, probably will be used for truck repair purposes and a larger building be erected at a later date for the painting department.

Adjacent to the west side of the new paint shop structure and opening on to it, is a row of smaller rooms built of thoroughly fireproof materials and designed for the following uses: One room will be used for paint mixing. A window connects this room with the paint shop and this window is provided with double automatic fire shutters. A room for the storage of paint is equipped with four Bowser long-distance pumps for drawing the oil supply from large storage tanks located underground outside the building. A door in the rear wall of this room will facilitate the handling of paint stock from the track outside into the building. This room has no direct connection with the main paint shop. A third additional room is being fitted up as an office for the master painter.

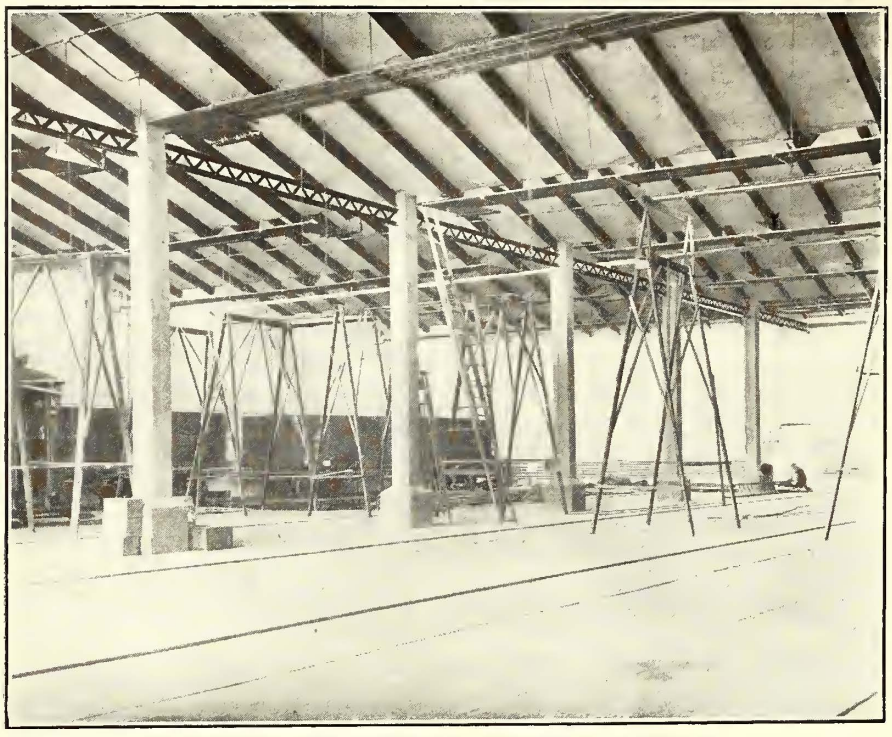
GENERAL DESIGN

The design for the new paint shop was executed in the offices of the chief engineer of the Indianapolis Traction & Terminal Company. The building is noteworthy for the excellence of the lighting and the freedom from roof supports. Accompanying illustrations show the principal features of the type of saw-tooth roof structures. Engravings made from photographs taken shortly before the occupation of the building illustrate the appearance of the roof from above and below.



Indianapolis Paint Shop—Structural Details

The roof structure is made up of seven saw-tooth sections similar in design. Each of these sections extends across the width of the building (approximately 100 ft. between side walls) and includes a vertical skylight with a clear opening 3½ ft. high by 100 ft. wide. The roof structure is supported by cross members, which are angle-iron trusses 6 ft. in depth. The sloping members are 9-in. I-beams. The main trusses are spaced on 20-ft. centers and each is a continuous structure across the width of the building, supported at the center by a 12-in. steel column resting on a concrete base 4 ft. deep. As a protection against fire these center columns are enclosed in a square casing of concrete 20 in. on a side. This type of construction leaves the entire floor area free of columns, with the exception of the single row extending down the middle of the building between the two center tracks. The side walls are of brick, 18 in. thick, carried to a height of 3 ft. above the roof trusses.



Indianapolis Paint Shop—Interior Just Before Completion

ROOF STRUCTURE

Reference to the cross-section of one of the truss members of the roof will show the method followed in connecting the 9-in. sloping rafters at the bottom of one truss and at the top of the next. The sloping rafters are spaced on 4-ft. 3¾-in. centers across the width of the building. The upper end of each rests on top of the main truss and the lower end is attached to the bottom of the next truss. These rafters are covered with a fireproof concrete roof, using Ferroinclave to support the concrete. A large fillet of concrete is formed at the lower side of each saw tooth. The roof is 1⅜ in. thick and is waterproofed with tar covered with gravel. The slope of the room at right angles to the saw teeth is 6 ft. in 20 ft. and crosswise of the building there is a pitch of 4 in. in 50 ft. to provide drainage away from the center.

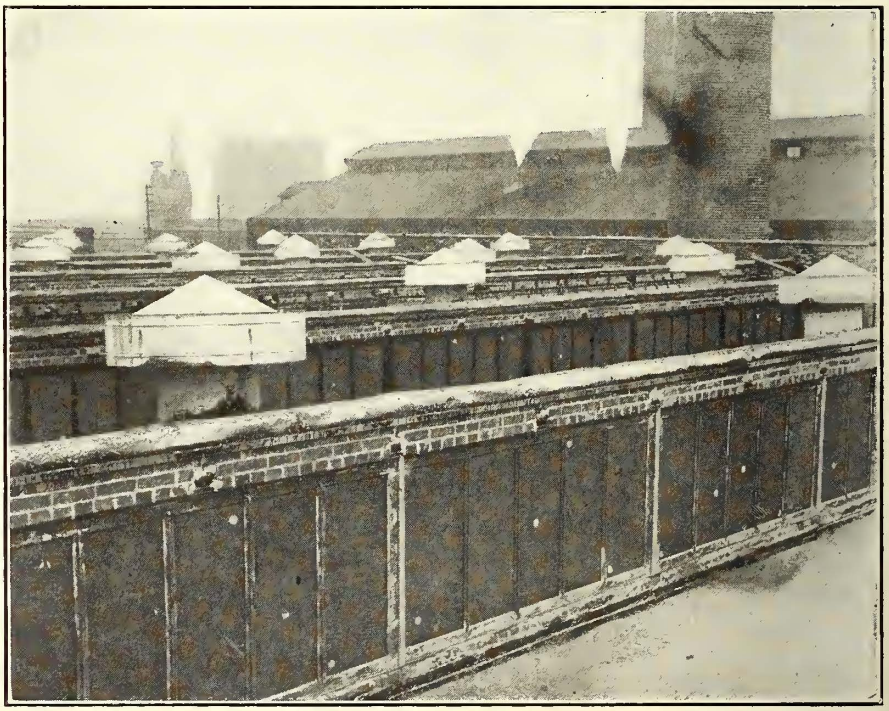
Each of the vertical sections of the roof is fitted with galvanized-iron sash enclosing wire glass. The detail construction of the sash, which are reinforced with angles, is illustrated. The lower sides of the sash rest on a brick coping supported on the lower angles of the large cross trusses. This brickwork forms a tight wall across the gutter at the bottom of each saw tooth. A similar brick wall 8 in. thick extends across the tops of the trusses and fills in the space on either side of the upper ends of the rafters. At the end walls of the building this brickwork is carried to a coping at a height 3 ft. above the tops of the trusses.

The sash in all of the vertical sides of the saw-tooth roof, except two, are permanently fixed in place. The sash in the north and middle trusses are hinged, and the windows may be operated by gearing extending to the floor level. Ventilation is provided by four large ventilator heads in each of the seven sections of the roof. These ventilator heads have brass-wire gauze inserted to protect freshly painted cars from dust.

HEATING

Provision has been made for heating the building with live steam obtained from the power station located on the same property with the shops. Radiation is had from eight wall coils mounted on the three sides of the building, 12 overhead coils and five radiators located in the spaces between the entrance doors. The total radiation approximates 5000 sq. ft. and the equipment is designed to heat the building to 70 deg. Fahr. in zero weather, when the air is completely changed twice an hour.

The live steam received from the power plant passes through a reducing valve which lowers the pressure to 20 lb. The radiation coils are fitted with steam and air traps manufactured by C. A. Dunham & Company. These traps are set to release the drips when the radiator piping reaches a temperature of 160 deg. Fahr. The loss of heat in the return pipe from the



Indianapolis Paint Shop—Saw-Tooth Roof with Ventilators

paint shop to the power house is about 20 deg. and thus the drip is returned to the feed-water heater in the plant at 140 deg.

ILLUMINATION

The general illumination for this paint shop will be obtained from Cooper Hewitt mercury vapor lamps supported 15 ft. above the floor. Local illumination will be had from single lamp drops with cords reaching to within 4 ft. of the floor. This generous length of cord will permit lowering the lamps to the bottoms of the cars without the use of extension plugs. All the wires are enclosed in iron conduit supported from the lower side of the roof purlins and having porcelain-protected outlets. Mercury vapor lamps have been used in the carpenter and older paint shop buildings at Indianapolis for about eight months and no trouble has been experienced because of the peculiarity of colors brought about the violet rays of this light. It is the practice to match all colors in daylight and apply the paint under the mercury vapor lamp, which gives a strong, well distributed illumination.

ELECTRIFICATION OF THE MONT CENIS RAILWAY

According to a recent issue of *Elektrische Kraftbetriebe und Bahnen* the Italian State Railways have begun to electrify the Mont Cenis Railway between Modana and Turin. It is expected that by the spring of 1911 it will be possible to operate electric locomotives into Turin and thereby promote the travel to the international exposition then to be opened in that city. Like the Simplon tunnel line, this road will be operated at 15 cycles, three-phase, with 3500-volt overhead conductors. Power will be purchased from a hydroelectric plant in Turin and transmitted at 50,000 volts, 50 cycles, to a converter station at Bardonnecchia. This converter station, which is to be equipped by the Milan branch of the Brown-Boveri Company, will be the first European trunk line equipment embracing such large units as 2000 kva for changing current from 50 cycles to 15 cycles. The principal apparatus will consist of the following: One 2200-kva, 50-cycle, 48,500/7000-volt oil-insulated, water-cooled, three-phase transformer; one frequency changer made up of one 40-ton fly-wheel, one semi-rigid coupling, one 2000 kva, 500 r.p.m. 3500-volt, 16 2/3 cycle three-phase generator, one rigid coupling, one 2500-hp, 7000-volt, 50-cycle induction motor, one semi-elastic coupling and one three-phase commutator motor for regulating the speed of the asynchronous motor between 400 r.p.m. and 500 r.p.m. The use of the very heavy fly-wheel cuts down the speed of the machines by 20 per cent and stores large masses of kinetic energy to care for line load fluctuations. When the speed drops from 500 r.p.m. to 400 r.p.m., the fly-wheel can give about 1000 hp for one minute. The three-phase commutator motor permits the asynchronous motor, with which it is connected in cascade, to approximate unit load factor.

As the line is to be fed from both ends, the station will also contain a 3000-kva, 3500/3850 volt, 16 2/3 cycle auto-transformer with two induction regulators which will be used to raise the potential at the Modane end by 5 per cent, namely, from 3500 volts to 3850 volts. In addition to the apparatus mentioned, the station will also be supplied with a 450 hp hydroelectric turbo-exciter set, small transformers, etc. The line equipment will be installed directly by the Italian State Railways. It is understood that experiments are to be made also with 50 cycle, three-phase locomotives.

The fourth annual convention of the Missouri Electric, Gas Street Railway & Water Works Association will be held at Jefferson City, Mo., April 14, 15 and 16. The program includes the following papers: "The Luminous Arc Rectifier System," by Louis Fredman; "Securing Profitable Day Load," by J. E. Harsh; "Condensers for Small Central Stations," by Chas. S. Lewis; "Electrically Driven Water-Works Plants," by H. W. Clark; "The Primary Law Relating to Public Utilities," by Geo. McCollum; "Data on Electric Plants," by Prof. H. B Shaw; "Power Plants in Public Service," by Edwin S. Harrison.

ECONOMY IN ELECTRIC CAR PAINTING

BY CARL F. WOODS, ARTHUR D. LITTLE LARORATORY OF ENGINEERING CHEMISTRY

The increasing demands imposed upon electric railways and the necessity of constantly improving the service afforded the public, without in many cases any proportionate increase in revenue, render it essential that the manager of such properties obtain the maximum efficiency from every dollar expended in maintenance. Among the problems of this nature which constantly arise there are few more troublesome than that of maintaining the appearance of the rolling stock to that degree of excellence which the traveling public demands, without expending an amount of money out of proportion to the relative importance of this item of maintenance. The fact that the cost of painting the same type of car varies on different roads from $30 to $60 and that certain companies are forced to repaint every two or three years while others are able to operate cars from 10 to 12 years before complete refinishing becomes necessary emphasizes the need of careful consideration of this important item of maintenance.

There are several factors which render the subject of car painting of particular and increasing importance to the manager who is attempting to reduce maintenance charges. With the advent of elevated lines and subways and the increasing use of cars of the semi-convertible type, the intrinsic earning power of each car and the direct financial loss for every day that the car is out of service are greatly increased. Other contributing causes are the inferior quality of woodwork which is to-day used by car builders owing to the necessity of cheap and rapid construction and the prevalence of adulterated and inferior paints and varnishes. The use of the latter is not due entirely to the desire of the paint manufacturer to deceive, but is very frequently the direct result of false economy by the purchasing department. In paint materials, as elsewhere, the most expensive is not of necessity the best, but it is equally true that the best is not the cheapest in first cost. The attempt to economize in painting by purchasing the cheapest materials usually results in actual extravagance, for first cost is a small item in the actual expense of painting. The purchaser who buys varnish to-day for $1.50 a gallon, when the price of the oil and gum going into it is greatly in excess of this figure, can only blame himself if he obtains a mixture of rosin and benzine. Such conditions are unfortunately very prevalent and many companies whose invoices show astonishingly low prices are actually spending far greater sums in the long run than the company which pays a price in proportion to the grade of material it desires and obtains from it satisfactory service.

It will be admitted by practically all railroad managers that it is essential to run cars which present as good an appearance as possible, but the exact meaning of this to the individual manager differs widely. To one it implies a car of many colors with ornate trimming and lettering; to another, a finish equal to that of automobiles or carriages, while to a third it represents a car of a pleasing color, clean and well kept but without ornamentation and unnecessary work. There is, however, a general tendency to do away with expensive finishing and decorating, as it becomes increasingly necessary to reduce expense, for however handsome a car may appear when fresh from the paint shop, a few weeks of service greatly impair its appearance.

The problem of reducing expense in car painting may properly be divided into two classes; first, the method of applying paints and varnish, and, second, the actual materials used. Both are of importance and both present in many cases considerable opportunity for economy, but the method of application offers an opportunity for greater direct financial savings as the labor and time cost is as a rule much more than the cost of the paint materials themselves.

There are two methods of car painting, essentially different in the principles upon which they are based, which have long been used by painters. These methods may be properly known

as the "lead and oil" process and the "surfacer" process. While there are many other systems in use, differing in one or more details, they all properly belong to one class or the other. There is, however, a third method which has recently come into considerable prominence and is sufficiently different from either to deserve separate classification. It may be distinguished as the "color and varnish" system.

LEAD AND OIL PROCESS

The "lead and oil" process is the oldest of car painting methods and is the direct outgrowth of carriage painting. The principle of the system in brief is the priming and filling of the wood with a white lead and linseed oil paint, the building up of a hard, smooth surface with "rough stuff," the application of the body color on this foundation and the final covering with varnish. The "rough stuff" coats, which are essentially a mineral silicate ground in varnish, dry very rapidly and can be brought to a very hard, smooth surface by rubbing with blocks of pumice. The color coats are ground in japan, and dry rapidly, presenting a "flat" color. The number of coats of each material applied varies considerably with the individual painter, but the principle of the process is the same in all cases.

SURFACER PROCESS

The "surfacer" process on the other hand was devised to reduce the length of time which was consumed by the slow drying paints of the "lead and oil" process. The fundamental idea of this system is the rapid building up of a surface by specially prepared paints, upon which are placed the flat color and varnish. The special paints or, more properly, varnishes known as surfacers, are composed of a mixture of white lead, ochre or some other mineral silicate ground in specially made varnishes which dry very rapidly and thoroughly. There are several well-known systems of this kind in general use in car painting, all of which are essentially the same. The surfacers are usually divided into three classes. The first serves as a priming coat, the second as a loading material, and the third the same purpose as the rough stuff coats of the older process. These can be brought to a very high degree of finish with pumice and are really very little different from rough stuff. It will be seen that the essential difference between the surfacer process and the lead and oil process is in the preparation of a surface, both systems using flat color and varnish for the final ornamentation and protection.

COLOR AND VARNISH PROCESS

The color and varnish process, which as previously stated is of rather recent origin, to a certain extent falls under the heading of a surfacer process, but differs sufficiently to warrant separate consideration. The fundamental idea of this process is that the less number of coats of paint on a given surface, such as a car body, and the more similar these coats are, the less liability will there be for cracking, and, consequently, the more durable will be the finish. With this in view, the system is so devised that the first application serves as a priming coat and the second, of which several coats are applied, depending upon the condition of the work, builds up a surface which can be brought to a reasonably smooth finish with pumice or with sandpaper, preferably the former, on which is applied the body color ground in varnish instead of japan, and followed by a final coat of finishing varnish. It is the intention with this system to use as nearly as possible the same varnish for all of the coats, so that each will have practically the same coefficient of expansion and will so far as possible blend and form an elastic and homogeneous film. As a further economy in time and material, the priming and surfacing coats are generally colored the same as the body color, so that less of the color and varnish is necessary, and, as will be seen, the use of the varnish color does away with the flat color of the other two processes.

SANDING PROCESS

A fourth process which is used to a large extent is sometimes distinguished as the sanding process, but it is really a modification of the lead and oil process, the underlying principle being the same. This method consists in priming with white lead and oil followed by a plaster coat of white lead putty which affords a thick surface of lead that can be brought to a reasonably smooth finish with sandpaper. On the surface so prepared, the flat color and the varnish are applied as in the other processes. This method saves considerable time by omitting the rough stuff coats, but, aside from this and the method of obtaining the surface, which is by sandpaper instead of pumice, the process is really the same as the lead and oil.

MERITS AND DEMERITS OF EACH SYSTEM

It is impossible to pick out one method as being universally better than the others and the choice must depend upon the local conditions to a large extent. There are, however, certain inherent faults and virtues of each system which are not generally understood, but a knowledge of them is of material value in forming a correct idea of their relative value. It should be stated at first that, where time and money are no consideration, the lead and oil process unquestionably produces the best appearance, but the finish obtained is very much better than necessary or even desirable for street car work. This process is designed to prepare a surface of great brilliancy and smoothness and is admirably adapted to carriage and automobile painting. Its use, however, even for this purpose is rapidly diminishing on account of the expense necessarily involved. The process requires time, for white lead is slow in drying and unless allowed to set thoroughly before the next coat is applied will cause trouble later on. Any attempt to hasten this system by diminishing the time allowed for drying always results in inferior work. For the proper application of a system of this kind, from four to five weeks is necessary in finishing a car body, and the greater part of this time is consumed in allowing the various coats to dry. It is obvious, therefore, that with the demand for speed and the limited shop facilities of most railroads this process is not feasible for street car work.

The surfacer process can be properly applied in from two to three weeks, depending upon the facilities, the number of coats which the work at hand requires and other conditions of similar nature. While there is a considerable saving in time by this process, the actual cost of finishing a car by this method is little different from one finished by the lead and oil process, for although less coats are required the surfacers are expensive. If proper materials are used and applied by careful workmen, and there is sufficient time for drying, this method produces very satisfactory resuts both in appearance and durability.

The color and varnish process was devised primarily to shorten the time and to lessen the expense of car painting. It has been applied in eight days with apparently successful results, although the short length of time which it has been used does not warrant a final conclusion regarding its relative value. This method is beset by many dangers. The attempt to quicken the drying of the surfacers and other coats often results in destroying the life, and the alteration of the body of the surfacer in order to lessen the amount of work necessary in rubbing frequently results in producing a material which is not permanent. The body colors ground in varnish as contrasted with the flat or japan colors of the two other processes are an excellent thing if made in a suitable manner, but if carelessly prepared are subject to very severe cracking which obviously destroys the appearance of the remainder of the work, no matter how well done. The theory of this process is, however, more rational than either of the others, for less material is applied. The various paint films are more nearly alike in physical qualities and the cost of application is materially reduced. Although the finish produced is less smooth and less brilliant than that obtained by the more expensive methods, the difference is not noticeable after the car has been in service a short time. Too much attention has been devoted in the past to appearance and too little to durability, and when it is realized that the use of this shorter

method enables a saving of $20 to $30 per car, without impairing the life of the finish, it is very doubtful whether the superior appearance produced by the other processes justifies the added expense.

The durability of car finishes depends to a large extent upon the foundation coats, and special attention should be devoted to this point. White lead paints are excellent but on account of their slow drying properties are not satisfactory. Properly made varnishes, which dry quickly but thoroughly saturate the wood and preserve their elasticity and toughness, are the ideal materials. The same holds true with the following coats: Rough stuff gives excellent results if properly made and applied, but carefully prepared surfacing coats afford an equally satisfactory surface and require far less labor in rubbing, which is one of the most expensive parts of car finishing. There is also no reasonable objection to coloring the undercoats, and in this way reducing the amount of body color required. Japan colors present a handsome appearance after varnishing, but they involve much unnecessary work which can be avoided by the use of varnish colors. The latter serve their purpose equally well and at the same time reduce the labor of applying separate varnish coats.

The employment of the shorter systems is of very recent origin, and there are doubtless many defects which long continued service will reveal, but the common-sense principles involved and the very marked financial savings possible of attainment justify careful and thorough investigation of their merits.

THE PURCHASE OF PAINTING MATERIAL

While the actual amount of money expended in the purchase of material for car painting is not great on most railways, the direct financial loss produced by using inferior materials is very large proportionately. It is a safe statement that few supplies are purchased of which the purchaser has less knowledge than paints and varnishes and as a result the amount of money wasted is excessive. The purchasing agent as a rule has no specific knowledge of the various materials and imbued as he is with a desire to economize is constantly tempted to try the cheapest. On large railroads, experience has proved beyond a doubt that purchase under careful specifications supplemented by thorough inspection saves many times the cost of such work. The condition of the Pennsylvania Railroad system, which is an eminent example of this sort of procedure, is a guarantee of the results possible of attainment. The electric railway, however, which is not sufficiently large to maintain a competent testing department, can save a great deal of money by intelligent selection of materials.

VARNISH

The two items of purchase which cause the greatest trouble are varnishes and body colors. Railway varnishes can be purchased from $1 to $6 a gallon, but the average price for properly made varnish is around $3. Any company paying materially less than this amount is not obtaining a strictly high-grade product, at the present price of raw material. The more expensive varnishes are generally worth the price for certain purposes, but it is doubtful whether the demands of street car service necessitate their use. There is, however, no one varnish which is suitable for all parts of a car. Exterior varnishes are required to withstand exposure to weather and must be elastic and durable. They are generally composed of about 25 gal. of linseed oil to 100 lb. of gum, and dry slowly but maintain their elasticity for a long time. Seat varnishes on the other hand must dry quickly and present a very hard, glossy surface. To obtain these characteristics the proportion of gum is largely increased, the composition usually being from 6 to 12 gal. of oil to 100 lb. of gum. In addition a harder gum is desirable, in order to obtain a dense surface. For finishing interior woodwork, a varnish part way between these two should be used, as a certain amount of hardness is requisite, but at the same time such a varnish should possess sufficient elasticity to withstand the wrenching and twisting of the car body. Many of the complaints regarding poor results are due to the employment of the wrong varnish. A number of roads continue the use of rubbing varnish on exteriors on account of the handsome finish which can be produced, although experience has repeatedly shown its unfitness for this purpose. This varnish is a "short oil" varnish containing hard gum, dries quickly, and is capable of being highly polished with steel wool or powdered pumice, but from its nature is non-elastic, and readily cracks when subjected to the expansion and contraction of the car body. Other companies employ finishing varnish for interior woodwork, on account of its durability, but are constantly annoyed by complaints from passengers regarding soiled clothing, for such varnish does not become hard for a long time, and the heat of the body is sufficient to produce a decided "tackiness."

A large proportion of varnish troubles arises from using inferior or adulterated material. Good varnish should contain nothing but linseed oil, gum, turpentine and the necessary driers, and attempts to reduce the price by substituting rosin for gum or benzine for turpentine invariably result in short life and consequent increase in the actual cost of painting.

SELECTION OF BODY COLOR

In selecting a body color, the first essential is to choose a color which is composed of durable pigments and is suited to the local conditions. No colors are absolutely permanent, but certain ones are very much more so than others. As a general rule, the darker colors are less liable to fade than the lighter and more brilliant ones, mainly because the former are made from natural pigments such as ochre, sienna, lamp black, etc., while the latter are either artificially made, or are produced by the aid of a dye. All chemically produced pigments and dyes are not fugitive—in fact many of the most permanent colors are of this type—but all are subject to imperfections of manufacture which impair their usefulness. For this reason many steam railroads and concerns like the Pullman Company have adopted brown or olive green as the most satisfactory colors available, and there is an increasing tendency among street railroads to adopt the same practice. When local conditions require the use of brilliant colors, as for instance in hot climates where dark colored cars produce an unpleasant effect, those colors should be selected which are least subject to imperfections of manufacture, and which can be most readily matched when repair work becomes necessary. The use of very light colored pigments is particularly undesirable both on account of their inherent tendency to fade and to the dirty appearance produced as the varnish ages. All varnish however light originally grows dark as it dries, and consequently the color seen through this yellow film appears to be much more dingy and faded than it really is. Such a result is produced with all colors, but it is particularly noticeable with the lighter tints.

ORNAMENTATION

The demands of economy necessitate the reduction of expense in the striping and lettering so characteristic of the electric car of a few years ago, and unquestionably a material saving can be properly effected along this line. The only strictly necessary ornamentation is the number in plain figures in a conspicuous place, and in a few instances the name or monogram of the company. Elaborate striping and scrollwork with gold leaf is a needless expense, and in many cases detracts rather than adds to the beauty of the car. The use of transfers for applying small signs to the windows or woodwork offers a further opportunity for reduction of labor. A careful study will reveal many other chances for reducing expense, such as dipping the fenders in a quick drying asphalt paint, and spraying the trucks with a similar paint.

The progressive manager who purchases materials of good quality, adopts such methods of application as are based upon sound principles, and is not afraid to try new ideas simply because they are new, will find few items of maintenance in which greater proportionate savings can be effected than in that of car painting.

SOME THOUGHTS ON TRACK MAINTENANCE AND COST DATA

BY M. J. FRENCH, ENGINEER MAINTENANCE OF WAY, UTICA & MOHAWK VALLEY RAILWAY

The ideal system of maintenance is that under which the tracks are kept in good condition at all times. The old saying, "a stitch in time saves nine," is, in its broader meaning, true in its application to track maintenance. It is certainly not good practice to neglect a piece of track until cars pound at each joint. The rails become cambered and the paving is disintegrated until complete reconstruction is necessary. The increased expense of car maintenance, due to operation on poor track in many cases, would pay for proper maintenance of the track. As soon as a joint pounds under a car it should be repaired to prevent a mashing of the receiving rail. If attention is not given promptly to such joints, the pavement becomes loosened, the bonds broken and the joint plates destroyed. The enmity of residents is developed by low joints as surely as by worn pinions or flat wheels.

The cambering of girder rails as a result of low joints has made it necessary to scrap rails before they were otherwise worn out. In the year 1902, in Utica, N. Y., the ends were sawed from 9-in. girder rails that were cambered at the joints because the rails were otherwise in good condition for use. The rails were then relaid with patented base-plate joints on yellow-pine ties spaced 2 ft. centers, embedded in concrete. In 1906, although the rails were not worn out in the heads, it became necessary to remove them on account of the flat spots that appeared at the receiving ends of rails as a result of the camber. We placed on the same ties new 9-in. girder rails and welded the joints with thermit. As these rails had previously been drilled with six holes, 1¼ in. diameter, they were not well suited for thermit welding. We have had a few breaks on this new rail, but repairs were made promptly and the track now rides as smoothly as when first laid. The point which the writer wishes to make is that the original 9-in. girder rails might still have been in use had the joints been properly maintained after originally installed.

The rails welded with thermit were part of an order for rails which it was the original intention to lay with regulation 12-bolt joint plates. The rest of the rails were used on this same street in 1905, and 590 joints were welded with thermit. About 20 joints have broken each year since then. Repairs have been made with thermit, if the direction of the break was vertical and close to the old weld; otherwise Continuous or Clark joints have been used. The average cost for repairs of these joints, including repaving, is $8. The breaks occurred in very nearly the same places each year and if they had not been repaired promptly there would now be sections of the track which would require early renewal. As the repairs were promptly made the track is in uniformly good condition. Another line laid with the same kind of rail, but with only two holes at each end, located back of the usual point of breakage, has 182 thermit welded joints. Since the first year, when five breaks occurred at defective welds, there has been only one break in two years.

Labor for maintenance of 27.8 miles of track in the streets of the city of Utica, consisting of joint, rail and pavement repairs, resurfacing, repairing switches and derailers and all minor work in connection with maintenance, costs about $560 per mile per year. Track maintenance on private right-of-way costs about $175 per mile of track for labor. This is the cost of work performed by the regular section gangs, such as track walking, ditching, surfacing, lining, shimming, fence and crossing repairs, etc. The estimated cost of materials per mile per year is $468. But this information as a lump sum is of very little value. It would be of great assistance to know the cost for each item of work that makes up the general maintenance schedule.

The problem of compiling accurate cost data on track and roadway maintenance is one that should be given serious and thorough attention. Many roads are adopting standards of construction that differ only slightly from each other in details, such as concrete and steel tie construction with either 9-in. girder rails, high T-rails or heavy sections of the standard steam-road rails. Another group is returning to wooden ties. Some are using inferior ties treated with preservatives, others are employing the best ties that can be obtained, imbedded in concrete as a preservative. The question of the proper joint to use is a vital one with all roads. With a standard system of keeping track accounts, and with concerted effort, track engineers should be able to determine within five years the type of joint that will give best results. It should not require over 10 years to solve our tie, rail and pavement problems in a satis-

FORM 101

Main Street Car House. JOB NO. 6008

HENRY CONOLLY CO., ROCHESTER, N. Y. 12102 YEAR 1910 ACCOUNT NOS. SHEET NO. 1.

	DATE		VOUCH. NO	QUAN	Account #3.	Account #5	Account #6	Account #8	Acct. #409.	Acct. #411	Acct. #431
	Jany.	2	4620	10	7.20			12.20			
	Feb.	10					6.50	28.40			
	Mar.	20				2.10		9.30			
	Mar.	23	5321	100					72.00		
	Mar.	25								250.00	
	Mar.	30									8000.00

Sheet A—Typical Job Distribution Sheet, Showing all Charges Distributed by Accounts and Forming an Index of Sheet B

FORM 100

Main Street Car House. JOB NO. 6008

HENRY CONOLLY CO. ROCHESTER N.Y. 12614 YEAR 1910 ACCOUNT NO. 8 SHEET NO. 1

	DATE		ITEM	LABOR	MATERIAL	TOTAL CHARGE	FOL.
	Jan. 2	1910.	Surfacing #6 Track	12.20		12.20	
	Feb.10	1910.	Placing Switch to #2 track	28.40			
	Feb.15	1910.	Repairing Joint Plates #3 Track	9.30		37.70	

Sheet B—Typical Detail Job Distribution Sheet, with Description of Account Work and Monthly Totals

factory and conclusive manner, if 20 or 30 of the larger systems will work in concert under some definite plan of keeping costs.

To bring the subject to the attention of the readers of the Electric Railway Journal the writer will describe the system that has been in use by the Utica & Mohawk Valley Railway Company since Jan. 1, 1910, in connection with a job-order system.

Beginning at the Utica terminus of one of the main lines of the system a job number is given to each piece of special work, each piece of track between specials or certain limits, each office building, station, car house, amusement park, bridge or any other structure on that line. Each line is taken up in turn as it radiates from Utica. On private right-of-way the numbered car stop signs form the dividing points of the sections, and each section is given a job number. The plan is that each job number will apply continually to that particular section or object as long as the system is maintained. Each job number may be chargeable with work under any of the numbered construction or maintenance accounts as established by the Public Service Commission of New York State. For example, the Main Street car house is designated as Job No. 6008. The track repair labor in this car house would then be charged to Account No. 8—Job 6008; the track bonding in this car house would be charged to Account No. 23—C—Job 6008; the ties used in the car house would be charged to Account No. 3—Job 6008. It will thus be seen that the job number fixes for all time the location of the charge for either material or labor and it is possible to determine at the end of any week, month or year just what that part of the system has cost for any particular kind of maintenance or for its entire maintenance. To keep this record, a well-defined system of time-keeping and storehouse and office book-keeping must be maintained. A brief description of this system follows:

The foreman of each gang gives the time-keeper a daily report of the nature and amount of work performed. The time-keeper makes a daily report of hours, rates and cost distributed according to account numbers and job numbers. A copy of this report goes to the auditor's office, where the charge is made on the card bearing the job number and in the column headed by the proper account number, the date appearing in the first column at the left. All materials must pass through the storehouse and the stock-keeper is responsible for the reporting of account and job number for all materials sent out. His detail report goes to the auditing department and each charge is properly entered on the job card under the particular account to which it belongs. The auditor's clerk does not make out a job card until he has an item to charge against that job number. In this way the number of job cards to be handled is kept at a minimum. Monthly and yearly statements are drawn off from these cards.

The total cost to date of any piece of construction or maintenance can be readily determined from the job card. Thus it is possible to tell the cost of track maintenance on one type of construction compared with the cost on another kind of construction, as each type of construction on any street may be given a job number. Some items of labor, such as track walking, cleaning and sanding tracks and removal of snow and ice are given separate job order numbers that refer also to the accounts. For instance, removal of snow and ice in the entire city of Utica is charged to one job number, and the same service in another town or track section is charged to another job number. There is no need to keep such work in greater detail. The work of reporting by foreman and timekeeper would also be too burdensome and would not give information of any particular value so far as small zones are concerned.

The time-keeper, foremen, material clerk and auditor's clerk who have to use or fill out these job cards have books giving all job order numbers arranged consecutively under alphabetically indexed headings of each particular street, line or section.

Under the system of accounts adopted by the Public Service Commission of New York State "additions and betterments," or construction work, is embraced under a separate group of account numbers which identify work of that character at once, so that charges may be made under the job number, as already outlined. As an example, an extension to Main Street car house would be charged to Account No. 431—Job 6008; new special work for an additional track would be charged to Account No. 411—Job 6008 and new ties for this track would be charged to Account No. 409—Job 6008. The job and account forms shown on page 612 illustrate the method of entering the maintenance charges described above. If the cost of some particular section not definitely described by job orders already in use is desired, the auditor's clerk will assign a job number to the work after he has been given a proper description of it.

Another essential in the standardization of track accounts is a standard book of rules for the maintenance of way departments, so that each section and company may base costs upon the same practice, so far as possible. The rule book should contain in front the general rules applicable to all employees, with the same wording used by the American Street & Interurban Railway Transportation & Traffic Association in its codes of interurban rules and city rules, so far as they may affect maintenance of way employees in the discharge of duty. Standard practice can be illustrated by drawings showing track construction of the various types in streets and on right-of-way.

COMMUTATOR SLOTTING AND ITS RELATION TO BRUSHES AND MICA

BY C. W. SQUIER, ENGINEER IN MECHANICAL DEPARTMENT, BROOKLYN RAPID TRANSIT SYSTEM

For several years the subject of slotted commutators has been an active one at the meetings of the different electric railway associations. While it is the general opinion that the slotting of commutators, together with the use of a higher grade brush, has reduced to a large extent the trouble due to flashing and flat spots on commutators, there are still some railways which find that the results obtained do not warrant the trouble and expense necessary to keep the commutators properly slotted. This question has been asked several times: "Why should it be necessary to slot our commutators now when for a good many years the very same motors have been running all right without slotting?"

Unless we keep an accurate record of our motor troubles for comparison, we are quite liable to forget the troubles we have had, and to consider only those which we are having at present. Nevertheless, the present conditions of railway service are more severe and the operating voltage is usually much higher than those in vogue a few years ago. Motors which were designed for 500 volts and operated at this potential in the past, now are running at 550 volts and 600 volts. This increased voltage and greater severity of service cause more sparking at the brushes, thereby burning away the copper bars and disintegrating the mica between them. If the various motor troubles be analyzed it will be found that about 50 per cent of them can be traced directly to the flashing from the brush-holders or commutators to the shell or from brush-holder to brush-holder. These flash-overs are responsible for the carbonization of the motor parts, flat or rough commutators and the grounding of brush-holders and commutators. Since the flashing in most cases is caused by sparking at the brushes the problem which we are endeavoring to solve by slotting commutators is to reduce this sparking as much as possible. The slotting of the commutators permits the use of a softer grade of brush, which has better conducting qualities than a brush with the cutting qualities necessary to keep down the mica in an unslotted commutator. This treatment will reduce the sparking at the brushes to some extent. We also are able to provide a better contact between the brushes and the commutator by slotting and thus reduce the sparking brought about by high mica or improper contact. There is little to be gained by slotting the commutators on roads where the brushes used have the cutting qualities necessary to keep the mica down as fast as

the copper is removed without abnormal wear of the brushes and commutator, and where it is found that such brushes have sufficient conductivity to meet the service requirements. However, if an electric railway is troubled with high mica, leading to rough and flat commutators, and it cannot find a brush of proper conductivity to keep this mica down, it should resort to slotting as a means of securing the desired results. In the discussion of this subject at the December, 1909, quarterly meeting of the Street Railway Association of the State of New York (published on pages 1232 and 1233 of the Electric Railway Journal of Dec. 18, 1909), the point was brought out that it might not be necessary to slot commutors if the softest grade of amber mica was used. Soft mica is liable to cause trouble, however, as it does not have sufficient resistance against compression and will squeeze out and distort the shape of the commutator. The best methods seem to be to use mica which is hard enough to prevent the commutator from losing its shape and then to slot out the mica to a moderate depth wherever necessary.

For the past year and a half the Brooklyn Rapid Transit System has been slotting the commutators of its 150-hp elevated service motors. When the commutator is slotted, there is installed a type of brush which, through service tests, has been found to be the best for use on slotted commutators. The total number of motor flashes for the last nine months is 30 per cent less than for the nine months immediately preceding the inauguration of the slotting practice. Furthermore, it is found that the number of cases of motor troubles as a whole has been rapidly decreasing as the number of motors with slotted commutators has increased. Formerly it was found necessary to turn these commutators every time an armature was removed; now, it is not necessary to turn a commutator oftener than once a year. At the present writing, 92 per cent of the Brooklyn 150-hp motors are run with slotted commutators. The company is also slotting as rapidly as possible the commutators of all motors used on the surface lines, but this work has not progressed far enough to allow a comparison of results. The surface motors are from 25 hp to 60 hp capacity.

Several types of machines have been tried for slotting commutators, but it has been found that those equipped with a circular saw or milling cutter are the most efficient. Machines of this type when mounted on a lathe and driven by a motor or belt from the lathe, can be used to good advantage on a road where all armatures are sent to a central point for maintenance. When the slotting is done at branch overhauling and inspection shops it is more advantageous to have a small portable air-driven machine. The armature can then be removed and supported on a couple of stands or by some other convenient method and the machine carried to the work. It is not necessary to use a lathe with this portable tool, a point which is worth noting in shops where the lathes are kept busy all the time on other work. The saws which have been found best are 7/8 in. diameter with 18 teeth, and are of the same thickness as the mica to be removed. The average number of saws used per commutator is 2¾. The slotting is 1/8 in. to 3/16 in. deep, and a man with one of these air-driven machines can slot from 12 to 15 commutators in 10 hours. A great amount of this time, of course, is consumed in changing saws, oiling the machine, etc.

After the commutator is slotted the saw leaves a slight burr on the edge of the slot. This burr is removed and the commutator sand-papered and polished. The slots are then cleaned and blown out with compressed air. It is necessary that the slots should be cleaned with great care, for if any mica is left at the edge of the slot the desired effect of the whole process will be lost. The motors and the commutator slots should also be blown out with compressed air at each inspection after the motor is placed in service, special attention being given to see that no carbon or copper dust is allowed to accumulate. The depth of slot that can be most satisfactorily used will depend on the ability to keep it clean. The shallow slot can be kept free from dirt and dust more easily, but the work of slotting necessarily would have to be done oftener.

MAINTENANCE PROVISIONS OF CLEVELAND ORDINANCE

BY H. J. DAVIES, SECRETARY AND TREASURER, CLEVELAND RAILWAY COMPANY

The new franchise ordinance recently passed by the City Council of Cleveland, granting to the Cleveland Railway Company a renewal of its rights to operate its railroad in that city, contains some unusual and some unique provisions, among them provisions for the maintenance of the physical property of the company.

According to the ordinance, the capitalization—bonds, floating debt and stock—of the company is the value of its property as determined by R. W. Tayler, judge of the United States Court in the Cleveland district, sitting as an arbitrator selected by the city and the company, and not as judge. This value is called in the ordinance "the capital value of the company." Upon this value, and upon additional capital that may be invested in additions, extensions and betterments, interest at limited rates is to be paid.

The property is to be maintained in a condition that will keep it worth at all times 70 per cent of the cost of reproducing it new.

The ordinance provides an allowance of 11½ cents per revenue car-mile, exclusive of car-house and car-yard miles, for operating expenses. The surplus above this allowance, and above the maintenance allowance, is to go into what is called the "interest fund," out of which all taxes, interest and dividends are to be paid; and any surplus in this interest fund above operating expenses, maintenance reserve, taxes, interest and dividends is to be absorbed in the reduction of fare.

The specific provisions in regard to maintenance are the following:

"In addition to the car-mile operating expense allowance, there shall, in the following months, be deducted from the gross receipts the following sums, to wit:

"In January, February, March, April, May and December 4 cents per car-mile, November 5 cents per car-mile and in June, July, August, September and October 6 cents per car-mile, the deductions being made for revenue miles, exclusive of car-house and car-yard miles, made by cars equipped with motors, and 60 per cent of said rates for similar miles made by trailers operated during said months.

"The sum so deducted each month shall be placed to the credit of the maintenance, depreciation and renewal account, and shall not thereafter be expended for any other purpose whatever. The sum so set aside shall, if not needed for immediate maintenance or renewals, be accumulated, and may from time to time be invested in the bonds of the company, or in the payment of its floating indebtedness, to the extent that the same form part of the capital value of the company; and, to facilitate the investment of said fund in such bonds, the company shall, in any bonds hereafter issued by it, stipulate the call price and conditions provided in Section 16 hereof; but if the amount so invested or paid is at any time needed for maintenance and renewals, the company may, for that purpose, issue new mortgage bonds, or incur new floating indebtedness, to the amount of such investment or payment, with the interest that would have accrued thereon, which new bonds or floating indebtedness shall become part of the capital value of the company.

"The amounts per car-mile allowed may be increased or decreased from time to time by agreement between the city and the company, so as to enable the company to meet the legitimate expenses of operation, insurance, accident and damage claims, and to prevent or make good any deficit on account of such operating expenses; and also the amount required to be set aside for maintenance, renewals and repairs may be similarly increased or decreased by agreement; and, in the event of disagreement, any such increase or decrease in either car-mile allowance shall be submitted to arbitration. Any surplus in the hands of the company at the expiration of any period of six months remaining unexpended for operating ex-

penses, as hereinbefore provided, out of the car-mile allowance provided by Section 19 hereof, exclusive of the amount required to be credited to the maintenance and renewal account, shall be placed to the credit of the interest fund.

"The intent hereof with regard to the sum authorized to be set aside for maintenance, depreciation and renewal is to enable the company to maintain, renew, replace, preserve and keep its railway system and property, and every part thereof, and all extensions, betterments and permanent improvements hereafter made pursuant hereto, in good condition, thorough repair and working order, the standard of such condition, repair and working order being an average for the entire system of 70 per cent of its reproduction value; and the car-mile allowance provided for the purpose of maintenance and renewal shall not at any time be diminished, unless the value of the property of the company and the amount accumulated in the maintenance and renewal fund aggregate more than 70 per cent of the reproduction value of the said entire system."

These provisions grew out of similar provisions that were contained in the lease that the company made of its property to the Municipal Traction Company on April 27, 1908, and the discussions that preceded the making of that lease. As the company, in leasing its property to the Traction company, was entrusting it to that company for operation and maintenance, and as the Traction company had a capital stock of but $10,000, only $1,000 of which had been paid in, it was important that the lease contain provisions that would compel proper upkeep of the property. Before the making of the lease, Tom L. Johnson, then Mayor of the city, and F. H. Goff, the company's representative, as arbitrators, appraised the physical property and franchises of the company. The value of the franchises was determined to be the then present worth of the future surplus earnings of the company, and in ascertaining the surplus earnings it was agreed by them that the cost of repairs and renewals of the physical property had been in the past, and would probably be in the future, about 5.85 cents per car-mile. In the making of the lease, the company asked that the lessee be required to set aside as large an amount per car-mile as the arbitrators had determined to be proper in their estimate of franchise value, contending that the fund or reserve should be ample to protect the company against deterioration or waste by neglect or mismanagement at any time within the 50-year term of the lease. The Municipal Traction Company, on the other hand, asked that the maintenance requirement be not more than 5 cents per car-mile. A compromise was agreed upon, and was expressed in the lease in the following language:

"That the Traction company will, during the term of this lease and any renewal hereof, keep an account known as 'maintenance and renewal account,' and will credit to said account and charge to operating expense account each month a sum equal to 5 cents per car-mile during the first year from the delivery of possession hereunder, 5¼ cents per car-mile during the second year, and 5½ cents per car-mile during each year thereafter until readjusted for each car-mile made in the operation of said street railways subject to this lease; and in ascertaining the same the mileage made by trailers not equipped with motors shall be computed at one-half the rate of motor cars. And against this account may be charged all expenditures and disbursements made for maintenance, repairs and renewals."

The rate was to be lower in the first two years than in subsequent years; first, because the Municipal Traction Company claimed that a fund of 5 cents per car-mile would be sufficient to enable it to keep up the property, and, secondly, to give it a better chance to make good its promise to the people of 3-cent fare.

In the discussion of last winter, preceding the passage of the "Tayler ordinance" (the present franchise), the Cleveland Railway Company asked that the maintenance, renewal and depreciation reserve account be credited with 5½ cents per car-mile, basing its request upon these provisions of the lease and the Goff-Johnson valuation of franchises, as expressing the judgment of those gentlemen, and of all concerned, as to the amount necessary for this purpose. As the quotations from the ordinance show, however, the amount fixed is an average of substantially 5 cents per revenue car-mile for the year, divided among the months in the proportions stated, but with a proviso that, if the allowance shall turn out to be inadequate or excessive, it may be increased or diminished.

As the ordinance contains an option to the city to purchase the company's railway at a fixed price at any time that it may have authority to own and operate street railroads, it is to the interest of the city that the system be maintained in good condition and thorough repair, in order that it may, if it purchases, acquire a property equal in value to the price to be paid. It is to the interest of the company, of course, that the property be kept up, and especially so because the ordinance reserves to the city a right to purchase at the end of the grant—in 1934—not at the price fixed in the ordinance for earlier purchase, but at the value at that time of the physical property only. If the property is permitted to depreciate, the company will receive for it less than "the capital value of the company."

THOUGHTS ON SHOP ORGANIZATION

BY A MASTER MECHANIC

The shop foreman is confronted with the problem of making good with the accepted methods of application of various kinds of apparatus, comprising car and other equipment. Most of these methods have been developed to a high state of efficiency through a long and expensive experience and cannot be greatly improved upon. Therefore, the main question with the shop foreman is how to get the best results from them. Loose gears and pinions are not the result of poor design. Manufacturers, as a rule, furnish material that is correct both as to design and detail, but error can be easily made in application. Given an armature shaft and pinion in good condition, there still remains the important fact that the pinion must be put on right and this applies with equal force to all other details of apparatus. First, the items of each detail must be correct and then the detail must be correctly applied. The first must be furnished by the manufacturer and the second by the maintenance force.

The problem is how to train that maintenance force to correct work. This is difficult because of the lack of mechanical training generally found in the class of men available for railway shop work. There are a good many of the "can-do-anything" class of men, and some foremen seem to favor that sort of an organization. The writer greatly desires to be saved from such. In a shop of any size, specialization is the best method to obtain results. If two or 50 pinions are replaced in a day or week, select one man to do it, and keep him at it. If, after being thoroughly trained, he is worth keeping employed, he will prevent loose pinions. If it is not possible to keep him fully employed at special work of the same character, let him work as helper to some one else who is a specialist in adjusting brush holders or wiring the field circuits.

The gear man may be worked as helper with the wheel-press man. He becomes skilled in replacing gears and is responsible for all of them. He will learn to keep the bolts just below the breaking strain, will be sure to report poor fitting keys or keyways, bad gears and seats to the machine shop, and, in fact, will act as a check on the work of the latter.

In the armature and wheel-replacing gangs work should be divided so that the same jobs are done day after day by the same man in accordance with the knowledge of the foreman. One man in each gang should be held responsible for the general inspection of trucks and motors, which should be made every time the car is over the pit. The regular inspectors should not be depended on for this. Make inspectors of the pitmen. Operations such as pressing on wheels, setting gears and pinions, adjusting brush holders, wiring field circuits, connecting motor leads, fitting bearings, etc., require skill and should be specialized. On the other hand, such work as replacing worn or loose bolts, brake rigging, pins, etc., reporting

loose gears and pinions, wheels, armatures or any other defects, should be regarded as within the province of every shop man.

This end, however, can be attained only when the esprit-de-corps of the organization is of a very high order. The cultivation of this spirit of mutual help is the most important function the foreman can perform. He must possess very pronounced characteristics for patience, courtesy and firmness, and be absolutely square in all his dealings with all of his men. Patience is necessary to train those slow of comprehension and generous sympathy must be shown with their small failures. It generally happens that the slow man is very dependable after he once "catches on." Courtesy to every man, from the lowest pitman to the highest skilled mechanic, pays big in the respect awarded the foreman by all rightly constituted men. Firmness is a quality that can be easily abused. It is not the proper quality when exercised to push through some plan or method after being convinced of error. Squareness must be apparent in all the little disagreements that arise between the men and in the allotment of work. There is then an occasional man who cannot be made suitable to the environment. That man must be discharged. Initiate a feeling among the men that their jobs depend only on themselves and that no one can undermine them. Eliminate petty bickerings and produce the co-operation of interest that produces success.

I have in mind a shop organization that has been very successful in carrying out routine work. It maintains about 150 motor cars and some trailers and supplies other shops with wheels, axles, bearings and occasional stock orders for the general storeroom. No extensive car body repairs or painting or winding are done at this shop, as those departments are handled at the main shop. The foreman has charge of the shop, the inspectors and the building. The clerk to the foreman is also the storekeeper. There are two carpenters, one of whom takes care of all minor repairs, such as windows, doors, bell ropes and fare boxes, while the other carpenter, who assists the first when necessary, also keeps up the repairs on drip rails, drawheads, bolsters and such vestibule and body work as does not require a thorough painting operation. Two blacksmiths and one helper attend to all blacksmith work required on cars, some track department work and a considerable amount of stock work for the main storeroom. One machinist does miscellaneous jobs, such as putting keyways in axles and armature shafts, making keys, manufacturing and keeping in repair all jigs and tools for this shop, repairing ratchet drills, gages and track jacks for the track department and all emergency jobs that arise. A second machinist turns commutators, bores bearings, fits all bearings to armature shafts, puts on pinions, straightens and sleeves shafts, makes pinion nuts and oil collars, etc. A third machinist turns axles and bores axle bearings for main storeroom stock. One wheel pressman, who bores wheels for about 325 cars, examines and tests all axles and presses on all wheels. One helper, who assists the wheel pressman, does all gear work and much of the drill-press work. Two electrical and air-brake men repair and clean controllers, circuit-breakers, automatic governors, compressors (do not oil compressors), engineer's valves, pipe brush holders and trolley poles and inspect the sprinkling system daily. Four pitmen, divided into two gangs, for motor repairs, remove and replace armature fields, axle bearings, gear casings and inspect and make light repairs on trucks. Three other pitmen remove and replace wheels, repair trucks and motor suspensions. One working foreman oversees the armature and truck gangs and places cars. The fireman who runs the steam plant is relieved by the night watchman. There are three general utility men whose time is divided between rough work in the machine shop and pit work; they are also used to take the place of absent men. One man is employed to clean the shop, paint fenders and trolley poles and attend to miscellaneous matters of minor importance. One man makes babbitt bearings for 325 cars and keeps shafting, bearings, and belts in repair.

While this organization has many weak spots no doubt, it certainly has its work well specialized and co-operative, harmonious methods have been developed in it to a high degree.

SPECIAL METHODS OF MAINTENANCE

BY ALBERT B. HERRICK

Your journal devotes an annual issue to maintenance, and thus gives special recognition to the importance of this problem for electric railways; and it is important for our industry because the increasing cost of labor and materials against the fixed fare is acting to produce a diminishing return on the investment.

Other industries have studied maintenance more thoroughly than has been the case with electric railways. The writer was privileged recently to examine the graphical records of a steam railroad, the records of which are carried in detail to a practical ultimate. Taking the bridges for illustration, the record showed graphically how much timber was put into each bridge for a series of years past. Further, the manager was able to predicate how many thousand feet of timber would be needed for each of a certain number of future years to maintain the average condition of the bridges, and what share should go into each particular bridge. The same railroad's records showed similar information for the other parts of the property. The operating elements which were plotted even included the individual monthly wage of many thousands of employees for months past, and all within the most compact limits. In approving the pay-rolls the general manager merely glanced down the charts and with the least mental effort saw how each wage payment compared with previous months and what names had been added and omitted, so that his approving signature became an act of really intelligent understanding. The maintenance of this steam railroad was guided by a master mind.

The electrical features of street railway maintenance may seem more elusive, yet they are not beyond control by suitable means. In the medical field we see a great effort made for the prevention of diseases. We see public campaigns carried on to prevent tuberculosis and numerous sanitariums established to avoid the necessity of resorting to hospitals. In railway operation accidents are the parallel to human diseases. Are the railway companies taking the same preventive measures?

The annual maintenance of our electrical railway systems is estimated to cost about $50,000,000, of which a substantial share is in the maintenance of the electrical equipment. Extensive experience enables the writer to predict confidently that one-half of this electric maintenance of cars can be saved by means he will proceed to outline.

What are accidents? The dictionary defines them generally as "anything that happens without design," or as "an unforeseen effect," and specifically as "an unfortunate happening," and finally as "non-essential." Now, the things that happen without design and are unforeseen and are unfortunate happen in the majority of cases from lack of foresight, and are "non-essential." This is particularly true of those accidents which repeat themselves month after month, so that their recurrence in succeeding months can be predicted. Each accident should be analyzed in all its relations, and it should be charted and compared with every previous accident, and the combination of conditions which permitted it should not be allowed to occur again. Improvements in the method of repairs are not needed so much as improvements in the method of prevention. Those happenings which repeat themselves too often should be called carelessness—not accidents.

Too often have breakdowns been ascribed to unavoidable service conditions caused by heavy grades, frequent stops and similar operating conditions. Yet it is evident that other elements control when broad investigation has proved that roads with heavy service conditions in severe climates have the least maintenance charges.

The general manager has records to show how many cars broke down the preceding month and how many cars were still out of service and undergoing repairs, but what does he have to show the dependence to be placed on those in service? The master mechanic may be skillful in making repairs economically and promptly, and probably shows great industry in improving

methods of repair, but does he spend an adequate time in precautions to avoid breakdowns? Most breakdowns occur on a grade or other point of maximum load, and are too often ascribed wholly to the grade. In truth, the grade has simply been the "straw to break the camel's back" and the equipment was overloaded all the while by unequal fields or other maladjustments. The master mechanic cannot be blamed for such a breakdown if he does not have the means to discover the maladjustments in advance.

Maintenance has three principal relations to operation: namely, quality of service to the public, because breakdowns affect quality; safety of transit, because accidents imperil the passengers' safety; and dividends to the stockholders, because improper methods of maintenance diminish dividends. It is the purpose, however, to restrict this article to the electrical maintenance of cars and the circumstances that have led to the writer's present development of special methods and apparatus. Some 25,000 inspection tests have been made for clients by him according to the means described.

In law suits on electrolysis, adverse witnesses would testify to finding a few defective rail bonds and leave the impression that all were poor. To controvert such an impression, it became necessary to measure all the bonds. A man walking along the track could not do it fast enough nor accurately enough, and human elements were involved in recording the measurements. Thus the writer was led to develop an apparatus which could be placed on a car, and while traversing the track measure the individual resistance of each bond and record it on paper without human intervention. This apparatus has been developed so that each bond can be measured accurately and the measurement recorded autographically on paper in one-thirtieth of a second. Track bonding of nearly 200 companies, and over 15,000 miles of track, has been thus measured. The apparatus is adapted for measuring the ohmic resistance from the power station to the test car of the overhead and return circuit, and likewise to record data on physical conditions, such as gage of track, position of trolley wire, poles, etc.

In the inspection of cars it was found necessary to provide apparatus which would make the required tests without disturbing the connections on the car, which could be used by the class of employees available in a car house and yield correct results and without damage to the instruments from improper connections. Such apparatus has been sold to several clients. For example, it is used in Philadelphia in the maintenance of some 3000 cars; by the Public Service Railway Company of New Jersey in the maintenance of nearly as many cars; by the Metropolitan Street Railway Company, New York, and other companies.

The writer has now combined these methods for the purposes of car inspection, the apparatus producing its own record on paper with a high degree of accuracy and at incredible speed. A general inspection of the car can be recorded within 40 seconds in the car-house or on the road. Such apparatus is usually set up for service on a car, and the inspection can be made in the car-house or at the end of a line while the cars are in service, and without delay to the schedule. If a car on the line is found in an unreliable condition it can be turned in.

The measurement is recorded instantaneously by an electric spark, and the apparatus will not act to produce an incorrect record. Each part of the apparatus is measured in terms of its standard, and a simple inspection of the record shows the faults without computation, comparison or other labor. The records can be produced in duplicate, or mimeographed in any desired number for various officials.

The general inspection shows the resistance of each rheostat step and of the motor armatures and fields. The motor resistances are checked by inductive measurements which are necessary and highly valuable to discover unequal pairing of fields, unequal division of load between motors and similar causes so prolific of breakdowns. If a magnetic joint is imperfect through paint, shims or other causes it will be recorded. The general inspection shows if a following detail inspection is needed further to localize any faults. This detail inspection includes the compressor motor, headlight, circuit-breaker and all auxiliary equipment, and measures by magnetic means and records in inches the position of armature in field to the sixteenth of an inch. This detail inspection ordinarily requires less than two minutes.

This apparatus has been designed to produce all needed practical measurements with laboratory accuracy and to record the same mechanically, without human error in observation or record, free from the illegibility of much ordinary writing. A clever employee from the car-house force, thoroughly familiar with all electrical connections of equipments, can operate the apparatus readily. Three thousand cars per month can easily be inspected with ordinary activity. The method and apparatus are not intended primarily to locate and measure damage that has already occurred, but to show up the maladjustments of equipment for preventive treatment against damage, and thereby to raise the condition of equipment to a higher standard and maintain it at a far less cost.

Any art develops along lines of specialization, and the attractiveness of maintaining the dollar invested at its highest physical value has been the motive of producing these mechanical-electrical methods of inspection with automatic features and autographic records. The master mechanic is furnished with a reliable foresight for the prevention of breakdowns; the general manager receives condition reports mechanically registered without human bias of every electrical equipment running or disabled, and rests in the confidence of furnishing a better service and larger dividends.

PREVENTION OF ACCIDENTS*

BY E. F. SCHNEIDER, GENERAL MANAGER, CLEVELAND, SOUTHWESTERN & COLUMBUS RAILWAY

It costs the people of the United States $125,000,000 each year for preventable accidents. According to figures which I have recently compiled, less than 2 per cent of all accidents upon railroads are due to hidden defects or the acts of God. About 13 per cent are due to the negligence of the public and 85 per cent are due to the negligence of the employees. The time has come, therefore, when we must devise means to prevent accidents because the greater number are the fault of our employees. We can no longer tolerate accidents from either a moral or a financial standpoint. We cannot correct the trouble, nor can we diminish the cost by the ordinary methods which have so long been in vogue. Payments for accidents have increased from year to year on both steam and electric roads. The reason is that with all the safeguards used the number has not diminished and the cost has been greatly increased. The greater cost is reflected not only in the larger judgments against us, but in the legal expenses, because it is a question now when we get through with a case whether the victim, the expert surgeon, the expert engineer, the expert detective, or the high-priced lawyer has received the most of our money.

I was brought up in the old school which followed the theory that almost every claimant should be considered a fraud. That day has gone by, but we still do too much fighting and too little thinking. If we had spent one-half of the money preventing that we did fighting, our accident account would not have been so great. In following steam railway practice in the claim department we have overlooked one fact, and that is that the majority of accidents on steam roads happen to employees of the road or trespassers, and the minority to passengers. On the electric lines the conditions are reversed; the majority of accidents happen to passengers and the lesser number to employees or trespassers. Accidents to employees or trespassers are of course much more easily adjusted than with passengers, but even employees are getting harder to deal and settle with than formerly.

As most steam railroad accidents are made up of injuries to employees or property damages, these companies attempted

*Abstract of paper presented at meeting of Central Electric Railway Association, South Bend, March 24, 1910.

to mitigate the accident situation by discipline and the use of appliances designed to remove the human element in railroading. This latter policy I consider incorrect. We want the human element, but that human agency should be educated in the business to be performed. I have heard managers say that a motorman is not a good man until he has had an accident. That is a mistake. All he needs is to have the matter brought to his attention in so graphic a way that it will make a lasting impression upon him. I do not believe in discipline as it is ordinarily meted out, 5 days, 10 days, 30 days, discharge. That kind of discipline does not correct evils any more than a workhouse sentence reforms a criminal; it hardens him. If a trainman is not sure of his position, if he feels that at any time something may happen and he will get discharged, he almost unconsciously acquires a devil-may-care spirit which is reflected in his work. His idea is to keep within the rules of the company if he can and cover up his mistakes if possible when trouble comes. This idea creates the spirit which tends toward the abuse of the machinery with which the man has to work, so long as he can do it without being found out.

I assure our men personally that we appreciate the old men, their services are valuable, their advice is valuable, their experience is valuable, the longer they stay, the better suited we are. We do not want discipline, we do not need discipline, but we do want every man so to do his duty toward his fellow beings and toward his company that there will be no need of punishing men.

Employees do not of themselves nor among themselves take up this question of preventing accidents further than as a matter of gossip. They seem to think it is not a question with which they should bother very much. It is a question for the management to solve. James O. Fagan, the signal tower man, has said, "Railroad managers sooner or later will come to understand that the one thing needed in the railroad business at the present day is to educate employees to appreciate the fact that successful and safe railroading in the future will have to depend, not upon the multiplication of safety devices, nor upon the reconstruction of rules, but upon the personal effort and conduct of conscientious, alert and careful men."

During the year 1907 it was my unfortunate lot to pass through a series of the most harrowing and heart-breaking accidents. I took upon myself at that time, and later, when I had time to collect my thoughts and plan for the future, a large share of the responsibility for those wrecks. I had known something was wrong but did not appreciate it at the time, and I made up my mind that I would get rid of that feeling of responsibility, and would at least try to do my part. Our road was well officered and well operated. Discipline was carefully, judiciously and conscientiously administered. I finally made the suggestion to one of our superintendents that I would like to meet our trainmen and talk the matter of accidents over with them. This was done. I had never made a speech or talk of any kind in my life, but my mind and heart were so full of this question that having prepared a talk for the trainmen I was bound to give them the ideas I had collected. My first idea was to impress upon their minds that we ought to look upon this question primarily from a social, moral and humanitarian standpoint, and secondarily from a financial standpoint. I tried especially to have them put themselves in the places of the victims and their families, and would ask them their feelings toward the negligent trainmen should their wife, sister, brother, father, mother or children be injured or killed under such fearful circumstances. Then I would put the financial loss into average fares, and when they found that we had to carry not only thousands but hundreds of thousands of passengers to pay for one wreck, they appreciated more fully than they could otherwise, the relative cost.

I have worked for over two years, talking to the trainmen every 60 days, giving them the best ideas and thoughts that I could collect, illustrating them with actual cases from our own experience when possible; when this was not practicable, drawing conclusions and illustrations from the misfortunes of other roads. At these meetings we try to keep out all extraneous matter, and as far as possible confine our discussions to the sole topic of accidents and how to prevent them.

Some roads make the mistake of having the meetings which relate to accidents held by the operating department. These meetings should be held by the claim department in order to exclude all operating questions unless they relate directly to the matter at hand. I have tried to hold meetings just often enough not to have them become irksome or burdensome and have spent a great deal of time preparing for them. My talks are usually about 45 minutes long and our meetings last from 2 to 2½ hours. It takes eight meetings to cover our road. I have tried to arrange for them when possible just before special occasions when it is necessary for trainmen to be more careful than ordinarily, such as before the Fourth of July, before fairs, when the leaves commence to fall, before the holidays, etc. I have also had special meetings for employees other than trainmen, namely power house and sub-station men, car barn men, line men and track men, and I want to say, gentlemen, you will feel proud of the men who wear overalls if you ask them to meet with you and discuss with them the moral proposition that they owe a duty to the public and the public is looking to them so to do their work that it may come to no harm. You will see these men interested, and when they promise you, as I hope they will, and as they have promised me, that they would co-operate with the trainmen and with each other to the end that their road would be one without accidents either to the public or to each other, you will feel more kindly toward them, and when you see them shoveling coal, working in the pit, climbing a pole or tamping ties, you will be more apt to exclaim with Robert Burns, "A man's a man for a' that."

In making the assertion that we were eventually going to run the Southwestern without accidents, one of our men said, "What are you going to do about the public?" "What are you going to do if a rig drives in front of the car or school children run in front of the car?" My reply was, "When you take care of your part as employees, without fault or negligence, I will devise ways and means to take care of the public." I wondered then whether I was doing my whole duty or not.

We have had several unfortunate accidents with school children, and there is no more distressing position to put a man in, than to send him to a home where the only child, a little girl of nine, lies dead, and expect him to transform that sad picture into dollars and cents. Would it not have been better to have prevented that accident? How could it have been done? I don't know, but I have gotten rid of a great responsibility. My assistant, Mr. McKissen, or I, and, one of our superintendents, Mr. Nester or Mr. Johnson, have visited every school house, be it public or parochial, city or district, on our 217 miles of road, and have talked to every grade from the kindergarten to the high schools, making in all over 360 addresses, and speaking to upward of 30,000 pupils. These were little talks lasting from 10 to 30 minutes, and we did our utmost to impress upon the minds of all to be careful; be careful when crossing the track. Be careful if you see a wire hanging down, do not touch it, it may be a live wire, explaining what a live wire is. Be careful when you get onto a car; be careful when you get off a car, telling the girls especially how to alight properly from a car; do not coast down hill on streets or cross streets where cars are likely to be; do not jump cars; do not roller skate near the cars; do not throw stones or snow balls at the cars; do not ride on the platform; do not get onto a car when it is moving, etc.

In one of our talks to our men, I said I was tired of hearing the phrase which is so easily and thoughtlessly quoted, namely, "You can't run a railroad without accidents." I say you can, and that is our motto now: "The Southwestern is to be run without accidents."

I have purposely put the figures last, because this to me is more than a question of dollars and cents, to me it means more that I may be the means of saving a life or a limb, saving some human being from suffering, saving some father, some mother, some husband, some wife a heartache. Our company during the last 10 years has paid out 6.35 per cent of the gross

income of those years for accident claims. I have not analyzed this by years, but have taken the gross amount for 10 years. To find out whether we were obtaining any results from the work we had started, I have kept an accurate account of the accidents occurring during the years 1908 and 1909, and the cost for the two years has been less than 1¼ per cent of the gross receipts after making an adequate allowance for any unsettled claims. The largest sum paid for any one accident occurring in these two years is $750. We have not had a lawsuit for damages started against our company in the last 2¼ years. We have no claims as far as we know in the year 1908 that are not settled, and only one claim during the year 1909 that has not been taken care of.

Before the year 1908 25 per cent of all of our accidents were rear platform accidents and when the question was raised that these accidents were caused by the crowding of cars I found that less than 7 per cent of this class of accidents happened upon cars that were crowded, and in the crowded cars I counted all cars having 60 or more passengers upon them. You can imagine my surprise when I found that 50 per cent of this class of accidents happened upon cars that did not carry over 10 passengers, showing conclusively that they were caused by the grossest kind of carelessness and inattention. By repeatedly calling attention to this class of accidents, we have practically eliminated them.

We never have received so many commendatory letters and so many compliments as we have had during the past year, and these are almost entirely due to the greater courtesy, the greater watchfulness, the greater carefulness of our employees, and the kindly feeling engendered by showing to the public concern for the lives and the limbs of the children.

MARCH MEETING CENTRAL ELECTRIC RAILWAY ASSOCIATION

A bi-monthly meeting of the Central Electric Railway Association was held at South Bend, Ind., on Mar. 24. George H. Whysall, the new president, was in the chair and about 100 members and guests attended each of the two sessions. Plans are being made for holding the next meeting in Toledo, Ohio, on May 26.

MORNING SESSION

The first session of the meeting was called to order at 10.30 a. m., by President Whysall. The minutes of the last previous meeting were read by A. L. Neereamer, secretary. Seven associate members were elected.

H. H. Buckman, master mechanic, Louisville & Northern Railway & Lighting Company, presented a report of the standardization committee. Lack of time had prevented the committee from making complete recommendations. After some discussion the association accepted as its standards the 7-in. 91-lb. high T-rail for city use and the 70-lb. A. S. C. E. section rail for interurban use.

The following report on "Loose Leaf Filing System," was presented by L. E. Gould, western editor, Electric Railway Journal, Chicago:

REPORT OF COMMITTEE ON LOOSE-LEAF FILING SYSTEM

"At the meeting held in Indianapolis on Nov. 18, 1909, your committee on the loose-leaf filing system presented a report which summed up a discussion on the feasibility of changing the form of technical publications with a view to making them more adaptable for filing and indexing for current use. The chief points considered were (1) the advisability of having wider binding margins, and (2) a standard punching that would be adaptable to a special set of covers for holding the leaves. The committee recommended that the association refer its report to the publishers of the technical journals devoted to electric railway work, and I was requested to consider the subject for them.

"The publishers of the electric railway papers are agreed that a proper system of filing information greatly enhances the value of a periodical to its subscribers. Probably every one has had the experience of recollecting having seen an account in a technical paper of something which he would like to copy in his own practice, but at the time he read the article he had no need to apply the information, and when he looked for it later he could not find it. Again, the railway man may be considering the purchase or construction of some equipment with which he is not fully familiar, and may be anxious to know what has been done by other companies. Naturally, he will wish to turn quickly to descriptions of such construction work, and for this use a good filing or indexing system is just what is required. As Mr. Hemming said in his paper, there is absolutely no doubt that by the intelligent use of any periodical a subscriber could greatly increase its value to him.

"Each of the publications devoted to the electric railway field issues free a periodical index, with which it is possible quickly to locate any article in a bound volume of the publication. A great many of the railway and engineering associations bind their papers each half year, and thus build up a valuable engineering library and history of the growth of the electric railway industry. Also, there are many readers who clip from the papers information which they desire to keep. These clippings are filed according to that system of indexing with which the subscriber is most familiar.

"On examination it has been found that hardly any two of the many readers who make their own indices follow the same system. The scheme for filing proposed by Mr. Hemming requires the use of a special loose-leaf book, in which the articles to be filed are inserted. This book also includes a number of ruled sheets on which a reference index is written, and each article is filed according to a subject and numerical classification.

"Undoubtedly the most common method of classifying and indexing articles extracted from current publications is by the use of the vertical filing system. Office practice has demonstrated that the vertical filing system is satisfactory for a great many uses. It is suitable for filing not only letters but blueprints and the various kinds of card records of the operating departments of railways. The vertical filing system can be expanded indefinitely. Its adaptability for general office use renders it most satisfactory for filing articles taken from technical papers. With a vertical filing system the articles can be pasted on cards or stored in envelopes, and these cards or envelopes can be indexed by subjects or numerically, as frequently is done in office work. Thus a subscriber in looking over his paper each week could indicate the articles which he desired to have filed, and the routine work could be performed by the office assistant who files the regular correspondence.

"Because the vertical system is flexible and offers great possibilities for classifying and indexing various data, and because the suggested use of wider margins and the punching of each copy would work a hardship on the publishers, and would be of value to but a very small percentage of the readers, it is the opinion of the representatives of the publishers that the association should not request a change in the present methods of issuing publications, but preferably should appoint a committee which would study the subject of filing and present a report that would include a typical index suitable for electric railway use, and outline a plan for using this index in connection with the regular vertical filing systems now used by the electric railway companies."

On motion, this report was accepted and the president instructed to appoint a committee to study the subject of filing information from current periodicals.

PRESIDENT'S ADDRESS

George H. Whysall, general manager, Columbus, Marion & Bucyrus Railway, the newly elected president, presented his address, which was published in last week's issue of this paper on page 538. The suggestions made in the address were received with much interest, and a committee was appointed to consider Mr. Whysall's recommendations in detail and report later to the association how they could be best put into effect.

Edward C. Spring, West Milton, Ohio, complimented the pres-

ident on the firm stand he had taken to improve the programs of the association meetings. He severely criticised several features of railway service. During the last year he had made an interurban trip of more than 2,000 miles, and as an operating official had made mental notes of the character of service and the efficiency of the employees on the lines traversed. He fully agreed with the suggestions regarding improving service set forth in the president's address. He had found that many railway employees, notably those at ticket offices, were poorly informed as to the schedules of connecting lines, and often they were not even courteous in answering inquiries regarding the service of their own lines. Passengers found many inconveniences in riding that were not conducive to long distance interurban travel. It should be remembered that it was necessary to replenish the treasury after the ordeal of a long winter, when operation was costly. This would require strict attention to duty on the part of the entire organization, in order to win the public favor.

Managers and general superintendents as a rule did not spend enough time riding over the properties in their charge and learning firsthand how the passengers were being treated. On some roads he had found that no executive was available after 6 p. m., whereas the most critical time in the day in interurban service was from 6 to 12 p. m. Arrangements should be made so that the manager or general superintendent could be reached quickly during those hours.

E. B. Grimes, assistant general manager, Ohmer Fare Register Company, Dayton, Ohio, spoke of the unreliability of many timetables issued in connection with unofficial advertising schemes. The merchants of Dayton, Ohio, had been solicited so frequently for these and other advertising schemes that it had been agreed by the merchants of Dayton that no publicity schemes of this sort should be used unless the medium had been endorsed by the publicity committee of the Chamber of Commerce. Mr. Grimes thought that some of the larger roads might find it profitable to have their own advertising agents, and solicit advertising, which would be published in connection with correct timetables and might more than pay the cost of printing.

SOLICITING TRAFFIC

C. O. Warfel, general agent, traffic department, Indianapolis & Cincinnati Traction Company, read a paper on "Soliciting Business," which was presented in last week's issue of the Electric Railway Journal, page 540. This paper was discussed by several traffic men.

W. S. Whitney, Ohio Electric Railway, called attention to the need for perseverance on the part of traffic solicitors. Another member spoke of the desirability of quick settlement of damage claims by connecting lines. From the public viewpoint, the electric railways were not considered separately, but the group of roads in one district was usually known as "The Interurban." Thus if a shipper had been treated unfairly by one road, he might work a hardship on all roads in the neighborhood when discussing his grievance with other shippers.

John F. Keys, general passenger agent, Detroit United Railway, spoke of the possibility of getting passenger business in competition with parallel steam lines. His company had secured and handled an eight-car-load excursion in the middle of the winter, carrying the passengers 101 miles from Saginaw to Detroit and return in special cars. The steam railroads did not think the electric roads capable of handling the traffic, and so had a train in readiness, but it was not needed, because the electric cars made the 101-mile trip in four hours. A snowfall of 14 in. occurred during the day, and the steam trains on the parallel route were five hours late.

John Crall, general freight and passenger agent, Terre Haute, Indianapolis & Eastern Traction Company, stated that a lack of co-operation between the operating and traffic departments sometimes hindered the building up of freight and express business. The solicitor was placed in an embarrassing position if he obtained a shipment which the operating department could not handle, or was unable to get over the road on time. A traffic department could not please the shippers fully until the road could promptly handle all the business offered it. Mr. Crall thought favorably of Mr. Warfel's recommendation that the Central Electric Traffic Association consider the adoption of a uniform acceptance sheet to be used by all members of the association.

C. O. Sullivan, general passenger and freight agent, Winona Interurban Railway, emphasized the need for the prompt settlement of all claims. He knew of several cases where considerable amounts of business had been given to the competitive steam roads because some small claim remained unsettled. This was frequently the case when the loss occurred on a connecting line.

Stephen Ridlen, general freight and passenger agent, Ben Hur route, who had just left steam railroad service to take up electric railway traffic work, said that formerly the steam lines did not take electric competition seriously, but the growth of electric railway express and freight traffic had largely changed this attitude. Mr. Ridlen also emphasized the need for prompt settlement of claims. He had found one unsettled claim for $10 that was six months old and had resulted in the loss of several hundred dollars' worth of freight. It was the duty of the traffic department to follow closely the adjustment of claims, so that no obstacles might hinder the possible increase of business.

H. S. Dickey, traffic manager, Chicago, South Bend & Northern Indiana Railway, told of the success that his company had had in using a map of the interurban lines in the C. E. R. A. territory when soliciting freight in competition with steam roads. A display of the map, indicating the great number of points reached, never had failed to command the interest of a possible shipper. Mr. Dickey said that his road operated its freight service in connection with a line of steamers between St. Joseph, Mich., and Chicago. Freight was received in Chicago until 11 p. m., and delivered at South Bend at 7:50 the next morning. He was confident that as soon as through service could be established with the electric lines in the centre of Indiana, a considerable growth of traffic would follow immediately. The possibilities of increasing this traffic would be limited only by the ability of the roads to handle the shipments.

C. E. Morgan, general manager, Indianapolis, Crawfordsville & Western Traction Company, emphasized the need for harmony between the traffic and operating departments. The latter department should make its schedules so that the trains could be kept on time, and when a proper schedule was found to be satisfactory, it should not be changed unless absolutely necessary. The schedule of the freight trains should be advertised. Then the shippers on connecting lines would soon become familiar with it, and business would grow without solicitation if the cars were operated close to schedule.

Charles L. Henry, president, Indianapolis & Cincinnati Traction Company, spoke in complimentary terms of the wonderful advancement made by interurban roads. The substantial growth of traffic should encourage the operators of the road to be energetic in improving the service. Such improvements as Mr. Whysall had outlined as being necessary must follow if the past record of advancement was to be maintained. During the winter just passed the electric railways of Indiana and Ohio, representing a business scarcely 10 years old, had demonstrated the kind of good service that it was possible to give. The results had been most remarkable. Close adherence to schedules by the electric cars was compared with the deranged train service of the steam roads, on which practically all trains were from 1 to 10 hours late during heavy snowstorms. Speaking of the growth of traffic in competition with parallel steam lines, Mr. Henry said that the Cincinnati, Hamilton & Dayton Railway paralleled the line of the Indianapolis & Cincinnati Traction Company for practically the entire length of the electric road from Indianapolis to Connersville. The steam railroad, since the advent of electric service, had discontinued stopping all trains at every station except Rushville, between Connersville and Indianapolis. The abandoned stops included six or eight towns varying in size up to 2,000 population, which do not now

receive passenger and express service from the steam road. On instruction from the Indiana Railroad Commission, the steam road is planning a schedule which will give the least possible number of stops and yet comply with an order issued to prevent discrimination.

Mr. Henry looked upon the freight traffic as a most important means of popularizing the several services which electric roads have to offer. On close examination he had found that the freight business (not including express traffic), based on established steam railroad freight rates, was showing a profit when debited with even more than its proportionate operating and overhead charges. As an example of the profit in serving shippers in the best possible way, Mr. Henry cited the instance of a switch and siding installed at a cost of approximately $150 and used for loading logs. In a few months the shipments from this siding, of which the advisability of installation had been questioned, had amounted to $1,500, and since the logs had been shipped, other traffic, including firewood, had been drawn to this loading point, so that it was now established as a profitable siding.

On motion, the president was instructed to appoint a committee which would consider the recommendations made in Mr. Warfel's paper.

By a unanimous vote, E. C. Spring was instructed to send a congratulatory telegram to the New England Street Railway Club on the occasion of its tenth anniversary.

AFTERNOON SESSION

The first paper of the afternoon was read by H. L. Weber, chief engineer, Columbus, Marion & Bucyrus Railway. This paper, entitled "Permanent City Track Construction for Interurbans," was presented in abstract in the Electric Railway Journal for Mar. 26, 1910, page 537. Following the reading of the paper, several members discussed ways and means for constructing brick pavements along tracks so that the brick would not rise above the rails.

Mayor Allen, of St. Joseph, Mich., was present and issued an invitation to the association to hold its September meeting in his city, which is located at the northern terminus of the interurban lines from South Bend, and which is the center of a popular summer resort district along the eastern shore of Lake Michigan.

A paper entitled "The Prevention of Accidents" was read by E. F. Schneider, general manager, Cleveland Southwestern & Columbus Railway. This paper, which merited the close attention of every railway man at the meeting, is presented in abstract elsewhere in this issue. On motion, the secretary of the association was instructed to have this paper printed and to mail a copy to each member of the association.

PUBLIC UTILITIES AND THE PUBLIC

A discussion of "Public Relations" was introduced by E. B. Grimes, assistant general manager, Ohmer Fare Register Company, Dayton. An abstract of Mr. Grimes' remarks follows:

"For a number of years I occupied the position of managing editor of a daily newspaper, and enjoyed a close relationship to the general public and to the public utilities. It was the best possible vantage point from which to view them. Members of the general public are inclined to find fault with public utilities, largely because representatives of the latter have neither the time nor the inclination to write articles defending themselves or their corporations against charges that are unjust and often wholly unreasonable. It is an inherent satisfaction for certain individuals to have their say, when assured all the while that there is no danger of being 'sassed back.'

"In some instances, the public and the utility are both inclined to be belligerent, and they then occupy the position of two military generals of opposing sides, engaged in a battle, resulting in loss to both. No corporation, however large it may become, ever entirely outgrows some one dominent personality in it, that is reflected in all its relations with the general public. If this dominant factor is of the molasses turn of mind, rather than of the vinegar type of disposition, the utility will be sweetened in temper, and friction with the general public will be largely eliminated. Therefore there is a far-reaching responsibility resting upon the heads of all utilities along this one particular line alone. And to use a railway term, it is a main line.

"The corruption found so generally within municipalities stands as one of the strongest arguments against the public ownership of utilities. As long as the utilities are so ably and successfully managed as at present, there is little danger of any large number of them being taken over by municipal bodies and municipalized into 'soft snaps' for public officials.

"The general public may learn a great many practical things from well-managed utilities that will be well for it to know. The competition among utilities, the strict supervision held over them by shrewd and enterprising managements, bring out all that is best in every department, and the whole is conducted in a business-like manner, insuring maximum results at a minimum cost. That the opposite is true in the conduct of the affairs of the general public is a lamentable fact, evidenced by increasing municipal indebtedness and higher taxation.

"The progressive, far-seeing men who blazed the way for successful public utilities, who have in many instances gone down to financial defeat in doing so, are deserving of the gratitude of mankind in the respective spheres, where their pioneer endeavors were put forth. They did untold good for the development of public interests, and others coming after them have received the reward of their meritorious beginning.

"The people have many reasons to be appreciative of the convenience, of the safety, and of manifold advantages offered by the utilities, which could not possibly be supplied by the individual or by the general government, and of which they are privileged to avail themselves, under most reasonable restrictions, and at comparatively little cost.

"Representatives of the general public who come to know the officials conducting railway utilities find them to be capable, practical men; men of sound judgment, of capacity for doing important things, and men who are giving the people, generally, more for their money than they are receiving from any other distinctive line of public corporations. The efficient and economical managements develop propositions that men of less force would never attempt to touch, even with other people's financial poles. Their pluck, their energy, their brains provide a medium of transportation within reach of the poorest among us, surrounded by the same provisional, protective comforts enjoyed by the rich."

Arthur W. Brady, president, Indiana Union Traction Company, emphatically stated that the improvement of relations existing between electric railroads and the public was a most important problem for the executives. In the operation of a property, the attention of the management was directed toward increasing the operating efficiency, and thereby adding to the net returns. Amicable relations with the public greatly assisted to the realization of this object. No one would doubt that during the last five years there had been a gradual disposition on the part of the public to diminish the incentive for operating railway properties in the way that they should be administered. The continual increase in the load of taxation placed heavier burdens on the road. Another reason assisting toward the straining of railway relations with the public was the increased cost due to regulation either directly by a public service commission or indirectly.

The general public, Mr. Brady said, had a highly exaggerated idea of the profitableness of electric railways. He did not know of another business that required so much ability and energy to gain reasonable profits. Considered in one light, electric railways were monopolies, because they offered services not duplicated by other agencies. Electric railway employees and managements in some instances, had treated the public in an unfair manner, and, therefore, were responsible for their strained relations. Some of the deficiencies as outlined in the president's address were the result of this independent attitude exhibited by the roads themselves. In general the public would not accept from a private corporation service of a character continually offered by municipal organizations. When

the interurban roads were new and offered the people a service that never had been given before, little weaknesses on the part of the roads were overlooked, but now that the popularity had worn off, the people looked for better service, and did not consider the wishes of the interurban roads as they did at the start.

Mr. Brady did not wish to be considered as a pessimist; he was enthusiastic over the possibilities of interurban railroading and held that each company should do everything possible to put the management of its road on a proper basis. Electric railroads were not gold mines and did have serious problems confronting them. One of the factors tending toward the correct solution of the railroad problems was the appointment of public service commissions. Several of these bodies had been the means of bringing about on the part of the electric roads a fuller knowledge of operating conditions.

ENTERTAINMENT FEATURES

At 8 a. m., preceding the first session of the South Bend meeting, 75 convention visitors were entertained with a trolley ride to Berrien Springs, Mich., and an inspection tour over the hydroelectric property of the Indiana & Michigan Electric Company. Officials of the Chicago, South Bend & Northern Indiana Railway Company and the Indiana & Michigan Electric Company acted as hosts. The 22-mile run from South Bend to Berrien Springs was made in 40 minutes in a special car, which took the party to a point within 1000 ft. of the dam of the hydroelectric power company.

The Berrien Springs plant is one of four hydroelectric generating stations owned by the Indiana & Michigan Electric Company. These plants operate in parallel, being connected by high-tension transmission lines which converge at South Bend, Ind., where the company has a steam turbine reserve station. The plant visited by the Central Electric Railway Association has an immediate capacity of 6000 kw, furnished by four Westinghouse revolving field a. c. generators, three of which are now in operation. Each generator is driven by a group of waterwheels operating under 22-ft. head. A hollow concrete dam extends across the St. Joseph River, which is about 2000 ft. wide. The backwater extends 8 miles upstream, thus furnishing a large reserve capacity. The Chicago, South Bend & Northern Indiana Railway Company purchases a portion of the output of this plant for operating all of its 10 substations.

SOUTH BEND-CHICAGO TRIP

At the close of the afternoon session, through the courtesy of C. N. Wilcoxon, general manager, Chicago, Lake Shore & South Bend Railway, about 60 members and guests were taken to Gary, Ind., and Pullman, Ill., over this high-speed single-phase line. The car for the special party was attached to a regular limited three-car train, and the run of 76 miles between South Bend and Pullman was made in three hours.

The attention of the health committee of the Liverpool Corporation, Liverpool, England, having been drawn to the unsightly condition of the streets, caused by tramway tickets being thrown away by passengers after leaving the cars, it has been decided to try on one route the experiment of placing a receptacle on the platform of each car, so that passengers may deposit therein their used tickets.

TABULATING CAR EQUIPMENT PROGRESS ON MASSACHUSETTS ELECTRIC COMPANIES' SYSTEM

The lines of the Massachusetts Electric Companies, covering the system of the Boston & Northern Street Railway Company and the Old Colony Street Railway Company, lying respectively north and south of Boston, include about 1000 miles of track under a single executive administration. About 2000 passenger cars are maintained on this system, and as the two companies are continually adding new equipment in the way of rolling stock, the problem of keeping a close watch upon all shop and assembly progress in connection with cars under contract is one of considerable importance.

FORM I—PROGRESS SHEET OF BUILDERS

Boston and Northern Street Railway Co.

Car No.	Erection Begun	Bottom Frame Erected	Side and End Frame Erected	Flooring in Place	Roof Canvas in Place	Wiring Begun	Outside Painting Begun	Outside Painting and Varnishing Comp't'd	Brake Rigging Comp't'd	Inside Trimmings Completed	Wiring Completed	Ready to Ship	Shipped
1391	10–22	10–27	11–1	10–29	11–9	11–8	11–17	12–10	12–21	12–24	12–16	12–29	12–29
1392	10–28	10–29	11–2	10–30	11–10	11–12	11–18	12–11	12–23	12–29	12–23	12–29	12–29
1393	11–1	11–2	11–6	11–4	11–10	11–12	11–18	12–12	12–24	12–31	12–23	12–31	12–31
1394	11–3	11–4	11–8	11–5	11–15	11–13	11–19	12–13	12–29	1–3	12–24	1–3	1–3
1395	11–5	11–5	11–9	11–6	11–15	11–15	11–23	12–17	12–29	1–5	12–26	1–7	1–7
1396	11–16	11–8	11–10	11–9	11–16	11–16	11–23	12–18	1–5	1–5	1–3	1–11	1–12
1397	11–8	11–9	11–11	11–9	11–18	11–19	11–23	12–20	1–7	1–7	1–5	1–11	1–12
1398	11–9	11–10	11–12	11–10	11–23	11–19	11–24	12–21	1–11	1–11	1–7	1–12	1–12
1399	11–10	11–10	11–11	11–11	11–24	11–20	11–24	12–23	1–13	1–17	1–10	1–17	1–17
1400	11–11	11–11	11–15	11–12	11–26	11–29	11–29	12–24	1–15	1–17	1–11	1–17	1–17

The headquarters of the equipment department are at 84 State Street, Boston, the rolling stock and shops being under the supervision of E. W. Holst, superintendent of equipment, who is responsible to C. F. Bancroft, superintendent of motive power and machinery. In view of the importance of this office being kept informed as to the exact status of all new rolling stock, from the time the contracts are signed to the date when the car is turned over to the operating department, the following system has been devised to show by tabular reports in blue print form the detailed progress of each car and its equipment toward completion.

The general plan of keeping the records is the same whether the information comes from the manufacturer's shops, from the car house where final assembly takes place, or from the headquarters office files. In brief, it consists of tabulating the car numbers in a primary column, with sub-columns headed by each of the more important processes through which the equipment is to pass before it can be placed in service. As fast as a car reaches a given stage of progress the date upon which the given point is reached is placed in the table opposite the car number and beneath the designation of the stage reached. This work is done on a tracing at the shop or office, as the case may be; blue prints are then sent to the proper official, and in this way the organization has the benefit of an exceedingly

FORM II—PRINTS SENT TO COMPANY BY BUILDERS

Number	Date	Title
4419–D	8/10/09	Bolster and Connections.
4347–G	8/23/09	Bottom Framing.
4528–D	9/22/09	Trap and Supports.
4545–G	9/22/09	Vestibule Plan Section.
4555–I	.....	Vestibule Post Section.
4592–E	"	Hood Vestibule.
4530–G	"	Step Tread Shape.
4723–E	"	End Panel (Switch Board).
4555–I	"	Vestibule Post Section.
4519–E	"	Monitor Sill and End Belt Connection.
4452–H	8/20/09	Monitor Sections.
4678–F	.....	Seat, End Corner.
4466–C	12/8/09	Glass for End Side Monitor.
4457–H	"	" " Upper Side Body.
4459–H	"	" " Ctr. Vestibule.
4454–D	"	" " End and Swing Sash.
4469–D	"	" " Vestibule Side.
4467–D	"	" " Center Monitor.
4420–E	"	L. D. Carline.
4468–C	"	Glass for Vestibule Door.
4651–B	12/18/09	Grab Bracket.
4748–C	"	Door Handles (Location of).
4585–C	"	" " Outside.
4654–C	"	" " Inside.
4615–D	"	Bell Cord Bracket.
4613–D	"	Pole Bracket.

graphic record of progress, showing the rate of equipment of each car, the existence of any delays, and anything unusual in the order of equipment.

Form I shows the upper 10 lines of a progress sheet covering the construction and equipment of 44 new semi-convertible cars which are just being completed for the Boston & Northern and Old Colony companies by the Laconia Car Company. The sheet shows the dates for each car on which erection began in the manufacturer's shop, when framing erection was completed, dates of placing flooring, roof canvas, commencement of wiring, painting, trimming, completion of brake rigging installation, completion of wiring and shipment date. This sheet tells at a glance whether any cars are delayed and if so the cause of the failure to complete them. It also gives the time required for each important part of the work and enables the equipment department of the railway company to compare the rates of progress of different cars, and to inquire as to the cause of any indicated delay.

FORM III—PROGRESS SHEET OF EQUIPMENT

Car No.	Car Body Received at Lowell	Trucks Received at Lowell	Motors Mounted	Car Received at Chelsea	Equipping Started	Wiring Completed	Piping Completed	Switches Installed	Equipping Completed	Car Tested	Put Into Service
1391	1–1	12–8	1–3	1–3	1–25	2–9	2–5	1–27	2–9	2–12	.....
1392	1–1	12–8	.....	1–2	1–3	.....	.....	1–21	.....	.....	.....
1393	1–5	12–8	1–8	1–7	1–26	.....	.....	1–28	2–11	2–12	.....
1394	1–5	12–13	1–5	1–5	1–21	2–3	2–3	1–25	2–3	2–4	.....
1395	1–11	12–13	1–11	1–11	1–29	2–9	2–5	1–29	2–12	2–12	.....
1396	1–13	12–13	1–12	1–17	2–1	2–11	2–12	2–3	.....	.....	.....
1397	1–13	12–17	1–13	1–18	.....	.....	.....	.....	.....	.....	.....
1398	1–13	12–17	1–13	1–17	.....	.....	.....	.....	.....	.....	.....
1399	1–18	12–17	1–18	1–22	.....	.....	.....	.....	.....	.....	.....
1400	1–19	12–17	1–19	1–21	.....	.....	.....	.....	.....	.....	.....

On another part of this sheet are two separate tables, one giving the number, title and dates of drawings sent from the manufacturer to the railway company, and the other those sent by the company to the manufacturer. The former is shown in Form II to give an idea of its general arrangement. This method of keeping these records is compact and graphic, and accurately expresses facts which if confined to ordinary correspondence files would be cumbersome, easily overlooked and difficult to keep in proper order. All drawings which pass between the railway company and the manufacturer in relation to the particular order covered by the car numbers are thus indicated, including prints from manufacturers of certain details, if necessary, suggestions of changes in the arrangement of apparatus, or other working particulars. The manufacturer has a tracing of the sheet which he fills in weekly, or at any other interval desired by the railway companies; one copy is sent to the Boston office of the railways, and one copy is given to the inspector at the shops of the manufacturer who represents the purchasing organization, for a check. The inspector may thus follow the work in relation to its time of completion with a minimum of difficulty and, in case of error, can quickly determine the fact and take proper measures to inform the car builder or his own superiors.

Form III shows the upper part of the sheet used to record equipment progress at the erecting shops and car houses of the railway companies. At each important erecting shop the equipment foreman sends in this daily report of the progress of the rolling stock, the blue print being received by the office of the superintendent of equipment at Boston. On the back of the print is stamped the date of its printing. The car numbers appear at the sides as before, and at the top of the several columns are the various steps which have to be taken between the arrival of the car at the point where the motors and trucks are assembled with the car body, and the final equipment for service. The sheet selected shows that of these Boston & Northern Laconia semi-convertible cars, none had been put in service on Feb. 14, although four had been tested out by Feb. 12. All the trucks had been received at Lowell, Mass., but not all the car bodies. A considerable number of cars had been received at the Chelsea erecting shops of the Boston & Northern Railway Company, but while equipment had become well started, little had been done in the way of wiring except in the case of the four tested. These sheets enable the department to follow the work in the railway companies' shops with the same degree of detailed care that obtains at the manufacturer's works, and the concentration of the information in so small a space, with its immediate indication of anything unusual in the conditions surrounding erection, is most helpful. The cost of the blue printing is a trifling matter in relation to the burden of routine correspondence which the use of the prints avoids. As the record is entirely historical, the tracing remains good for indefinite use at the car shops and the erecting point, and it is unnecessary to repeat any records, since these are automatically reproduced for all the previous operations every time a blue print is made.

Form IV is a reproduction in type of the upper part of a summary sheet used in the office of the equipment department, and combining the information received periodically from the manufacturers and the car houses where erection is under way. The sheet is made out regularly from the segregated tabulations shown in Forms I and III, and covers all the rolling stock under construction, regardless of its type and service anticipations. For convenience the two systems of lines north and south of Boston are separated in the summary sheet.

FORM IV—PROGRESS SHEET SUMMARY

Car No.	Erection Begun	Bottom Frame Erected	Side and End Frame Erected	Flooring in Place	Roof Canvas in Place?	Wiring Begun	Outside Painting Begun	Outside Painting and Varnishing Completed	Brake Rigging Completed	Inside Trimmings Completed	Wiring Completed	Ready to Ship	Shipped	Car Bodies Received	Trucks Received	Equipment Received	Equipping Begun	Trucks Equipped and Mounted	Equipping Completed	Tested	Ready for Service
1391	10–22	10–27	11–1	10–29	11–9	11–8	11–17	12–10	12–21	12–24	12–16	12–29	12–29	1–1	12–8	10–11	1–25	1–3	.....	.....	.....
1392	10–28	10–29	11–2	10–30	11–10	11–12	11–18	12–11	12–23	12–29	12–16	12–29	12–29	1–1	12–8	to	1–3	.....	.....	.....	.....
1393	11–1	11–2	11–6	11–4	11–10	11–12	11–18	12–12	12–24	12–31	12–23	12–31	12–31	1–5	12–8	11–9	1–26	1–8	.....	.....	.....
1394	11–3	11–4	11–8	11–5	11–15	11–13	11–19	12–13	12–29	1–3	12–24	1–3	1–3	1–5	12–13	11–9	1–21	1–5	2–3	2–4	2–7
1395	11–5	11–5	11–9	11–6	11–15	11–15	11–23	12–17	12–29	1–5	12–26	1–7	1–7	1–11	12–13	11–9	1–29	1–11	.....	.....	.....
1396	11–16	11–8	11–10	11–9	11–16	11–16	11–23	12–18	1–5	1–5	1–3	1–11	1–12	1–13	12–13	11–9	1–1	1–12	.....	.....	.....
1397	11–8	11–9	11–11	11–9	11–18	11–19	11–23	12–20	1–7	1–7	1–5	1–11	1–12	1–13	12–17	11–9	.....	1–13	.....	.....	.....
1398	11–9	11–10	11–12	11–10	11–23	11–19	11–24	12–21	1–11	1–11	1–7	1–12	1–12	1–13	12–17	11–9	.....	1–13	.....	.....	.....
1399	11–10	11–10	11–11	11–11	11–24	11–20	11–24	12–23	1–13	1–17	1–10	1–17	1–17	1–18	12–17	11–9	.....	1–18	.....	.....	.....
1400	11–11	11–11	11–15	11–12	11–26	11–29	11–29	12–24	1–15	1–17	1–11	1–17	1–17	1–19	12–17	11–9	.....	1–19	.....	.....	.....

POWER STATION LUBRICATION RECORDS FROM BERLIN

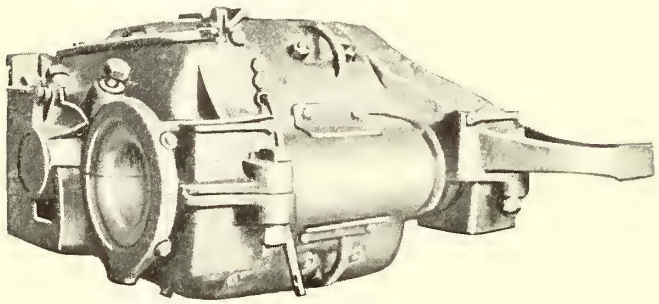
The Berlin (Germany) Electricity Works has recently published some figures showing the saving in lubricating costs due to the displacement of reciprocating engines by steam turbines. In the fiscal year 1905-1906, when the first turbines were installed there were required 252,052 kg (554,514 lb.) of cylinder oil and 93,806 kg (206,373 lb.) of engine oil. The output of the station for the year in question was 166,865,122 kw-hours. In the fiscal year, 1909-1910, the output of the station was about 210,000,000 kw-hours but owing to the fact that the station is now operated entirely by steam turbines the consumption of cylinder oil was only 47,000 kg (103,400 lb.) and of engine oil also 47,000 kg.

ROLLING STOCK IMPROVEMENTS OF BEN HUR ROUTE

The Indianapolis, Crawfordsville & Western Traction Company is now putting all its large interurban cars through the shop for repainting and thorough inspection. Westinghouse 304 A type motors with commutating poles are being placed under all equipments. These motors are rated at 90 hp. Westinghouse K 34 platform controllers are being installed on some of the cars.

The illustration shows the new dust guards which are supplied with the 304 A motors. One guard is made up of two semi-circular collars which fit over the end of the axle bearing on the commutator end. The collars are lined with felt to prevent the intrusion of dust. The larger guard encloses the axle. It is made of sheet steel in the form of a half-cylinder, which fills the space between the two axle bearing housings. The edges of this guard are also supplied with heavy felt which is held tightly in place against the motor casing when the guard is clamped in place. On this axle guard is a riveted angle pierced with two elliptical holes which permit it to be hooked over two bolts set in the motor casing. Two cap screws pass through a similar angle riveted to the lower part of the guard and serve to clamp it tightly in place. The form of the top connection is such that if the lower bolts work loose the guard will not drop to the track. It is thought that this protection for the axle will considerably increase the life of the motor bearings.

When the cars of this road were first equipped a type of air gage without illuminating lamps was placed in the cab. It



Westinghouse 304-A Motor with Dust Guards

since has been found desirable to illuminate the gages and a scheme for doing this without purchasing new gages and without using the miniature gage lamps has been applied to some of the cars which have just been shopped. The motorman's cab of these cars, which are built for single-end operation, is about 3 ft. long and is set off from the baggage compartment by a substantial bulkhead. One of the door posts in the bulkhead is directly opposite the window post which carries the air gage. A 16-cp lamp has been mounted substantially on this door post and is connected with four other lamps inside the baggage compartment. This lamp is enclosed in a cylinder of tin firmly held in place. A pin hole in the front side of the tin cylinder permits a beam of light to fall directly on the face of the air gage. This scheme was adopted because it is economical; it has a low first cost, does not require the miniature lamps, which are troublesome from the point of renewals. The enclosed lamp illuminates the gage properly without giving any stray light to bother the motorman's view ahead of the car.

The trolley wheels used on the cars of this road are 6 in. in diameter mounted in Hensley harps and use grease lubrication. Formerly the trolley poles were 12 ft. 6 in. long and the usual trouble from wheels leaving the wire at high speeds was experienced. As the result of trying poles of various lengths all the poles were shortened at 12 ft. A careful comparison of the life of the trolley wheels shows an increase of about 700 miles. The trolley rope now hangs vertically directly above the retriever. While the old wheels wore a U-shaped groove and the rims were severely cut, now that the poles have been shortened there is practically no undue wear on the rims and the body of the wheels is properly used. The average life of wheels now is 3583 miles.

ANNUAL MEETING OF THE NEW ENGLAND STREET RAILWAY CLUB

The annual meeting of the New England Street Railway Club was held at the Hotel Somerset, Boston, on March 24. In the afternoon the polls were opened for the election of officers, and the officers whose names were published in this paper last week were elected. In the evening the annual banquet was held in the large dining room in the hotel. As it was the tenth banquet of the club, special efforts were made in the way of entertainment. The six governors of the New England States had accepted the invitation of the club to be present, and all were in attendance, except Governor Draper, of Massachusetts, who was detained through illness. He was represented, however, by Lieutenant-Governor Louis A. Frothingham. It was said that only once before in the history of New England had so many of the governors participated in a meeting, and that this was the first time at which so many had met at the invitation of a private association.

After the banquet, Charles H. Hile, assistant to the vice-president of the Boston Elevated Railway, the newly elected president of the association, referred to the rapid growth of the membership of the club. He considered it very fortunate that the constitution of the club provided for the membership in the club of men of all departments of the electric railway industry. He thought that the mutual acquaintanceship thereby fostered was broadening. He urged those in each department to take an interest in all topics concerning the other departments of electric railway work, as thereby they could do better work in their own department. He then introduced Russell A. Sears, of the Boston Elevated Railway, as toastmaster.

Mr. Sears said that it is sometimes dangerous to have five aces or five kings, but he did not think that this applied to five governors, and congratulated the club on their attendance. He then introduced Lieutenant-Governor Louis Frothingham to speak in the interest of Massachusetts.

Lieutenant-Governor Frothingham's remarks related principally to the intimate ties connecting the New England States, dating back to the earliest history of the colonies.

James F. Shaw, president of the American Street & Interurban Railway Association, was then presented. Mr. Shaw extended to the club the congratulations of the American Association, and spoke of the important work which the association was doing for the industry. A step recently taken to foster close relations with the local organizations was the appointment of the presidents of all of the State associations on the committee on public relations of the American Association. Mr. Shaw believed that the work of this committee was one of the most important being undertaken by the association, and in conclusion presented a strong plea to all present who are not associate members of the main organization to join.

Mr. Sears then introduced P. F. Sullivan, president of the Boston & Northern Street Railway Company. An abstract of Mr. Sullivan's remarks follows.

MR. SULLIVAN'S SPEECH

Mr. Sullivan said that the companies represented in the club were 128 in number, operated 5300 miles of single track in the six New England States, and had an investment of over $300,000,000. These companies, which, upon a basis of one passenger for each unit of fare in 1908, carried 906,527,346 revenue passengers. Stated in another form, private capital in 1908 provided $50 for every man, woman and child in New England for the purpose of supplying cheap and safe conveyance for that portion of the population which, as a rule, could not afford any other means. This investment, which was $50 in 1908, was $23 in 1898, and less than $7 in 1888. Lest the amount of the investment might be questioned, Mr. Sullivan added that, while there was in 1888 a mile of track for 6,000 of population, in 1908 there was a mile of track for 1,200 of population.

Comparing New England street railway conditions with those in other places, Mr. Sullivan said that New York and Pennsylvania, which led in the largest street railway mileage of the

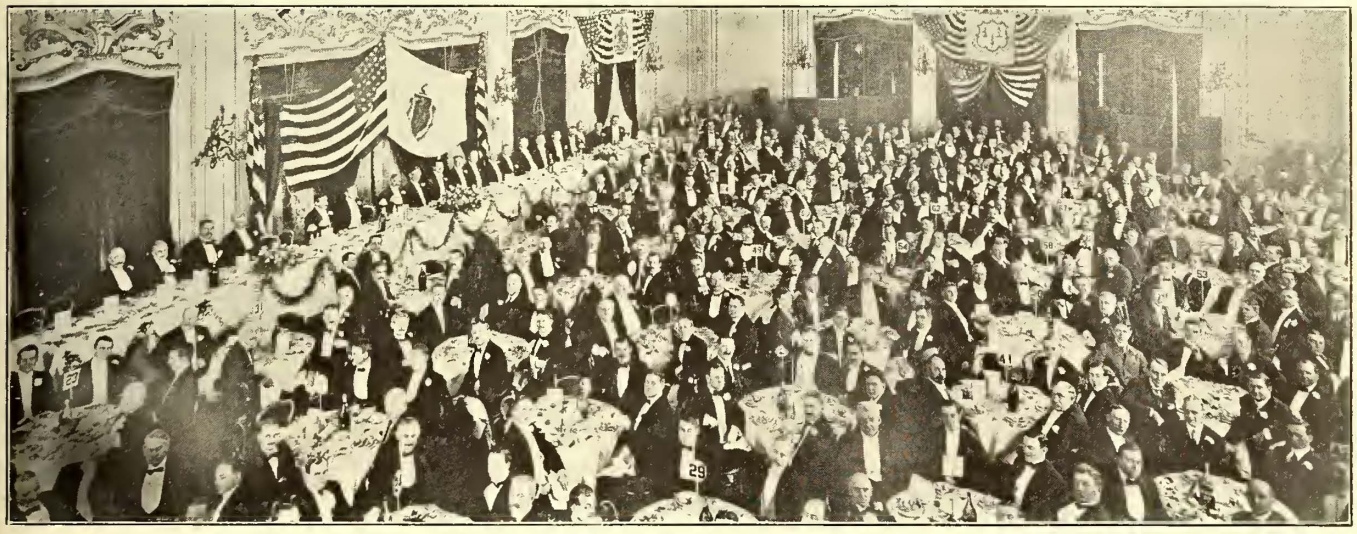
United States, had each only a mile of track for 1,800 of population, as against a mile of track for 1,200 population in New England and a mile of track for 11 sq. miles of territory, as against a mile of track for less than 3 sq. miles in Massachusetts. Great Britain, with a population of 38,000,000, had less than 4,000 miles of street railway track, or a mile of track for nearly 10,000 of population; yet in New England, Maine, New Hampshire and Vermont are only partially developed from a street railway standpoint.

Mr. Sullivan said that this was a record of achievement to which the public might point with pride, but not the investor. In Massachusetts, for illustration, no reasonable man would say that the street railway securities were watered, yet the return upon all classes of securities was barely 5 per cent, and this, too, without any allowance for depreciation. The larger number of companies could not sell their bonds upon better than a 5 per cent basis, nor could they, year in and year out, borrow money at better than a 5 per cent rate. Under such conditions, and with both classes of securities ahead of the stock, the speaker asked whether it was unreasonable for the stockholder to expect, even to insist, that he should have more than 5 per cent to compensate him for the risk. As he did not receive this amount in most cases, he hesitated before investing additional capital.

The result of this doubt—this hesitancy—was shown in the last five or six years, for that period showed the least street railway development of the last 20 years. From 1888 to 1898 the increase in investment was 250 per cent, and track extensions nearly 200 per cent. From 1898 to 1903 the increase in investment was 100 per cent; track extensions, 60 per cent, while from 1903 to 1908 investment increased only 13 per cent, and track extensions less than 9 per cent. Some might claim that this falling off was due to overdevelopment, but those on the ground knew better. More capital was needed generally, and even in Boston, for extensions, for double tracking, additional equipment and other improvement, but capital hesitated. In the cases of many of the smaller companies it was not hesitancy but absolute impossibility to find necessary capital. They wanted a fair return from their investment, and this they could not get without radical changes.

Mr. Sullivan referred to his previous statement that the three northern New England States were only partially developed through street railway investment, and believed that these States could well learn a lesson from the experience of others. By this statement he did not mean that he wished to see any substantial changes in the laws providing safeguards around the issue of securities. He meant that if these States expected street railway development they must by their laws offer not only encouragement, but also protection to capital, so that it might at least hope for such return from the investment as would compensate it for the risk. Maine had shown the greatest progress of the three States in the last six or seven years, largely through the efforts of a Massachusetts man who publicly stated he was forced to sell his street railway investments in Massachusetts because of local conditions. While it was not probable that the three northern States would be developed to the same extent as Massachusetts, it was possible, owing to valuable water powers and other natural advantages, that they could and would be developed so as to increase their wealth and population materially. He believed that if Massachusetts was to continue to develop it would be only after realization that a 5-cent unit of fare, while reasonable in some instances, was not a proper measure of service. A distinction should be made between congested centers of large population and high density of traffic and thinly settled communities and low density of traffic. Those in Massachusetts and other States charged with the administration of the street railway statutes must also come to a realization that, while the railway companies did not object to supervision of the issue of securities and regulation of service, they did most strenuously object to interference in operation. Should a State attempt to direct or suggest operation it would be forced to underwrite street railway securities or to purchase and operate the railways.

As New England, Massachusetts and Boston were the pioneers in the application of electricity to street railways, the companies hoped to continue to lead in giving the best and cheapest service, all things considered, not only in this country, but in the world. But, being human, they could not perform impossibilities. They could not do for the public what it was their highest hope to do, unless they had the co-operation of the public—unless the public would bear a just and fair portion of the burden. The companies realized fully that they accepted the charters and franchises under which they did their business under an implied contract to perform a semi-public duty in good faith—to give the public reasonably good service at reasonable rates. The public, on the other hand, entered into an implied contract to expect no more than reasonable service at reasonable rates—and these they are entitled to, no more nor no less. To perform this contract, capital must have a fair return commensurate with the risk, and the public must pay reasonable rates; and these rates must naturally and necessarily vary with the increased cost of doing business.



View of Banquet Room at Annual Meeting of New England Street Railway Club

OTHER SPEECHES

At the conclusion of Mr. Sullivan's remarks Mr. Sears called upon each of the governors for remarks.

Hon. Frank B. Weeks, Governor of Connecticut, congratulated the club on its flourishing condition, and spoke about the diverse functions of steam and electric railways. In his opinion, the property of any community is dependent largely upon good transportation facilities. He also referred to the number of

patents taken out by citizens of Connecticut during the past year.

Hon. Henry B. Quinby, Governor of New Hampshire, said in the strongest terms that he was favorable to the extension of railroad facilities in his State, and considered that he represented the best interests of the citizens of the State in this position. Nothing was more essential to material development. He also paid a compliment to the electric railway system in Boston, which, he said, was the equal of any in the world.

Hon Aram J. Pothier, Governor of Rhode Island, thought the development of railroad facilities essential in New England, and particularly to his own State. He referred to pending legislation in Rhode Island, and then spoke of the responsibility which railway companies owed the public to give good service. This was especially true where territory has been developed by home-builders with the understanding that the railway system would provide adequate and comfortable means of reaching and returning from their employment. This was a right which the people would expect and exact.

Hon. George H. Prouty, Governor of Vermont, said that the statistics given by Mr. Sullivan were a revelation to him. There were now 107 miles of electric railway in Vermont, and he wished that there were more. He thought that there was splendid opportunity in Vermont for new electric railways, certainly so far as right-of-way was concerned. The State was ready to give just and reasonable charters, and had had no unfortunate experience with railroad companies.

Hon. Bert M. Fernald, Governor of Maine, referred to the great opportunities in that State for railway and power development, and said that he thought a community of interest between steam and railroad companies was desirable. He hoped that the railway men would go to Maine and help develop the resources of that State.

William A. Murphy, secretary to Governor Eben S. Draper, presented the concluding speech. He spoke of the unrest prevailing throughout the country, owing to higher cost of living and other economical and political conditions. He did not consider this condition unfortunate, as it led to a study of causes and effects.

NEW JERSEY PUBLIC UTILITY COMMISSION LAW

In signing the New Jersey Public Utility Commission bill on March 24, Governor Fort made a public statement in which he said:

"As to the general features of the bill and its probable value as a law to effectively and authoritatively regulate utilities companies, I have conferred very fully with Frank H. Sommers, the president of the Railroad Commission. He deems the bill to contain many valuable features, and with ample authority to do effective work under it. My own study of its provisions has convinced me that it is in many respects an effective act. It certainly is a long step in advance. If it did nothing else than give the commission power to inquire into and expose unjust exaction and to inhibit unjust discriminations as to rates and charges—which it clearly does—it would be unfortunate if it should fail of enactment. But it does go farther, in that it confers upon the utilities board, in the strongest language possible, power to compel safe and adequate service by all utilities companies.

"Of course, there are serious omissions in the bill. It should contain a rate-making clause, giving the commission power to fix rates upon complaint by a municipal board or a given number of citizens. I have never favored a rate-making power on the initiative of the commission. I so stated when a candidate before the people, but I do emphatically favor some rate-making power under reasonable terms which will assure the good faith of the demand upon the commission that rates be investigated and fixed.

"The thing to do is to insist most vigorously that this bill is only accepted as a basis of additional regulative legislation, and to go steadily on educating the people by letting them see what can be done even under this law; that they may appreciate of what great value a really effective public utilities law would be."

A comparison of the Public Utility Commission law of New Jersey with the New York Public Service Commissions law has been made and is published in this issue. This shows that the New York law contains 50 octavo pages, while the proposed New Jersey law, with the present Railroad Commission law, of which it is an amendment, contains less than 15 octavo pages.

TEXT OF THE BILL.

The New Jersey bill amending the law is, in full, as follows:

"1. The title of the act to which this is a further amendment and supplement is hereby amended to read as follows: 'An act to create a Board of Public Utility Commissioners for the State of New Jersey, and to prescribe its powers and duties.'

"2. The name of the board created by section one of the act to which this is a further amendment and supplement, and which is therein called the Board of Railroad Commissioners, is hereby changed to the Board of Public Utility Commissioners.

"3. The members of said board shall receive a compensation of $6,000 per annum. The secretary of said board shall receive a salary to be fixed by said board, not exceeding $4,000 per annum. The total expenses of the board, including salaries, shall not exceed $50,000 per annum. No employee of said board shall have any official relation with or hold any stock in any public utility as hereinafter defined, operating within the State of New Jersey. No member of said board shall sit or take any part in any proceedings concerning or with regard to any such public utility in which he holds any stock, bonds or other securities, nor shall any member of said board or employee thereof hold any office under the Government of the United States, or any other salaried office under the government of this State.

"4. The jurisdiction of said board is hereby extended to and over all public utilities, which term is herein defined to include every railroad, express, street railway, traction, canal, subway, gas, electric light, heat and power, water, pipe line, sewer, telephone, telegraph or other corporation, association or joint stock company, operating within the State of New Jersey for public use under privileges granted by the State or by any municipality thereof.

"5. Said commission shall have general supervision over all public utilities as herein defined, and shall have power, after hearing upon notice, by order in writing:

"(a) To require every public utility as herein defined to comply with the laws of this State relating thereto, and to perform the public duties imposed upon it thereby;

"(b) To require every public utility, as herein defined, to furnish safe and adequate service;

"(c) To require every public utility, as herein defined, to keep its books, records and accounts so as to afford an intelligent understanding of the conduct of its business, and to that end to require every such public utility of the same class to adopt a uniform system of accounting.

"(d) To direct any public utility, as herein defined, found to be granting rebates, or other unjust, unfair and unreasonable discriminations to immediately cease therefrom.

"Said commission shall also have power to investigate any accident happening in connection with the operation of any public utility, as herein defined; to hear and examine complaints concerning rates charged by any such public utility, and to make such recommendations as it may see fit concerning accidents and rates.

"In furtherance of the foregoing powers, said commission shall also have power to compel the attendance of witnesses and the production of papers, accounts and documents, to swear witnesses and issue subpœnas, all in the manner provided in the act to which this is an amendment and supplement.

"6. No issuance, sale and delivery of its stock or of securities authorized by it and maturing more than 12 months from the date thereof, hereafter made by any such public utility, as

herein defined and created by this State, shall be valid until approved by said board. It shall be the duty of said board to approve of any such proposed issuance, sale and delivery of stock or securities, maturing more than 12 months from the date thereof, upon being satisfied that said proposed issuance, sale and delivery is to be made in accordance with the provisions of law relating thereto. No lease of its property, rights and franchises by any such public utility, and no merger or consolidation of its property, rights and franchises by any such public utility with the property, rights and franchises of any other such public utility shall be valid until approved by said board.

"7. All orders made by said commission pursuant to this act shall be enforceable in the manner provided in the act to which this is a further amendment and supplement, and the right of appeal from all orders of said commission is hereby conferred upon every public utility, as herein defined, to be exercised in the manner now provided in said act.

"8. No privileges or franchise hereafter granted to any public utility, as herein defined, by any local, municipal or county governing body shall be valid until approved by said board, whenever it shall, after due hearing, determine that such privilege or franchise is necessary and proper for the public convenience.

"9. Any public utility, as herein defined, may appeal to said board from any order or regulation made under existing law by any local, municipal or county governing body, and said board is hereby given jurisdiction to hear said appeal and to determine the matter in question on the merits, and make such order in the premises as may seem just and reasonable; and no such public utility, as herein defined, shall hereafter give, grant or bestow upon any local, municipal or country official any discrimination, gratuity or free service whatsoever, but nothing herein contained shall prevent the free transportation of uniformed public officers while engaged in the performance of their public duties.

"10. Nothing in this act shall be held to modify or repeal any of the provisions of the act to which this is an amendment and supplement, except in so far as such provisions are inconsistent with this act."

COMPARISON OF IMPORTANT PROVISIONS OF NEW YORK AND NEW JERSEY COMMISSION LAWS

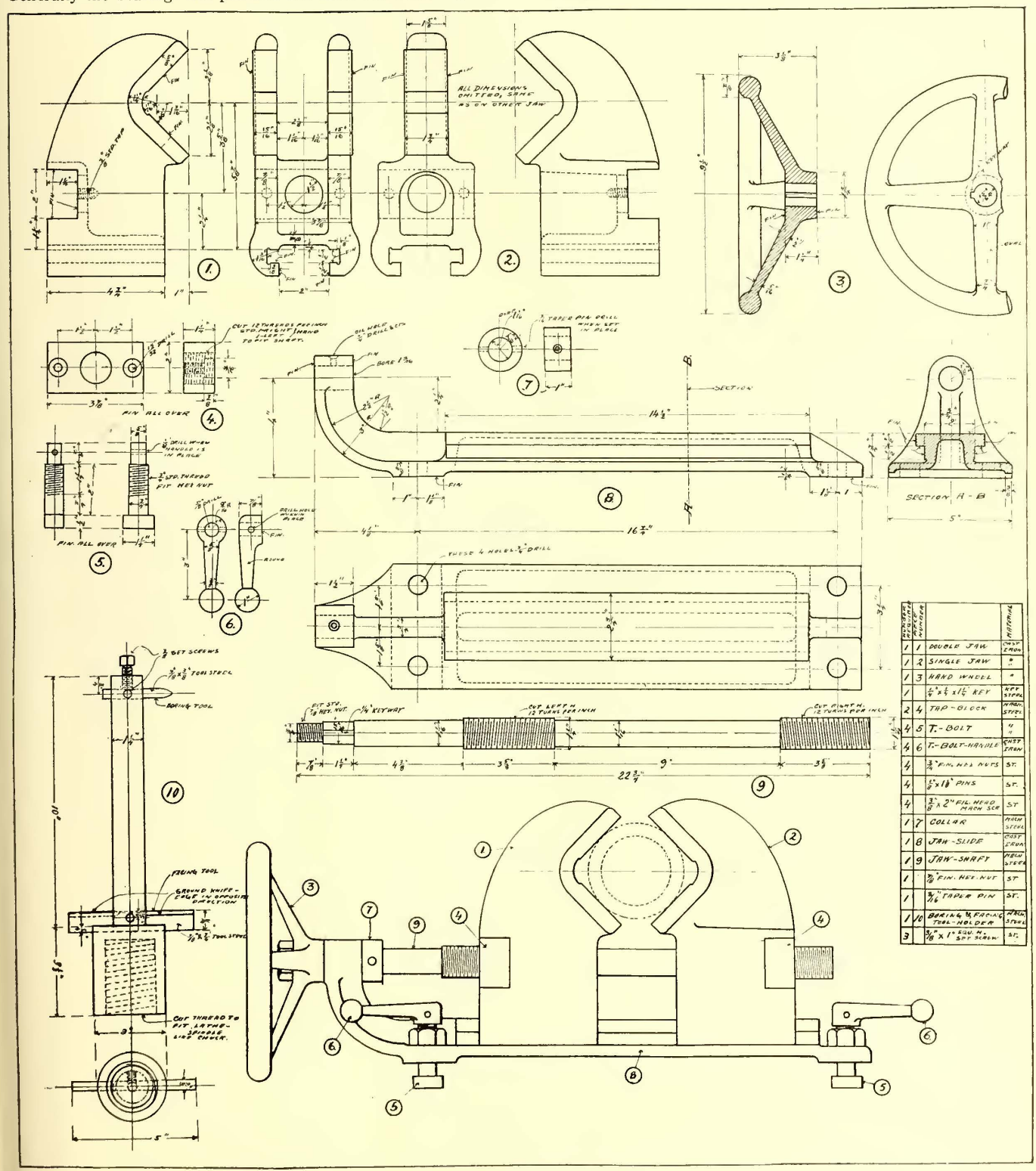
New York Public Service Commissions Law	*New Jersey Public Utility Commission Law*
GENERAL	
NUMBER OF COMMISSIONS	
1. Provides two commissions, one for New York City, the other for the remainder of the State. (Art. I, Sect. 3.)	1. Provides one commission. (P. U. Sect. 2.)
MEMBERS	
2. Each commission to consist of five members with appointments by Governor; term of office five years. (Art. I, Sect. 4.)	2. Commission to consist of three present Railroad Commissioners with appointment by Governor; term of office six years. (R. R. Sect. 1.)
JURISDICTION	
3. Jurisdiction extends over: 1. Railroads. 2. Street railroads. 3. Common carriers, including railroads, street railroads, express, car, sleeping car, freight and freight line companies. 4. Gas companies. 5. Electric light, heat and power companies. 6. Rapid transit railways in New York City. (Art. I, Sect. 5.)	3. Jurisdiction extends over all public utilities, including: 1. Railroad. 2. Express. 3. Street railway. 4. Traction. 5. Canal. 6. Subway. 7. Gas. 8. Pipe line. 9. Electric light, heat and power. 10. Water. 11. Sewer. 12. Telephone. 13. Telegraph. 14. Or other company operating within the State for public use. (P. U. Sect. 4.)
COUNSEL	
4. Each commission shall appoint a counsel with assistant attorneys, counsellors-at-law, stenographers and process servers. (Art. I, Sect. 6.)	4. The Attorney-General shall be the adviser and legal counsel of the Board. (R. R. Sect. 8.)
EMPLOYEES	
5. Each commission shall appoint a secretary and such officers, clerks, inspectors, experts and employees as it may deem necessary. (Art. I, Sects. 7, 8.)	5. The commission shall appoint a secretary, two inspectors, and such other clerical and expert help as may be necessary. (R. R. Sect. 2.)
OFFICES	
6. Offices shall be in New York City and in Albany, in rooms designated by trustees of public buildings. (Art. I, Sect. 10.)	6. Office shall be in the State House in Trenton. (R. R. Sect. 2.)
SALARIES AND EXPENDITURES	
7. Annual salaries of each commissioner $15,000, and of secretary $6,000. No limit to amount of expenditure. (Art. I, Sects. 13, 14.)	7. Annual salaries of each commissioner $6,000, and of secretar $4,000. Total annual expenditures of board shall not exceed $50,000 (P. U. Sect. 3.)
ANNUAL REPORT	
8. Each commission shall make an annual reoprt to the Legislature. (Art. I, Sect. 16.)	8. The commission shall report annually to the Governor and Legislature. (R. R. Sect. 8.)
LEGAL PROCEDURE.	
9. Provisions regarding attendance of witnesses, practice before the commissions, court proceedings, preferences, service and effect of orders and action to recover penalties are fully set forth. (Art. I, Sects. 19, 20, 21, 22, 23, 24.)	9. Details as to attendance of witnesses, production of papers, court proceedings, precedences, enforcement of orders, right of appeal and action to recover penalties are set forth. (R. R. Sects. 6, 8, 9; P. U. Sect. 5, 7.)
RAILROADS, STREET RAILROADS AND COMMON CARRIERS	
SERVICE AND FACILITIES	
10. Every common carrier shall furnish safe and adequate, just and reasonable service and facilities, and the commission shall determine just, reasonable, safe, adequate and proper regulations, practices, equipment, appliances and service, and fix same by order. The commission may order common carriers to make repairs, improvements, changes and additions, in order to promote security or convenience of public or employees, or to secure adequate service or facilities. The commission may order changes in time schedules and additional cars and trains. (Art. II, Sect. 26; Art. III, Sect. 49, 50, 51.) General provisions outlined as to railroads and common carriers regarding switch and side track connections, publication of tariff schedules, issuance of passes, connecting lines, distribution of cars, liability for damage in general accordance with the Interstate Commerce Commission act. Each commission shall have general supervision over all common carriers as to adequacy, security and accommodations of service, and also with respect to their compliance with the law, the orders of the commission and their charter requirements. (Art. II, Sects. 27, 28, 29, 30, 33, 35, 37, 38, 39, 40; Art. III, Sects. 45, 49.)	10. The commission shall have general supervision over all public utilities, and shall have power after hearing upon notice, by order in writing, (a) To require every public utility to comply with the laws of the state relating thereto, to perform the public duties imposed upon it thereby, to furnish safe and adequate service, and cease from granting unjust, unfair, and unreasonable discriminations. (P. U. Sect. 5.) The commission shall hear and examine complaints touching railroad service, car service, terminal facilities, switch connections, connecting lines, changes of stations, abolition of grade crossings, and all other matters of railroad operation, and make recommendations to any railroad company as to improvement of service, etc. The commission may order railroad companies to furnish proper and adequate transportation facilities and stations. No public utility shall give any gratuity or free service to any municipal or county official. (R. R. Sect. 8; R. R. Amend. Sects. 1, 2, 3, 5; P. U. Sect. 9.)

New York Public Service Commissions Law	*New Jersey Public Utility Commission Law*
RATES	
11. All charges by a common carrier shall be just and reasonable, and not more than allowed by law or by order of the commission. Every unjust and unreasonable charge, unjust discrimination or unreasonable preference is prohibited. The commission may determine just and reasonable maximum rates and fix them by order. (Art. II, Sects. 26, 31, 32, 34, 35, 36; Art. III, Sect. 49.)	11. The commission shall have power: (a) To direct any public utility to cease from granting rebates or other unjust, unfair and unreasonable discriminations. (b) To hear and examine complaints and make recommendations concerning rates; and, (c) To require compliance with the laws. (P. U. Sect. 5.)
ACCOUNTING	
12. Each commission may examine all books and records of common carriers and may require copies to be filed with it. Each commission shall prescribe the form of the annual report to be made by common carriers under provisions similar to the Interstate Commerce Commission, and also system of accounts, records and memoranda. (Art. III, Sects. 45, 46, 52.)	12. The commission shall have power to require every public utility to keep its books, records and accounts so as to afford an intelligent understanding of the conduct of its business, and to that end to require every public utility of the same class to adopt a uniform system of accounting. (P. U. Sect. 5; also R. R. Amend. Sect. 4.)
RECOMMENDATIONS TO LEGISLATURE	
13. Either commission may when requested by Governor or Legislature conduct hearings and make recommendations regarding changes in the railroad law. (Art. III, Sect. 45.)	13. The commission shall make such recommendations to the Legislature as it may from time to time deem proper. (R. R. Sect. 8.)
ACCIDENTS	
14. Common carriers required to notify commission immediately of accidents and commission shall investigate cause. (Act III, Sect. 47.)	14. Every public utility shall keep its records so as to afford an intelligent understanding of the conduct of its business. The commission shall have power to investigate any accidents of any public utility and to make recommendations concerning accidents. Every railroad shall give immediate notice to the commission whenever an accident occurs on its line, and the commission may investigate it. (P. U. Sect. 5; R. R. Sect. 7.)
FRANCHISES AND PRIVILEGES	
15. Without the approval of the commission no common carrier shall exercise any franchise. The commission shall have power to grant such approval when it shall determine such franchise or privilege is necessary or convenient for the public service. (Art. III, Sect. 53.)	15. No privilege or franchise shall be valid until approved by the commission, whenever it shall after due hearing determine that such privilege or franchise is necessary and proper for the public convenience. (P. U. Sect. 8.)
LEASES, MERGERS AND SALE OF SECURITIES.	
16. Any assignment, transfer, lease or contract, affecting any railroad or street railroad franchise shall not be valid unless approved by the commission. No corporation shall purchase stock of a domestic railroad or street railroad company without the consent of the commission. All issues by common carriers of stock or indebtedness payable at periods of more than 12 months shall be subject to approval by the commission provided. The commission shall have no power to authorize the capitalization of franchises; the capital stock of a merged corporation shall not exceed the sum of the stocks of the corporations so consolidated, and contracts and leases shall not be capitalized. (Art. III, Sects. 54, 55.)	16. No sale by any public utility of its stock or securities, maturing more than 12 months from date, shall be valid until approved by the commission, which before granting such approval shall be satisfied that the sale is made in accordance with the law (see laws of 1907-08 against stock watering). No lease or merger of its property, rights and franchises by any public utility shall be valid until approved by the commission. (P. U. Sect. 6.)
PENALTIES	
17. Any common carrier violating this act or disobeying an order of the commission shall forfeit not to exceed $5,000 for each offense; every violation of every day's continuance thereof shall be a separate offense. Every officer or agent of such common carrier abetting such violation shall be guilty of a misdemeanor. The commission may apply for mandamus or injunction. The penalty for corporations other than common carriers shall not exceed $1,000 for each offense. (Art. III, Sects. 56, 57, 58.)	17. In default of compliance with an order of the commission, the public utility shall be subject to a penalty not exceeding $100 per day. By court proceedings, witnesses can be compelled to attend, testify and produce books and papers, under a jail penalty of not exceeding 90 days. (R. R. Sects. 6, 8; P. U. Sect. 7.)
INTERSTATE TRAFFIC	
18. Either commission may investigate interstate traffic on railroads within the State and may report to the Interstate Commerce Commission violations of the Interstate Commerce Law. (Art. III, Sect. 60.)	18. The commission shall, on request, make report to the Interstate Commerce Commission. (R. R. Sect. 8.)
GAS AND ELECTRIC CORPORATIONS	
SUPERVISION	
19. Each commission shall have general supervision over gas and electric corporations. (Art. IV, Sect. 66.)	19. See No. 10 above as to general supervision over all public utilities.
SERVICE	
20. The commission shall investigate the quality of gas supplied, the methods of manufacture, supply and transmission of gas or electricity, and have power to order such improvements as will promote the public interest, preserve the public health and protect those using or manufacturing; also to fix standard of gas illumination and pressure, and to prescribe methods of regulation of electricity supply and efficiency of incandescent lamps. (Art. IV, Sect. 66.)	20. See No. 10 above as to requiring every public utility to furnish safe and adequate service.
ACCOUNTING	
21. The commission may prescribe uniform methods of accounts, require annual reports and examine the books, property or affairs of gas and electric corporations. (Art. IV, Sect. 66.)	21. See No. 12 above as to every public utility of the same class adopting a uniform system of accounting.
MUNICIPAL GAS AND ELECTRIC CORPORATIONS	
22. Each municipality operating gas or electricity supply shall make an annual report to the commission and otherwise be under its supervision. (Art. IV, Sect. 66.)	22. The jurisdiction of the commission extends to every other corporation or association operating for public use under privileges granted by the State. (P. U. Sect. 4.)
INSPECTION OF METERS	
23. Each commission shall appoint inspectors of gas and electric meters. If meters are not correct within certain percentages, the cost of test shall be paid by the corporation, otherwise by the consumer requesting the test. (Art. IV, Sect. 67.)	23. See No. 5 above as to additional expert help and No. 10 above as to adequate service and unfair discrimination.
FRANCHISES	
24. Without the commission's approval, no gas or electrical corporation shall exercise any franchise, nor shall any municipality operate any public supply of gas or electricity. (Art. IV, Sect. 68.)	24. See No. 15 above as to approval of franchises by the commission.
LEASES, MERGERS AND SALE OF SECURITIES	
25. Same provisions for gas or electrical corporations as for railroads or street railroads; see No. 16 above. (Art. IV, Sects. 69, 70.)	25. See No. 16 above.
COMPLAINTS	
26. Investigations of service and rates shall be made upon complaint in writing of the mayor of a city, trustees of village, town board of town or of not less than from 25 to 100 customers. After hearing, the commission may within lawful limits fix the maximum price to be charged, and may order improvements in service. (Art. IV, Sects. 71, 72.)	26. The commission has power to prevent discrimination, to hear and examine complaints and make recommendations concerning rates, and to require compliance with the laws of the State. (P. U. Sect. 5.)
PENALTIES	
27. Same provisions as in No. 17 above. (Art. IV, Sects. 73, 74.)	27. No. 17 above applies to every public utility.
Note.—Above references are to the Public Service Commissions Law of State of New York, Chap. 429, Laws of 1907.	Note.—In above "R. R." refers to the Railroad Commission, Act Chap. 197, Laws of 1907, and to its amendment by Chap. 169, Laws of 1909; "R. R. Amend." refers to Amendments by Chap. 189, Laws of 1909, and "P. U." to the proposed Public Utility amendment by bill just passed by the N. J. Legislature.

LATHE ATTACHMENT FOR BORING AND FACING ARMATURE BEARINGS

Many electric railway shops do not realize how much the life of an armature bearing can be lengthened if it is properly faced and bored when first placed in service after babbitting. Generally the bearings are put into the lathe for centering and lining-up by hand with a piece of chalk. This method not only requires the services of a good machinist, but also at least half-an-hour's time. With the attachment shown, however, the same work can be done with absolute accuracy in no more than four minutes.

The accompanying detail and assembly drawing shows the apparatus with dimensions to fit an 18-in. lathe. The same idea, of course, can be carried out for other sizes. As the drawing is so complete it is not necessary to explain every detail, but a little advice on a few points may not be out of place. Piece No. 4 must be fitted after the rest is assembled and the thickness will have to be planed until the threads will come in position to set the jaws in the correct center. To do this right it is best to take a 3-in. or 4-in. truing shaft, place it between the centers of the lathe and set the jaws against it. This will show how much must be planed off from piece No. 4. The T-bolts fit into the grooves on the carriage slide of the lathe. Besides these screws, there should be one ¼-in. dowel pin on each slide to get the apparatus in line on the lathe. The dowel pins should be fastened to the jaw slide No. 8 and the holes to receive them should be drilled in the slide on the lathe. No. 10



1	1	DOUBLE JAW	CAST IRON
1	2	SINGLE JAW	"
1	3	HAND WHEEL	"
1		¼" x ¾" x 1½" KEY	CAST STEEL
2	4	TAP-BLOCK	MACH. STEEL
4	5	T.-BOLT	"
4	6	T.-BOLT-HANDLE	CAST IRON
4		¾" FIN. HEX NUTS	ST.
4		⅝" x 1⅛" PINS	ST.
4		⅜" x 2" FIL. HEAD MACH. SCR.	ST.
1	7	COLLAR	MACH. STEEL
1	8	JAW-SLIDE	CAST IRON
1	9	JAW-SHAFT	MACH. STEEL
1		⅞" FIN. HEX. NUT	ST.
1		9/16" TAPER PIN	ST.
1	10	BORING & FACING TOOL-HOLDER	MACH. STEEL
3		⅝" x 1" SQU. H. SET SCREW	ST.

Assembly and Details of Lathe Attachment for Facing and Boring Bearings

is the boring tool, which fits the chuck threads on the lathe spindle.

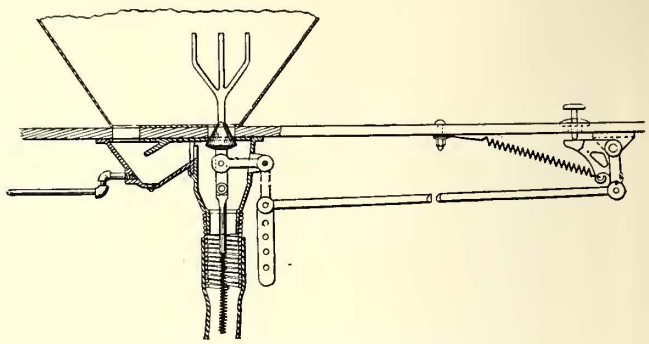
The process of boring is carried out as follows: Adjust the bearing with the large end toward the left or spindle on the lathe and fasten with the hand wheel. This will instantly bring the bearing in line and in center. Then set the tool at the end of the boring bar for a rough cut about 1/16 in. less than the final cut. Set the feed in the carriage and run the tool through from left to right. When through, stop the feed and run the carriage by hand over to the right until the facing tool strikes the bearing. Then press gently and the tool will cut the babbitt in thin ribbons from the bearing until the desired size is obtained. Then set the tool at the end of the boring bar to the exact size, set the reverse feed and run through from right to left. When through, adjust the carriage by hand so that the boring tool will take off the edge. This completes the bearing. The device has been in use in the repair shop of a Southern railway for a year and is not patented.

COST OF MAINTENANCE IN MASSACHUSETTS

In view of the general interest in the subject of maintenance cost, the following figures deduced from the report of the Massachusetts Railroad Commission for 1908 are presented through the courtesy of the Boston & Northern Street Railway Company. They show the cost of maintenance of car bodies, electrical and miscellaneous equipment of all Massachusetts street railways for the year ending Sept. 30, 1908:

A NEW SAND BOX

E. A. Longmire, master mechanic of the Norfolk & Portsmouth Traction Company, Norfolk, Va., has recently patented a sand box which is now in regular operation on the cars of the company named. As shown in the accompanying drawing, the box is designed for operation either by the platform pedal or by air from the motorman's valve. Simultaneous operation by foot and air is recommended only in emergencies. The box



Sand Box Used in Norfolk, Va.

is supplied with an air-trap attachment as well as a conical valve with a fork. The latter extends up into the hopper to break up the sand should the latter become packed. It will be noted that this valve has a small flexible shaft made of a coil spring which works up and down in a hose, thereby insuring a free passage and the elimination of obstructions.

Name of Company.	Cost of Maintenance.	Car Mileage.	No. of Cars.	Avg. Cost Per Car.	Avg. Cost Per Car Mile, Cents.
Amesbury & Hampton Street Railway Company	$2,662.50	139,000	11	$242.04	1.92
Athol & Orange Street Railway Company	4,018.27	147,147	13	309.10	2.73
Berkshire Street Railway Company	46,423.04	1,712,835	65	714.20	2.71
Blue Hill Street Railway Company	12,555.86	375,973	27	465.03	3.34
Boston Elevated Railway Company	1,121,031.08	51,625,143	3,464	323.62	2.17
Boston & Northern Street Railway Company	361,784.83	17,221,440	1,177	307.38	2.10
Boston & Worcester Street Railway Company	54,931.15	1,842,946	77	713.39	2.98
Bristol & Norfolk Street Railway Company	1,673.06	65,665	5	334.61	2.55
Brockton & Plymouth Street Railway Company	11.670.72	467,072	25	466.82	2.49
Citizens' Electric Street Railway Company	7,420.56	340,744	26	285.40	2.17
Connecticut Valley Street Railway Company	9,089.38	790.937	39	233.06	1.14
Concord, Maynard & Hudson Street Railway Company	2,801.02	237,531	16	175.06	1.18
Conway Electric Street Railway Company	1,379.16	26,292	3	459.72	5.24
Dartmouth & Westport Street Railway Company	13,067.26	492,131	24	544.47	2.65
Dedham & Franklin Street Railway Company	3,195.51	132,844	8	399.44	2.40
East Taunton Street Railway Company	2,467.30	149,723	7	352.47	1.65
Fitchburg & Leominster Street Railway Company	12,650.33	985,706	53	238.68	1.28
Gardner, West & Fitchburg Street Railway Company	3,301.74	253,412	12	157.22	1.30
Haverhill & Amesbury Street Railway Company	14,509.86	531,341	44	329.77	2.73
Haverhill & Plaistow Street Railway Company	1,293.40	64,400	..	....	....
Haverhill & Southern New Hampshire Street Railway Company	5,519.46	243,700	11	501.77	2.26
Holyoke Street Railway Company	43,626.70	1,961,346	127	343.51	2.22
Interstate Consolidated Street Railway Company	....	605,332	..	....	....
Lawrence & Methuen Street Railway Company	8,456.18	369,900	12	704.68	2.28
Lexington & Boston Street Railway Company	21,056.58	708,217	61	345.19	2.97
Linwood Street Railway Company	1,526.25	47,213	4	381.56	3.23
Lowell, Acton & Maynard Street Railway Company	....	43,175	..	....	....
Lowell & Fitchburg Street Railway Company	6,798.67	245,468	8	849.86	2.77
Lowell & Pelham Street Railway Company	1,683.72	76,000	9	187.08	2.21
Marlborough & Westborough Street Railway Company	5,254.42	199,868	11	477.67	2.63
Medfield & Medway Street Railway Company	1,547.88	151,072	5	309.57	1.02
Middlesex & Boston Street Railway Company	4,858.98	370,947	13	373.76	1.31
Milford, Attleboro & Woonsocket	12,234.61	430,403	21	582.60	2.84
Milford & Uxbridge Street Railway Company	8,958.70	697,470	45	199.08	1.28
Nahant & Lynn Street Railway Company	786.26	115,684	14	56.16	0.68
Natick & Cochituate Street Railway Company	7,477.48	491,598	39	191.20	1.52
New Bedford & Onset Street Railway Company	7,006.55	439,435	29	241.60	1.59
Newton Street Railway Company	20,219.08	1,538,841	143	141.39	1.31
Newton & Boston Street Railway Company	7,078.88	308,909	17	416.40	2.29
Norfolk & Bristol Street Railway Company	6,115.47	453,306	12	509.62	1.35
Northampton Street Railway Company	14,735.70	803,369	44	334.90	1.83
Norton & Taunton Street Railway Company	6,571.45	371,834	18	365.08	1.77
Norwood, Canton & Sharon Street Railway Company	721.20	68,447	7	103.21	1.05
Oak Bluff Street Railway Company	742.85	23,584	5	148.57	3.15
Old Colony Street Railway Company	222,198.91	10,090,027	728	305.21	2.22
Pittsfield Electric Street Railway Company	29,689.79	889,926	37	802.42	3.34
Plymouth & Sandwich Street Railway Company	696.90	47,612	4	174.22	1.46
Providence & Fall River Street Railway Company	11,902.27	245,232	19	621.17	4.85
Shelbourne Falls & Colrain Street Railway	1,083.65	56,239	4	270.91	1.92
Springfield Street Railway Company	122,968.28	5,649,401	284	432.98	2.17
Taunton & Pawtucket Street Railway Company	6,253.17	264,756	15	416.87	2.36
Templeton Street Railway Company	5,821.64	236,130	15	388.11	2.46
Union Street Railway Company	30,436.29	1,730,441	140	217.40	1.75
Uxbridge & Blackstone Street Railway Company	2,688.89	315,389	5	537.77	0.85
Ware & Brookfield Street Railway Company	4,279.73	158,199	12	356.64	2.70
Warren, Brookfield & Spencer Street Railway	2,466.17	321,337	17	145.07	0.77
Westborough & Hopkinton Street Railway Company	953.93	79,480	..	....	....
Western Massachusetts Street Railway Company	5,169.91	857,777	37	139.72	0.60
Worcester & Blackstone Valley	6,701.36	362,584	18	372.29	1.85
Worcester Consolidated Street Railway Company	143,064.97	5,909,117	343	417.09	2.42
Worcester & Holden Street Railway Comoany	4,559.98	185,419	7	651.42	2.45
Worcester & Southbridge Street Railway Company	20,162.30	1,215,523	63	320.03	1.65
1909—					
Boston & Northern Street Railway Company	427,501.53	17,491,555	1,165	367.03	2.44
Old Colony Street Railway Company	228,367.43	10,209,504	713	320.29	2.24

TURN-OUT SELECTOR MECHANISM FOR ELECTRIC RAILWAY DISPATCHING

The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., which is well known to electric railways through its telephone dispatching system, recently has added to this line the interesting dispatcher's selector mechanism described in the following paragraphs.

The master selector is at the train dispatcher's office arranged so that the dispatcher can operate it conveniently without rising from his chair. This master selector has a dial upon which is shown the number of each turn-out on the division and immediately under these numbers are holes for inserting a removable plug when selecting and operating a signal. A selector very similar in appearance to the master is located at each turn-out in a booth. This selector, when aided by a semaphore trip, operates the semaphore from the "clear" to the "stop" position at the will of the dispatcher. There is also a tape recorder on the train dispatcher's desk which is operated by impulses created by an individual station when the semaphore at that particular point has gravitated to "full danger." To illustrate, when semaphore No. 5 is set to "danger" by the dispatcher, the semaphore at station No. 5 automatically releases the mechanism at station No. 5. This causes five impulses to go forth on the line. These are immediately recorded as five perforations on the dispatcher's tape. In the same way, station No. 6, when operated, would generate six impulses on the line. The mechanism which controls this "answer-back" is not released to operate until the semaphore actually has been set to the full "stop" position. The answer-back device is mounted in the same case with the trip mechanism.

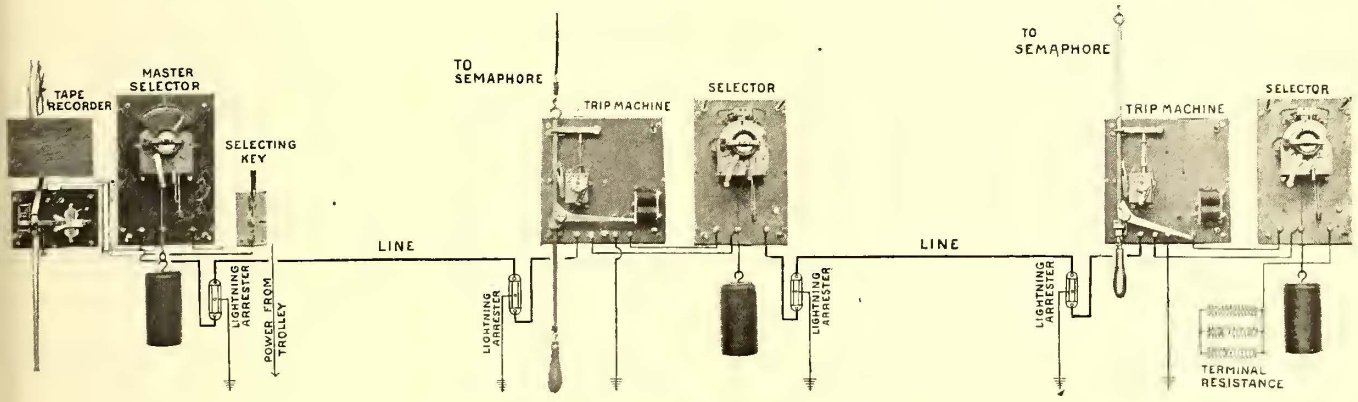
To set a signal against a car at some point on the line, the dispatcher throws a controlling switch to the battery. This starts the beating of the mechanisms with all clocks in the same relative position. The effect of this battery current is to energize a magnetic coil, which causes an armature to pull up and release the driving wheels of the clock movements at each of the stations. The wheels in all of the stations are rotated at the starting position by suspended weights. The dispatcher then inserts the plug in the dial hole of the master device corresponding to the station for which the danger signal is to be set. Then he throws to the firing position the controlling switch previously mentioned.

When the switch is thus thrown the battery current through the line is broken. Consequently, the magnets in the selectors release their armatures so that the friction wheel comes into contact with the moving wheels or disks. As all the clock movements are in operation, the contact-carrying disks continue to move together and pass over the contacts for the various stations in their order until the master selector touches the plug which had been inserted in the dial hole corresponding to the desired station. As soon as this contact with the plug is established, the corresponding local station selector moves the contact-carrying disk into contact with the springs and completes the circuit for operating the trip mechanism. The movement of the trip releases the semaphore, cuts the trip from the circuit and also closes the circuit which permits the answer-back mechanism to send back the tell-tale impulses for the dispatcher's tape. This occurs because the semaphore upon reaching the full danger point has automatically set the answer-back mechanism in operation. The moving disk of each clock also is restored to the starting position, leaving every selector ready for further operation.

Aside from the apparatus described, with which 30 to 40 signals can be operated straight away selectively, there is required only one bare iron line wire and a source of power.

The power for the battery is generally obtained from the trolley circuit at the dispatcher's office. There are no local batteries along the line. Only a small voltage is required for the operation of the selectors, and this is used only momentarily while actually operating a signal.

The value of this apparatus may be better understood by assuming an operating case. For instance, a dispatcher wishing to give two crews orders to meet at a certain turn-out would set the signal to "stop" position at that point. His answer-back at once would be automatically thrown upon the wire at the distant station and automatically recorded on the dispatcher's tape register. He would then set the semaphore to "danger" at other selected points to get in touch with the two respective crews and give them orders to meet at the selected point, where, as a preliminary move, he had set the signal to danger to enforce obedience to the orders which he issued later. The first crew of the two arriving at the meeting point, finding the signal set against them communicate by telephone with the dispatcher and are reminded of the order to wait for the other car. They are also instructed to restore the signal to "clear" to avoid any delay to the other car. The purpose of the signal is served, of course, when the first crew has been checked.



Apparatus for Selector Dispatching System

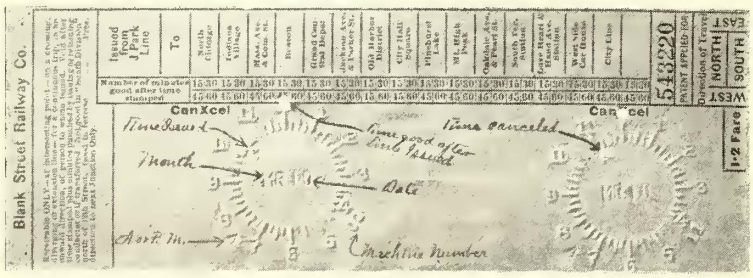
Mishaps can almost invariably be traced to the unusual meeting points which a disarranged schedule had made necessary and which are repeatedly overrun by the crews. The object of the dispatcher's signals described is to reinforce the dispatcher's orders at such points, as well as to provide a means whereby the dispatcher can establish immediate telephonic communication between himself and any crew at any turn-out.

The report of the directors of the Costa Rica Electric Light & Traction Company, London, England, for the year ended June 30, 1909, shows that the net earnings in Costa Rica amounted to £13,938, as compared with £14,402 in the previous year. The decrease in profits was due to the heavy repairs required to the rolling stock, some of the cars having been rebuilt. The Guadalupe extension was inaugurated by the President of Costa Rica on Oct. 12, 1908, and the line is proving a valuable addition. The auditors of the report point out that no provision has been made for depreciation. The company also has received a concession for a 3000-kw hydroelectric plant at El Brazil.

AUTOMATIC TIME PUNCH FOR TRANSFERS

A new system for the control of transfers has been recently perfected by the Transfer Issuing Machine Company, of Boston, Mass. This device, known as the Smith punch, takes the place of the ordinary punch used by street railway conductors. The use of this punch enables conductors with only one operation to indicate upon the transfer the month, date, time of day, number of punch and destination of passenger. It is, therefore, a large time saver, as a conductor is now frequently obliged to punch a transfer from two to five or more times to accomplish the same result. The time saving, however, is only one of the minor gains made by the use of the punch. The date and time are stamped on the transfer automatically so that transfers cannot be timed or dated ahead of the time of actual issue. Thus it tends to prevent the misuse of the transfers.

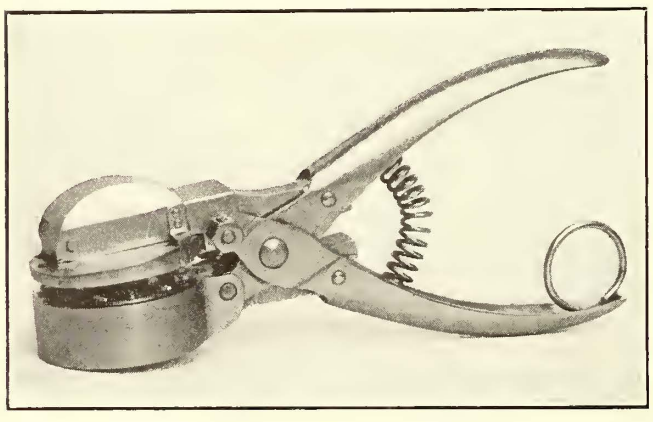
The punch also places upon the transfer the time beyond that of actual issue within which the transfer may be used by the



Sample Transfer Stamped with Time Punch

passenger. This time limit being automatically placed upon the transfer enables the receiving conductor to see at a glance whether the transfer is being used within the time limit or not, and as the time limit is placed by machine the receiving conductor can with safety decline to receive a transfer beyond the limit indicated upon it. This places a positive check upon the passenger and makes the time-limit feature of a transfer of real value. It thus effectually prevents the use of a transfer as a stop-over ticket.

The illustrations show the method of printing upon the transfer the various indications mentioned above. The receiving conductor also cancels the transfers received and in so doing prints upon the transfer the time of receipt, thus compelling him to make a record of the actual time at which he receives the transfer, and forcing him to regard the time limit. The transfer, therefore bears upon it a complete history of its use,



Automatic Transfer Time Punch

both by the issuing conductor, the passenger using the transfer and the receiving conductor. The checking up of transfers is, therefore, very easy and rapid.

The punch contains a strong, reliable time mechanism and dating wheels so arranged that they can be easily changed in the office from day to day. The indications made by the punch cannot be changed except by an authorized person, as the operating mechanism is sealed after being wound for the day.

The illustration of a hypothetical transfer, under this system, shows it was issued from J Park Line to Beacon by Punch 00 on March 10 at 10:15 a. m., and that it is good for 45 minutes beyond that time, or until 11 a. m. The second impression gives the number of the punch carried by the receiving conductor, the time at which the transfer was received and that the transfer was received within the proper time limit. The same punch is used both in issuing and receiving the transfers. Each conductor carries but one punch. This punch can be used as an ordinary punch also if desired.

EXPANSION BORING BAR

The expansion boring bar shown in the accompanying cut is made for steel and cast-iron wheels by the Buck Boring Bar Company, Huntington, W. Va. It is stated that this expansion borer will complete the boring of a steel wheel in five minutes and a cast-iron wheel in less time. The principal feature of the bar is embodied in its four cutters, each of which has separate expansion. Each cutter is adjusted so as to divide into four parts the metal to be bored out. This makes the work easier for the cutters, gives longer life to the cutting edge and results in securing a standard size hole. The bar has a water attachment which supplies a small stream direct to the point of the cutting tools, thereby keeping the cutters cool and allowing the machine to be run at high speed. As the water is applied through the bar, there is no piping around the machine to encumber the operator. It has been found that with this bar one set of tool-steel cutters can bore 2000 steel wheels.

Expansion Borer

While the bar was designed for speed in taking two operations, the roughing cut and finishing cut separately, it will bore in one operation all that a boring mill can pull. It is being operated in this way. To take two operations with the bar, the finishing cutters are removed and, after taking the roughing cut, are replaced to take the finishing cut. It is asserted that this can be done in one-half the time required by other bars.

To adjust for the size of hole wanted, a gage is placed over the full width of the cutters, the latter being expanded to the gage. This has been found to be more correct than to graduate the expansion adjustment as provided on some other bars, for, in graduating the adjustment, the cutters must be kept ground perfectly square and exactly the same length. Since the cutters become shorter every time they are ground, the starting point is lost when they are replaced in the tool. This company's method of boring by gage makes the bar particularly applicable in railway shops where boring is required to fit various size wheel seats. Another important feature is that the cutters have a 2-in. range of expansion, so that one bar will answer for wheels with two sizes M. C. B. standard bore.

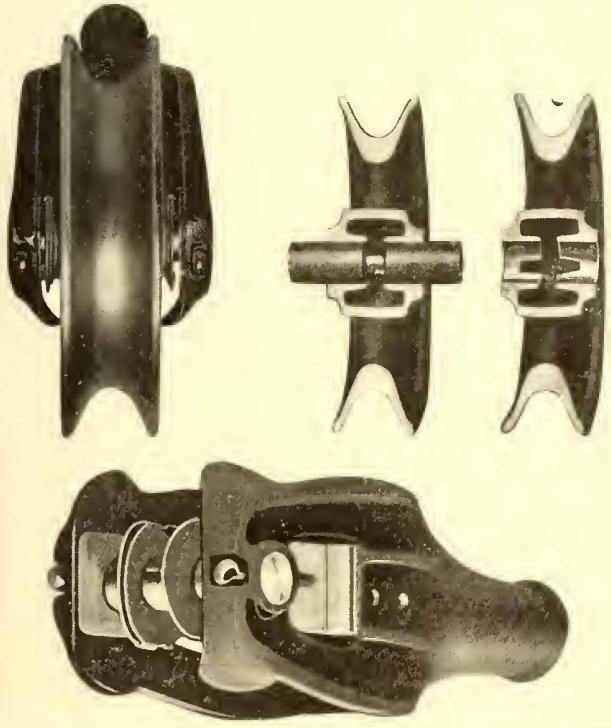
A CLAMP DERAILER

The Freeland derailer, manufactured by the Hobart-Allfree Company, Old Colony Building, Chicago, which has given satisfactory service on some of the largest interurban railway systems, has recently been improved by the addition of a "derail protection." The latter, when the derail is in the open position, secures it against damage from dragging brake-beams or other parts of the equipment. The derailer is so designed that it can be operated either mechanically or as a hand throw and thus may be adopted as standard by a railway which requires either or both methods of operation.

AN IMPROVED TROLLEY WHEEL AND HARP

Trolley wheels and harps of improved types manufactured by the Hensley Trolley Company, Detroit, Mich., are making excellent records in all classes of electric railway service. These devices are noteworthy because they have very few parts, each of which is designed so that the efficiency of any one is not sacrificed for another.

The Hensley trolley wheels are made of "Resisto" bronze, a composition which is said to afford especially long life to the wheel without unduly wearing the trolley wire. Several sizes of wheels are supplied, each for a particular class of service. The wheels are cast in one piece and provided with a large hub cored out to retain the lubricating material. No bushings are used and the wheels are mounted directly on machine-steel spindles ¾ in. in diameter, which are firmly held in the harps by cotter pins. The bearing is designed to outwear the rim of the wheel and that such results are obtained is said to be due to the improved method of lubrication. Continuous lubrication of the bearing is effected by a supply of grease or graphite compound enclosed in an annular well cored out of the wheel hub. This well surrounds the spindle and is connected to the wearing surfaces by several slots. The lubricating material is forced into the well through a hole drilled into the end of the spindle and terminating in a grease retaining ring cut around the center of the spindle. One advantage which this design of wheel has in addition to that of long life, is that a considerable amount of lubricant can be forced into the lubricant chamber through the end of the spindle without removing the wheel or uncapping an orifice. Other advantages credited to this device are the non-leakage of the lubricant, a small number of parts, simple method of lubricating, small liability of breakage and the resulting low maintenance cost.

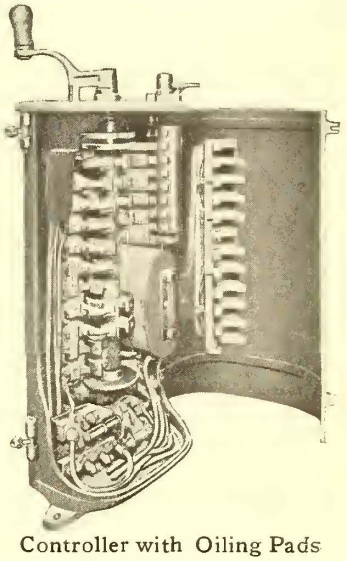


Trolley Wheel, Harp and Wheel Sections, Showing the Means for Lubrication

The Hensley trolley harps which carry the wheels of the same name are designed in several types suitable for all services. The contact washers used are made of half-tempered copper, which is tough, giving long service and high conducting capacity. The washers are provided with ears which bend back to form guideways for the springs, the combination of the two being self-adjusting and permitting a free movement on the spindle without any wedging action. The contact springs are made of tempered copper riveted firmly to the harp and the outer ends of these springs have straight edges to carry the contact washers in a central position so that they will mate with elongated openings in the spindles. The ends of the trolley harps have aprons which extend inwardly close to the web of the trolley wheel. These aprons protect the contact washers from damage in case the wheel leaves the wire and so the harp can be jockeyed into position without fear of damaging the overhead construction.

LUBRICATING CONTROLLERS WITH OIL PADS

Ever since car controllers have been used, it has been the custom to hand-lubricate the fingers and segments with vaseline to avoid wear and cutting. This method has worked fairly well where controllers were inspected, say, every three days. It is known, however, that the tendency of the fingers is to push the vaseline along until it lodges back of the segments from whence it is difficult to remove. Furthermore, after a few applications of the controller, the vaseline is burnt off of the points of contact where the lubrication is needed most. As the result, blistering and cutting sets in and unless frequent inspections are made, the metallic dust, roughened segments and bent fingers will result in the production of short-circuits and other expensive troubles.



Controller with Oiling Pads

To overcome these hindrances toward placing the controller on the same long mileage inspection basis as less sensitive electrical equipment, the Third Avenue Railroad Company, New York, began to install last summer a novel felt-oiling device for the controller on about 350 cars. As shown in the accompanying illustration this contrivance consists of a board carrying a row of oil pads spaced so as to come directly opposite the fingers and segments.

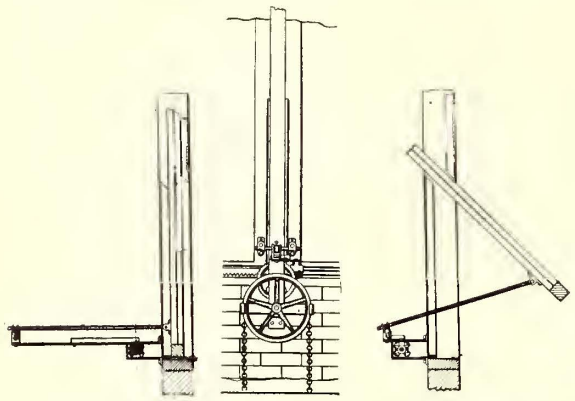
This board is set between the main and reverse cylinders on the back of the arc deflector, so that in turning the controller handle the segments lubricate themselves by rubbing against the oil-soaked felt pieces. The entire contrivance consists of the felt, a backboard of ¼ in. or ⅛ in. thickness, and a flat spring to hold the board in position. It has been found in the case of the Third Avenue Railroad's installation that controllers equipped with this device can easily be run for 3200 miles without lubrication. The controller shown in the illustration is used on a transfer table at the One Hundred and Twenty-ninth Street car house, and is operated, of course, on resistance points only. Despite this condition, the segments and fingers have required no attention after one year's service. It is the experience of the mechanical department of this company that this method of lubrication will at least double the life of fingers and segments.

This method was invented and has been patented by W. P. Wiswall, general foreman of the Third Avenue Railroad. Mr. Wiswall has already supplied a number of these lubricators to the Ithaca (N. Y.) Street Railway Company, United Railways & Electric Company, Baltimore, Md.; Union Railway Company, New York; New York & Queens County Traction Company, etc.

Consul Alonzo B. Garrett reports that a new electric street railway is about to be built in Nuevo Laredo, Mexico. The steel rails and ties are on the ground and the right-of-way secured. The line will extend from the tramway bridge to the custom house, and it is planned to extend it a little later to the machine shops of the National Railway Lines of Mexico.

SASH OPERATING DEVICE

The G. Drouvé Company, Bridgeport, Conn., the maker of the "Anti-Pluvius" puttyless skylight and the "Lovell" and other types of sash operators, recently has added to its lines the "Straight-Push" operator illustrated for the mechanical control of pivoted or hinged sash. Pivoted windows are not always made to fit their frames without binding and changes of weather and swelling of the wood often make a chisel and hammer necessary to open them. The man operating the sash sometimes does not take these facts into consideration and when the device refuses to answer to his efforts he either gets assistance or reinforces his own strength with an iron-bar. Something is sure to break under such conditions, particularly where worm and gear devices are used. In the design of the new "Straight-Push" operator, the direct pushing outward of

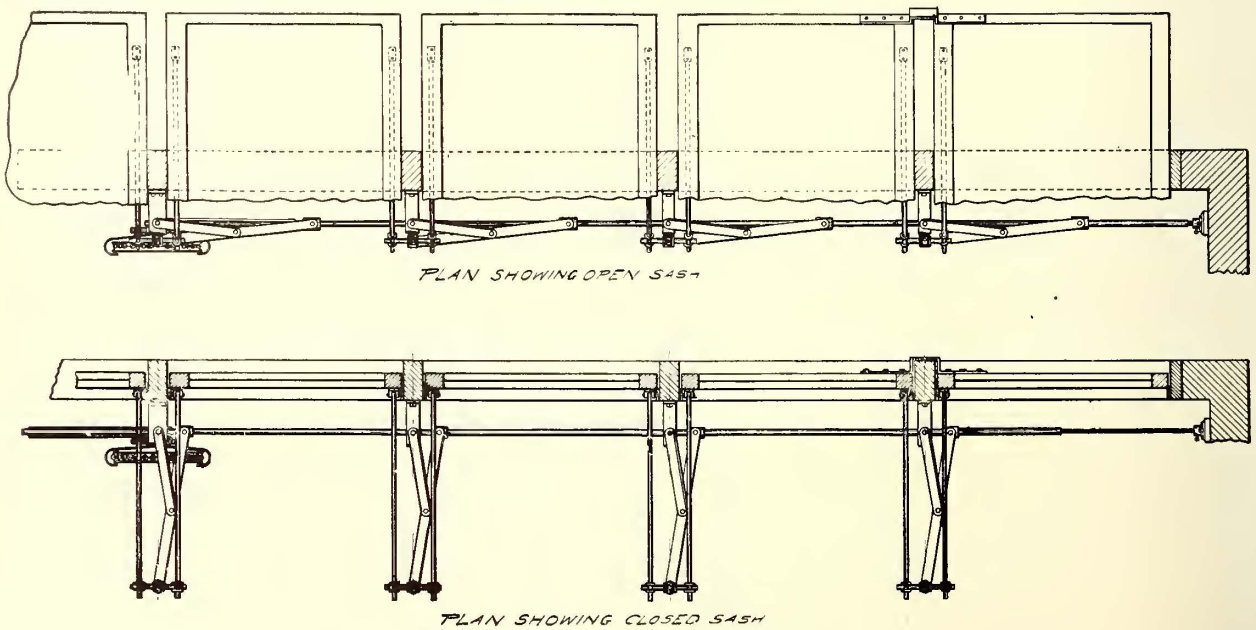


End Elevation of Window Operator, Open and Closed

the sash with two ½-in. steel rods by leverage, one arm being fastened to each side of the sash at the lower part of the side rail, insures the opening of the window. These two arms are adjustable to give a 30 deg. or 45 deg. opening. A line of ¾-in. pipe shaft to which the main lever is fastened at each sash with an open coupling is moved backward and forward between spool roller brackets at each interval between the windows. A rack and pinion with geared wheel, controlled by a floor chain, gives the forward and return movement. A guide lever is secured to the top of each bracket and in turn is fastened to the main lever. The unattached end of the main lever has a U-chair riveted to it which supports the shaft connecting the two steel arms. While the arms bind to the connecting shaft, the latter works freely in the U-chair support, allowing the arms to follow the inclination of the sash. The movement of the main shaft back or forth operates the levers at each window. As the arms are directed straight at each side of the sash and work simultaneously, the windows open or close as desired and with the same power of application throughout. Several different sizes of wheels are made for operating any number of sash from 10 to 100 under one control. The operating parts cannot rust together as the connections are phosphor bronze to iron.

This apparatus is adapted for pivoted side or pivoted top-and-bottom sash, top-hinged and bottom-hinged sash. The device is also adapted to meet unusual conditions as where a crane, while not interfering with the hinged or pivoted sash when opened, does interfere with the installation of operating parts in the usual positions. Instead of pushing the sash outward from the bottom, the sash are pulled inward from the top and are pushed closed; thus reversing the ordinary directions of opening and closing. In monitor or lantern construction where it would ordinarily be necessary to bring the operating chain down the underside slope of the roof and then to the floor, the operating wheel can be placed at the end of the building, with the chain coming down the end wall to give direct floor control. Idlers or pulleys can be used with this window operator to make corners with greater ease than is afforded by torsion shafts.

The sash can be opened as much as may be required for proper ventilation and held at any position. The straight arms act as a brace against wind pressure. In case of fire, rain or dust storms drafts, can be checked at once by the quick-closing characteristic of this sash operator. The safety valve of the device is the chain, which controls the operating wheel. This chain is heavy enough to operate any number of sash on the line and will stand a reasonable strain, yet it will part under an abnormal weight. Nevertheless it is easy to close an open link and to replace the chain on the wheel. The opening of the link will direct attention to the trouble. Only the offending binding windows need be dropped off the line until they have been planed by the carpenter. The working parts of the apparatus, therefore, are not broken nor are all the windows put out of commission. Otherwise replacements of vital working parts might be put off from time to time and bad conditions endured indefinitely.



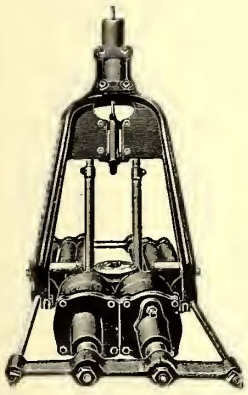
Plan and Side Elevation of Window Operating Mechanism, Open and Closed

An agreement has been entered into between the Mayor and the Anglo-Argentine Tramway, Buenos Ayres, Argentina, for the construction of an underground railway in Buenos Ayres in connection with the surface system.

A PNEUMATIC TROLLEY RETRIEVER

A novel combination trolley base and retriever which has been in use between Lockport and Buffalo, N. Y., since August, 1909, has been placed on the market by A. L. Prentiss & Co., of Buffalo. The basic features of this device are the application of compressed air from the air-brake system to operate the retrieving mechanism in the trolley base; and the hinged attachment of the harp to the pole by which the automatic control and connection of the air pressure system is assured. No light tension springs and dogs are necessary to make this retriever operate. The rope is used only to guide the trolley wheel back to the wire, so that it makes no difference whether it is taut, wet or frozen. There is no coiling drum at the end of the car, because the retrieving device is entirely self-contained in the base.

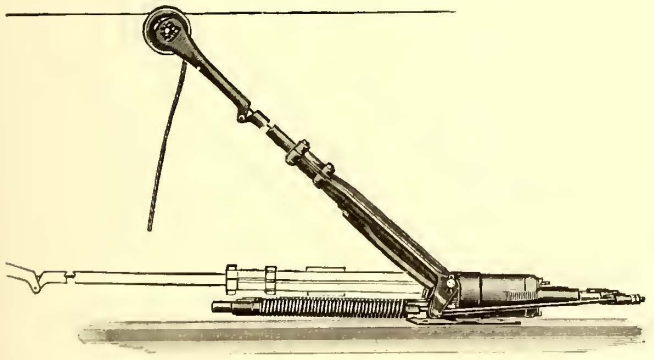
A very important point is that the pole does not have to ascend several feet, with the possibility of causing damage before it retrieves itself. The instant the wheel leaves the wire, the pole is drawn down on the top of the car, no matter what the height of the wire, the length of the pole or the pressure may be. The pole remains flat on the top of the car until the rope is pulled, when it immediately rises and is guided to the wire.



Trolley Base

The damage caused by jumping poles and wheels is so great that, rather than have the wheel leave the wire, it is necessary to use a much greater tension on the wire than is advisable, in spite of the fact that a high tension wears out the wire and wheel faster. Hence the use of a reliable retriever should result in the material reduction of maintenance charges and expenses for damages. It is hardly necessary to point out that when using a retriever the conductor can pay more attention to the care of his passengers, as he does not have to drop all other matters and rush for the rope when the wheel leaves the wire. The pole is out of the way until the conductor can reach the rear platform to restore it to its place.

The trolley base part of this mechanism works with powerful tension springs, after the manner of all standard trolley bases, and operates without reference to the air connections.

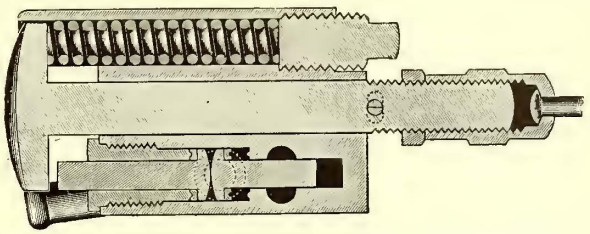


Hinged Pole Used with Pneumatic Retriever

It conforms in outline to the common standard, and may be as easily attached. The stand is of malleable iron with a 5-in. stud, over which is forced a hardened steel sheave 2⅞ in. in diameter. It is screwed to the running board in the usual manner. The base is of cast iron, having the center hole fitted with a hardened steel bushing in which are thirty-eight ¼-in. tool steel rolls to give it a very sensitive lateral motion. This feature gives easy adjustment between the pole and the wire, no matter what outline the wire may take, and also takes off all lateral pressure from the wheel and wire on curves.

Two 4¼-in. diameter cylinders extending forward are fitted with cylinder heads having long stems to support the piston rods on which a cross-head is fitted. This cross-head is connected to the toe of the yoke by the two side rods that have free movement in the cross-head, allowing the piston to remain stationary as the pole moves up or down to adjust itself to varying heights of the wire. From the base there extend rearward two standards which are threaded and fitted with nuts, and against these a cross-head rests for tensioning the springs.

The toe is arranged so that several connections can be made,



Section Showing Spring Which Elevates Harp, Spring-Tension Screw, Air Valves, Etc.

each affording a different leverage to allow the retriever to be properly connected to air-brake systems having pressures ranging from 60 lb. to 100 lb., and irrespective of the wheel pressure. The yoke is of malleable iron and is hinged to the base by two ⅞-in. steel studs held by cotter pins. The pole is screwed to the yoke in the usual manner. There is bolted to the yoke, near the pole end, a valve section made of solid cast bronze, which eliminates the question of rust, and which is so situated as to be free from dust and grease. This valve section is connected to the base by two flexible tubes, one of which leads to a port entering both cylinders and the other through the base to the air-brake system. The springs are of the expansion type, four to a base, 1⅞ in. outside diameter, 15 in. long, and 13-32 in. round. Nuts are screwed into the ends, to expand the springs.

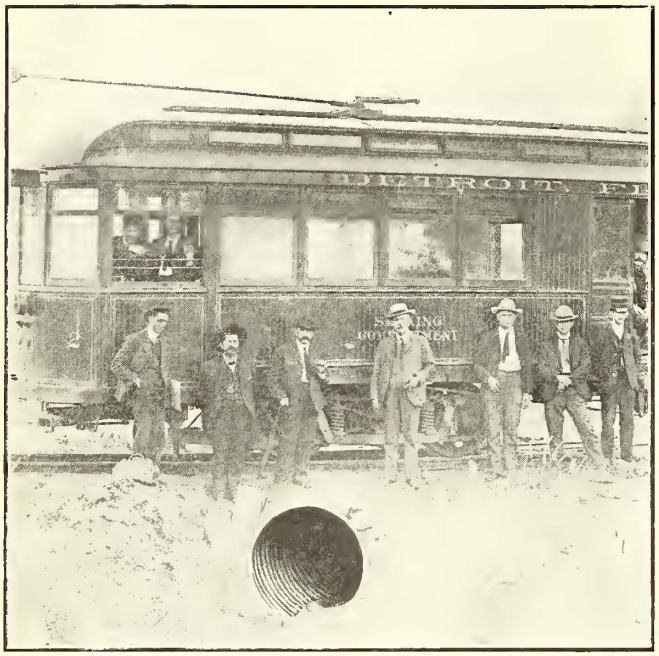
The pole is of the standard tubular pattern. The harp, instead of being attached rigidly to the pole, is hinged to it. Running from the harp through the center of the pole is a rod that manipulates the valves to the air chambers of the cylinders in the trolley base. When there is a pressure on the wheel or harp, the valve that admits the compressed air is closed and an exhaust valve is opened. The tension spring then keeps the wheel on the wire. When the pressure is removed from the wheel or harp, as when the wheel leaves the wire, the valve admitting the air to the cylinders opposite to the tension springs opens, the exhaust closes, and the air pressure is regulated to be more powerful than the spring, the pole is instantly forced to a horizontal position on the top of the car. From this position a slight pull on the rope attached to the hinged harp shuts off the air pressure, when the tension springs cause the pole to rise, and it is readily guided to the wire.

NEW PRUSSIAN SINGLE-PHASE RAILWAY

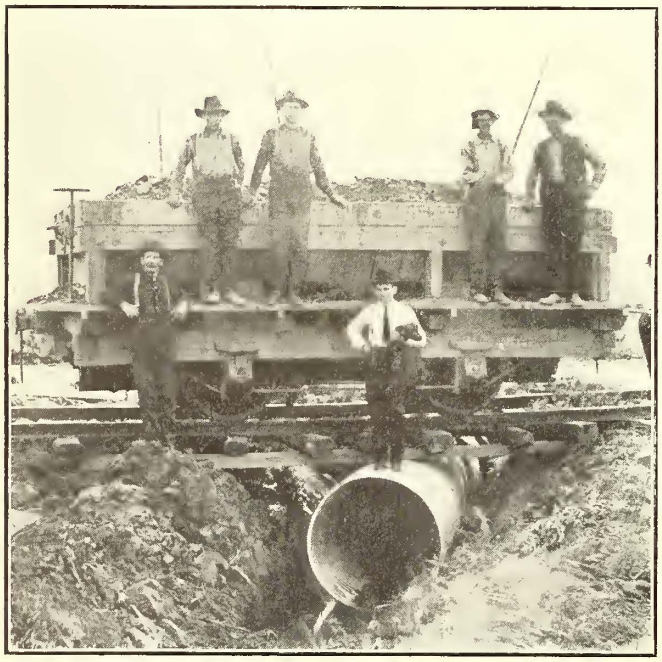
The Prussian State Railways are preparing to equip for single-phase operation a 30-km (18.6 miles) section of steam railroad track, comprising the main line division between Bitterfeld and Dessau. The general design of the overhead construction and car equipment is to follow that of the Hamburg-Altona line with the significant difference that the motors will be built for 15 cycles instead of 25 cycles. The power house, which will be located at Bitterfeld, is to have a two-pole, 900 r.p.m., 3000-kw turbo-alternator. The present electrification will cost about 2,000,000 marks ($480,000) and if successful will be followed by the electrification of the lines between Leipzig, Magdeburg and Halle at an additional cost of 26,000,000 marks ($1,248,000).

CORRUGATED IRON CULVERT PIPE

Cast-iron and vitrified clay pipes and reinforced concrete structures up to the present time have been commonly used for small drainage openings in embankments. Cast-iron pipe combines strength with reasonable durability, but is expensive and difficult to transport and set. Vitrified tile, while it does not decay, is fragile and requires a deep cover over it in order to withstand concentrated loads. The economy of reinforced concrete structures depends very largely on the local conditions under which they are built. Since the recent production on a commercial scale of iron sheets of 99.94 per cent purity and remarkable rust-resisting properties it has been possible to manufacture corrugated culvert pipes of this metal which weigh only about one-tenth as much as cast-iron pipes of the same size, with equal or greater strength against crushing. The cost is less than half that of cast-iron pipe and the life is estimated at not less than 40 years under the most unfavorable conditions.



Corrugated Iron Culvert Pipe, 36 in. in Diameter, with Shallow Cover Supporting Interurban Car Without Deflection



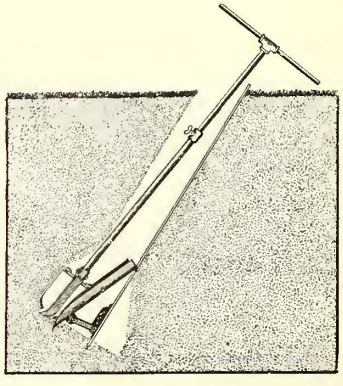
Corrugated Iron Culvert Pipe Supporting Track Laid Directly Upon It

The American Rolling Mill Company, of Middletown, Ohio, is now rolling from ingots made by a special process sheets of iron containing less than 0.06 per cent of impurities, and is furnishing these sheets to a number of manufacturers throughout the country, who are making from them corrugated pipe of all sizes and thicknesses. The iron from which these sheets are made is purified in the molten state and the slag formed during the process rises to the surface. The removal of this slag leaves the metal free from entrained impurities and improves its physical properties of tensile strength, elongation and reduction of area. This almost chemically pure iron has the quality of resisting corrosion to a marked degree, due to its homogeneity and freedom from manganese and carbon, which impurities set up local electrolytic action, the primary cause of rust. As an example of the comparative resistance to corrosion of this new product and ordinary steel, the loss in weight of a sample of steel immersed for 24 days in a 5 per cent solution of sulphuric acid was 14.41 per cent, while a sample of iron lost only 0.21 per cent, or but one-seventieth as much as the steel sample.

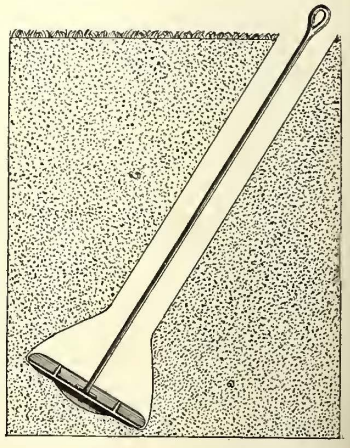
Corrugated pipes made from sheets of this rust-resisting iron combine great strength with light weight and long life. They may be used under depth of cover or set so close under the rails as to bear the direct downward thrust of the ties. Their light weight is an advantage as the cost of hauling and difficulty of setting is materially reduced. They may be embedded in an earth embankment without end protection or finished at the ends with concrete face walls, as desired.

NON-CREEPING POLE GUY ANCHOR

The accompanying engravings illustrate a new anchor for pole guy wires and a special auger deflector for placing the anchor in the ground. The anchor plate is large enough to resist any pulling strain up to the tensile strength of the rod and it bears against solid ground in the enlarged bottom of the hole; the anchor, it is claimed, will not creep. To install these anchors a hole of uniform diameter is bored to the desired depth with an ordinary dirt auger. The special deflector is then inserted in the hole and the points pushed well into the ground to hold it in place. By turning the auger in the deflector one-half of the bottom of the hole is enlarged. To enlarge the other half the deflector is turned half-way around in the hole and the operation repeated. The bottom of the hole can be enlarged in from 5 to 10 minutes.



Enlarging Bottom of Hole with Deflector



Safety Guy Anchor Set in Enlarged Hole

These anchors are made in five sizes with either galvanized or black finish. The deflector is adjustable and may be used for setting any size of anchors. Both devices are made by the Miller Anchor Company, Norwalk, Ohio.

LONDON LETTER

(From Our Regular Correspondent)

The thirteenth annual meeting of the Tramways & Light Railways Association was held in February, 1910. Arthur Stanley, who presided, referred to the satisfactory financial condition of the association, and said that the chief events in the history of the association during the year were the adoption by the inland revenue authorities of the standard allowances for depreciation for income tax assessment, and the appointment by the board of trade of an arbitrator to determine who should bear the cost of fuses and heat coils inserted in the post office telegraphs. The arbitrator's decision was unfavorable to the association. Three special committees were at work at present. One was a reconstituted and enlarged committee on brakes and braking arrangements; the second was a committee to test various speed indicators designed for tramways, of which there were 16 under trial; the third was a committee to consider the advisability of the association taking up the case of the Blackpool & Fleetwood Company's appeal in regard to rating. At the annual dinner and smoker held at the Gaiety restaurant, the Duke of Argyll occupied the chair. Sir Henry Cunyngham proposed the toast, "The Tramways and Light Railways Association." The amount of capital invested in tramways and light railways in Great Britain was £70,000,000, the length of the lines 2526 miles, and the number of passengers annually 2,660,000,000. The annual congress of the association will be held at Dublin on May 12 and 13, 1910, as announced in the Electric Railway Journal of March 19, 1910, page 501.

Reference has previously been made to a proposed bill to be promoted in Parliament this year for an underground railway from the Strand to the Crystal Palace, to be operated by the Kearney underground system, which was demonstrated recently at the Crystal Palace. The system is a modification of the monorail, with an overhead rolling contact to retain the cars in an upright position. It is intended to use one tube, with a double tube turn-out or siding at the stations. The road as proposed would extend from the Oval to Cricklewood, with stations at Vauxhall, Pimlico, Victoria, Hyde Park Corner, Marble Arch, Edgware Road, Lord's and Brondesbury, and from the Oval, via Kennington Road and Waterloo, to the Strand. It is also intended to construct a line on the surface from the Oval to the Crystal Palace, with stations at North Brixton, East Brixton, and Herne Hill.

As mentioned in the Electric Railway Journal of March 5, 1910, the recent London County Council elections have resulted in a large amount of literature being issued on the subject of tramways, in favor of both the Progressives and the Moderates. It is now maintained that the tramway system of London has decreased the death rate of the city. In 1905 the death rate was 159 per 10,000, whereas in 1909 the rate was only 142 per 10,000. The efficient and cheap service of the tramways is said to have enabled hundreds of thousands to move from the overcrowded districts in the heart of the metropolis to cheaper, better and healthier homes in suburban districts. Of course, the improvements in drainage, supply of pure milk, etc., have all helped to decrease the death rate, but electric railways without doubt have been the most important contributing factor.

The mileage of the tramways in London has increased from 58½ miles in 1907 to more than 110 miles in 1910. In 1909 nearly 413,000,000 passengers were carried, an increase of nearly 122,000,000 since 1907. During the same period the number of cars in operation has been increased from 671 to 1170. About £1,500,000 is being expended annually on new tramways. The number of workmen's tickets which are used has also increased. The cheap fares now commence at 1:30 a. m. instead of at 5 a. m. Under the new system of keeping the tramways accounts the balances go to the reserve fund instead of being applied for the relief of the rates. In 1907 the debt outstanding was £6,133,564, the renewal fund £141,855, and the total reserve £141,855. In 1909 the total debt outstanding was £8,126,697, but the renewal fund had increased to £264,837 and the total reserve to more than £300,000. In the system used by the Progressives the renewal fund was used for the ordinary purposes of the undertaking, but as the auditors held it should be properly invested, the Reformers have invested the money in securities. The lines do not show a greater profit because it has been decided to reduce the fares to a point where the revenue would build up substantial renewal and reserve funds and nothing more.

The Wigan Corporation, which was considering a proposal from the Lancashire United Tramways to purchase the electrical undertakings belonging to the Corporation, which include trams in majority of the townships in the Wigan Union, has refused to entertain the proposal for the time being. The Lancashire United Tramways is said to feel that many economies could be worked in the operation of the lines of the Wigan Corporation through joint management and operation. The Lancashire United Tramways took over the Farnworth Tramways some time ago when that system was losing £2,000 a year and has so managed the property since then that the deficit has been converted into a surplus. If the proposal to purchase the Wigan tramways should be accepted, it is understood that a new company would be formed.

While the cable tramways of Edinburgh are, perhaps, the most successful in Great Britain, the inflexibility of the system is strikingly emphasized where short extensions are to be built. Heretofore, all efforts to induce the Corporation to introduce electricity have failed, but in March, 1910, the tramway committee of the Council finally agreed to recommend the construction of an overhead electric railway from Ardmillan Terrace to the new Markets at Gorgie. The amount of the contract is £12,265 and the contractors are Dick, Kerr & Company, who have guaranteed to finish the work by May 14, 1910. The proposal to construct an electric tramway was brought before the committee two months ago, and the action recently taken marks the beginning of electric traction in Edinburgh.

The scheme for the electrification of the Isle of Wight railways and the alternative scheme for the construction of light railways or electric tramways, which have been under consideration by a representative committee composed of the members of the different public bodies in the island, have been abandoned. It was reported by the chairman of Isle of Wight Central Railway at the last conference that the advantages of electrical working of a mixed traffic of passengers, goods and minerals have not yet been demonstrated by the experience of other railway companies in the country, and in the absence of such experience the companies were not prepared to propose the conversion of their lines. Such a contention is, of course, wrong, as the North Eastern Railway operates such a railway at Newcastle, but the report is sufficient to kill the project for the time being.

One of the most up-to-date generating stations in Great Britain has just been opened by Prof. Ewing of the British Navy at Dundee. For many years Dundee has struggled with a totally inadequate power supply from its electric lighting station, built many years ago and increased by small units until it has become a heterogenous mass of machinery, representing various stages of the art. The new Stanergate station is the result of the advice of Mr. Richardson, electrical engineer, who was formerly at Newcastle. It has been built on the water side and is equipped with the most modern boilers, coaling machinery and turbines.

The Belfast Corporation has decided to extend its generating plant by adding a 1500-kw Willans impulse disk and drum type turbine, coupled to a direct-current dynamo, in view of the opposition to the adoption of direct-current turbines when the previous contracts were settled during February, 1907. On that occasion two 1000-kw units were required. After the matter had been twice referred back from the Council to the tramway and electric lighting committee, it was finally decided to place an order with Willans & Robinson for the supply of the two 1000-kw direct-current sets. These units have now been in daily operation for two years, and their performance compares favorably with dynamos running at more moderate speeds. Mr Bloxam, the city electrical engineer of Belfast, has also recommended the Council to install a further unit of 1500-kw capacity, and as it is intended to obtain this output from one dynamo, the present unit will be the largest single direct-current turbine set installed in England, the largest sets at present being the two 1200-kw units which Willans & Robinson have in hand for the Admiralty for the Devonport Dockyard.

A. C. S.

News of Electric Railways

Hearings on Subway and Elevated Service in New York

Hearings were held before William R. Willcox and John E. Eustis, of the Public Service Commission of the First District of New York, on March 28, regarding the service on the elevated lines of the Interborough Rapid Transit Company and the extension of the Broadway express and local service in the subway. A rehearing was held on the same day regarding service in the subway. H. H. Whitman acted as counsel for the commission. The Interborough Rapid Transit Company was represented by T. L. Waugh, of counsel; Frank Hedley, vice-president and general manager, and George Keegan, assistant to Mr. Hedley.

Mr. Hedley said that the new service in the subway provided a seat for every passenger during the non-rush hours, and that during the rush hours the company was running as many trains on both its local and express tracks as was physically possible. The headway on the local trains during the non-rush hours was 2½ minutes, 3 minutes and 3½ minutes at different times of the day. It takes about 30 days to equip a car, and the company was putting new cars in the service as fast as possible.

E. G. Connette, transportation engineer of the commission, presented figures which substantiated the statements made by Mr. Hedley.

Regarding the elevated lines, Mr. Hedley said that the service now given was in accordance with the schedule which he had proposed at the previous hearing. During the non-rush hours sufficient cars were operated to provide seats for every passenger and during the rush hours the company was running as many trains as possible. The longest headway was about 4 minutes. The new schedule had increased the service materially, but Mr. Hadley was not prepared to say just what the increase was in percentage.

Mr. Connette said that observations showed that cars were operated on the elevated lines in accordance with the proposal previously made by Mr. Hedley.

In conclusion, Mr. Hedley said that he did not think that the commission ought to issue a formal order regarding the operation of trains on the elevated lines, as such an order would require him to operate strictly in accordance with the schedule from day to day, whereas traffic frequently fluctuated and the necessity existed for withdrawing trains at short notice. The hearing on the elevated service was then closed.

The hearing regarding the extension of the Broadway express and local service was called as a result of a petition to the commission by the Washington Heights Property Owners' Association. It had to do largely with the details of the operation of trains from the district represented by the association. Charts were presented by Mr. Connette to show the distribution of traffic, the number of trains, the number of seats provided and the headway of trains.

Cleveland Traction Situation

Officers of the Cleveland Railway and G. H. Dahl, street railway commissioner, have failed to agree upon the proportion of the cost of reconstructing tracks that should be charged to capital account. The representatives of the company contend that the difference between the Goff-Johnson valuation of the tracks and the cost of replacing them should be charged to capital, but Mr. Dahl insists that the difference between the cost of the new track and the first cost of the track now down should be charged to capital, the remainder to be taken from the profits. The discussion was precipitated by the announcement of the company that plans were being made to renew the track on 10 lines of the system at an estimated cost of $734,173. The City Council was requested to approve the proposed betterments and add $525,300 to the capital value.

On March 21 Commissioner Dahl was officially notified by the company that the 3-cent fare would not be extended to Collinwood. The company stated that it could not grant a fare different from what is provided in the Tayler ordinance to any part of the city or the suburbs; that a new ordinance, amending the original, would be subject to a referendum vote; that any concessions made to Collinwood would have to be repeated in the case of the admission of other suburbs to the city, and that as the company was now operating under the initial fare fixed by the Tayler ordinance, within the limits prescribed at the time of its adoption, the officers believed it unwise to modify conditions until the expiration of the eight months stipulated for experimental operation.

Following a suggestion from Mr. Dahl notices have been placed in all the cars to the effect that full fare will be charged in the suburbs unless passengers inform conductors at the time they pay their fare that they desire a suburban fare slip.

The company has declined to negotiate with the Humphrey Company on the subject of reducing the fare to Euclid Beach. Smith, Taft & Arter, attorneys for the Humphrey Company, claim that the franchise granted by East Cleveland provides for the lower fare to Collinwood and Euclid Beach, just as it does for Euclid Avenue in the other direction and that, if cars are routed by way of Euclid Avenue, as formerly, the company cannot refuse. Council has control of the car routing. The attorneys make their claim under a franchise granted in 1896, when Collinwood and Euclid Beach were both within the boundaries of East Cleveland.

Retail merchants of Cleveland propose to take up, at once, actively, the question of securing a union depot for the interurban lines entering Cleveland. A ticket office and waiting room are maintained in the Forest City Building, but the merchants desire something more commodious. Reports of the Chamber of Commerce show that 4,600,000 passengers were handled in 1909 by the electric railways operating into Cleveland.

Tom L. Johnson, ex-Mayor of Cleveland, has sailed from New York on the *Mauretania*. Other than that he was going to Europe in the hope of benefiting his health, Mr. Johnson refused to make any statement.

Association Meetings

Missouri Electric, Gas, Street Railway & Water Works Association.—Jefferson City, Mo., April 14, 15 and 16.

Central Electric Traffic Association.—Lima, Ohio, April 16.

Iowa Street & Interurban Railway Association.—Sioux City, Ia., April 21, 22 and 23.

Arkansas Association of Public Utility Operators.—Pine Bluff, Ark., April 27, 28 and 29.

New England Street Railway Club.—Boston, Mass., April 28.

Oklahoma Public Utilities Association.—Sapulpa, Okla., May 10.

Southwestern Electrical & Gas Association.—Beaumont, Tex., May 12, 13 and 14.

Pacific Claim Agents' Association.—San Francisco, Cal., May 20 and 21.

Central Electric Railway Association.—Toledo, Ohio, May 26.

Central Electric Accounting Conference.—Toledo, Ohio, June 25.

Street Railway Association of the State of New York.—Cooperstown, N. Y., June 27 and 28.

Colorado Electric Light, Power & Railway Association.—Glenwood Springs, Col., Sept. 21, 22 and 23.

Franchise Question in Toledo.—W. W. Miller, representing the bondholders' committee of the Toledo Railway & Light Company, Toledo, Ohio. has informed the City Council of Toledo that Albion E. Lang, president of the company, has been requested to communicate directly with the Council relative to negotiations for a new grant..

Franchise Extension Granted a Canadian Company.—A by-law was carried by the ratepayers of Sherbrooke, Que.,

on March 21, 1910, extending the franchise of the Sherbrooke Street Railway 28 years. In return for the franchise the company promises to spend $500,000 in extensions and in developing a power plant. The company has an option on the water power of the Magog River, which runs through the city.

Announcement of Underground Line for Montreal.—W G. Ross, president of the Montreal (Que.) Street Railway, has announced that an underground railway will be constructed in Montreal underneath St. James Street from St. Lawrence Street to Victoria Square, as soon as the necessary legislative authority is obtained. Mr. Ross places the cost of the construction of the first section of the proposed line at about $1,500,000 per mile.

Entertainment of New Jersey Employees.—The third annual smoker of the New Jersey Street Railway Employees Benevolent Association, composed of employees of the Public Service Railway, Newark, N. J., was held at Newark on March 25, 1910. Delegates were in attendance from every division of the company. Thos. N. McCarter, president of the company, addressed the men. Mr. McCarter said that the officers keenly appreciated the service which the men were called upon to perform. He referred to the increase in wages granted on Jan. 1, 1910, and said that the details of a pension fund for the men were now being arranged. Mr. McCarter paid a special tribute to the work of Newton W. Bolen, superintendent of transportation of the company.

Convention of the Engineering Society of Pennsylvania.—The second annual convention of the Engineering Society of Pennsylvania will be held at Harrisburg on June 1, 2 and 3, 1910. The program of the meeting is still to be announced. It has been decided, however, to follow the practice begun last year of holding an exhibition in connection with the convention, and arrangements have been made for displaying apparatus in the new reinforced concrete building of the Central Pennsylvania Traction Company at Cameron and Forster Streets, Harrisburg, where approximately 26,000 square feet will be available. Fred W. Cohen, of the bridge and construction department of the Pennsylvania Steel Company, is chairman of the exhibition committee, and has prepared a circular showing the location of booths for the proposed exhibits and also a circular giving complete details regarding the arrangement of the booths, exhibition hours, the transportation of goods to and from the exhibit hall, etc.

Subway Plan Proposed in Providence.—A plan has been submitted to the Council of Providence, R. I., for the construction of a subway to relieve congestion on the lines of the Rhode Island Company in the downtown section of the city. The lines at present have their terminals at either of two places less than 300 yards apart, Market Square or at Dorrance and Westminster Streets. The business center of Providence lies on Weybosset Street and Westminster Street, mainly, and they form a bow, about half a mile long, with Westminster Street as the connecting link. Westminster Street is very narrow and only one track is laid there. Consequently all cars on Westminster Street run out of the city, while Weybosset is used in either direction. Additional lines of the Rhode Island Company are operated on Washington Street, so that the out-going traffic on Westminster Street is practically the same as the total incoming traffic. The subway as proposed provides a tunnel from the junction of Weybosset and Westminster Streets at Cathedral Square, under Weybosset Street to Dorrance Street, thence under Westminster Street with a loop near the Union station. The line would be 2200 ft. long and would cost about $752,000.

Decision Sustaining Franchise in Portland, Ore.—The Oregon Supreme Court has handed down a decision which in effect sustains the franchise covering parts of 40 streets passed over the Mayor's veto on April 28, 1909, by the City Council. The case which was appealed from Multonomah County involves the construction of the initiative and referendum laws of the State and of Portland. The ordinance was passed by the City Council on April 14, 1909; vetoed by the Mayor on April 26, 1909; passed over the veto on April 28, 1909. The company accepted the ordinance on May 14, 1909, and began building the tracks authorized by the ordinance. Within 30 days after the passage of the latter by the Council a petition to refer it to the people was filed with the City Auditor. The charter of Portland provides that initiative petitions shall be filed within 15 days of the passage of a franchise ordinance, while section 11 of the State Laws of 1907 provides that such petitions shall be filed within 30 days. The Supreme Court holds that in cases of this kind the city charter, and not the State law, controls, and that, therefore, the ordinance became effective on May 13, 1909, and the referendum petition filed on May 25, 1909, was not filed within the time prescribed by law, and for that reason insufficient to prevent the enforcement of the ordinance.

LEGISLATION AFFECTING ELECTRIC RAILWAYS

Illinois.—The special session of the Legislature of Illinois, convened by order of Governon Deneen on Dec. 14, 1909, adjourned on March 2, 1910. Twenty-two bills were passed and positive action was taken on 16 of the 24 subjects included in the call. The most important measure to the electric railway interests, the Chicago subway bill, was permitted to languish after being advanced to third reading in the Senate. A commission of six employers and six employees was authorized to consider the question of employers' liability and report all such recommendations as four of each group can agree upon not later than Sept. 15, 1910. The members of the commission representing the employers follow: Ira G. Rawn, president of the Chicago, Indianapolis & Louisville Railroad, Chicago; E. T. Bent, secretary of the Illinois Coal Operators' Association, Chicago; P. A. Peterson, furniture manufacturer, Rockford; Charles Piez, president of the Link Belt Machinery Company, Chicago; Mason B. Starring, president of the Northwestern Elevated Railroad, Chicago; Robert E. Conway, manufacturer, East St. Louis.

Maryland.—The Marbury public utility bill, recently introduced in the Legislature, has been so amended that the number of commissioners is reduced from five to three, and $5,000 is added to the working fund of the commission. The commission is also empowered to examine into the management and conduct of public service corporations, take such testimony as may be deemed advisable by it, require the attendance of witnesses and the production of books and papers, and order examinations by expert accountants. The commission is to recommend to the Governor and Legislature such change in rates, tolls and fares as may be thought necessary, and to prepare bills to carry out these recommendations, which are to be submitted to the Legislature.

Massachusetts.—The committee on street railways has reported against the bill limiting street railway locations at the side of a highway in towns of specified size. The bill to authorize railroads to operate their lines by electricity or other power subject to the approval of the Railroad Commission has passed to a second reading in the Senate. An attempt has been made to revive the bill accompanying the petition for legislation to provide for State and city ownership of street railways. The bill was reported unfavorably by the committee on street railways, but the report has not yet been acted upon by the House. The committee on metropolitan affairs has heard the bill for locating the terminus of the Riverbank Subway near the intersection of Beacon Street and Commonwealth Avenue instead of at Charlesgate East. The House has accepted the report of the committee on street railways against the bill authorizing the transportation of baggage, express matter and freight over the lines of street railways, elevated railways and electric railways. The House has accepted the adverse report of the same committee on the bills for legislation to prevent the issuing of passes and tickets at reduced rates by railroads and street railways and to provide for the establishment of waiting stations for passengers by street railways.

New Jersey.—The Governor has signed the Wakelee public utility bill, and the complete text of the measure is printed on page 626 of this issue. A bill has been introduced in the House to make it a misdemeanor to sell or give away a transfer. An effort is being made to revive the rights granted some time ago to the State Line Trolley Company, which proposes to build an electric railway from Paterson to Rutherford.

Financial and Corporate

New York Stock and Money Market

March 29, 1910.

After several days of depressive inactivity prior to the Easter holidays, and after a rather sharp break yesterday the stock market to-day gave some evidence of a return to confidence. Prices were better and trading more active. Traction stocks were as active as any other issues. This was especially true with regard to Interborough-Metropolitan. Large blocks of this stock have been traded in and the prices have held steadfast in the face of a declining market.

The money market continues satisfactory. The banks are well equipped with cash and rates are unchanged. Rates to-day were: Call, 2¾ to 3 per cent; 90 days, 4 to 4¼ per cent..

Other Markets

There has been practically no improvement in the market for traction stocks in Philadelphia, except that the pressure to sell has been removed in a measure and transactions have been fewer.

In the Boston market there has been no change in the situation. Small blocks of Boston Elevated and Massachusetts Electric continue to find their way into the market, but prices are practically unchanged.

In the Chicago market, the traction stocks have been almost entirely ignored during the past week. Except for a few shares of Metropolitan Elevated preferred, at former prices, there have been no sales.

There have been no traction stocks traded in on the Baltimore Exchange during the past week. The bonds of the United Railways continued to be reasonably active. Prices are unchanged.

Quotations of various traction securities as compared with last week follow:

	Mar. 22.	Mar. 29.
American Railways Company	a45½	a45¼
Aurora, Elgin & Chicago Railroad (common)	*57¾	*57¾
Aurora, Elgin & Chicago Railroad (preferred)	*94¼	*94¼
Boston Elevated Railway	129	128
Boston & Suburban Electric Companies	a16	a16
Boston & Suburban Electric Companies (preferred)	a76	a76
Boston & Worcester Electric Companies (common)	a10½	a10½
Boston & Worcester Electric Companies (preferred)	a46	a46
Brooklyn Rapid Transit Company	77½	77
Brooklyn Rapid Transit Company, 1st pref. conv. 4s	84¾	84⅛
Capital Traction Company, Washington	*133	a133
Chicago City Railway	*195	a185
Chicago & Oak Park Elevated Railroad (common)	*3½	*3½
Chicago & Oak Park Elevated Railroad (preferred)	*7½	*7½
Chicago Railways, ptcptg., ctf. 1	a106	a106
Chicago Railways, ptcptg., ctf. 2	a33	a33
Chicago Railways, ptcptg., ctf. 3	a19	a16
Chicago Railways, ptcptg., ctf. 4s	*0⅛	a9
Cleveland Railways	*91½	*91½
Consolidated Traction of New Jersey	a76½	a76½
Consolidated Traction of New Jersey, 5 per cent bonds	a105½	a106½
Detroit United Railway	*62	*65
General Electric Company	154½	150
Georgia Railway & Electric Company (common)	107	109½
Georgia Railway & Electric Company (preferred)	a88	a90
Interborough-Metropolitan Company (common)	23½	22¾
Interborough-Metropolitan Company (preferred)	59⅛	58¼
Interborough-Metropolitan Company (4½s)	82	81¼
Kansas City Railway & Light Company (common)	a30½	28
Kansas City Railway & Light Company (preferred)	*75	a78
Manhattan Railway	137⅛	136⅞
Massachusetts Electric Companies (common)	a18	a18
Massachusetts Electric Companies (preferred)	a84	84
Metropolitan West Side, Chicago (common)	a16½	a16½
Metropolitan West Side, Chicago (preferred)	a53	a52
Metropolitan Street Railway	*15	*15
Milwaukee Electric Railway & Light (preferred)	*110	*110
North American Company	*81¼	76½
Northwestern Elevated Railroad (common)	a17	a16
Northwestern Elevated Railroad (preferred)	60	a68
Philadelphia Company, Pittsburg (common)	a51¼	a51¼
Philadelphia Company, Pittsburg (preferred)	a44	a44½
Philadelphia Rapid Transit Company	a22	a21½
Philadelphia Traction Company	87	a87
Public Service Corporation, 5 per cent col. notes	*100⅛	*100⅛
Public Service Corporation, ctfs	a105½	a105½
Seattle Electric Company (common)	a115	a114
Seattle Electric Company (preferred)	*102	a102
South Side Elevated Railroad (Chicago)	a53	a53
Third Avenue Railroad, New York	7½	6½
Toledo Railways & Light Company	*11¾	11
Twin City Rapid Transit, Minneapolis (common)	115¼	115¼
Union Traction Company, Philadelphia	a49	a49¼
United Rys. & Electric Company, Baltimore	a13½	a13⅝
United Rys. Inv. Co. (common)	*37	*37
United Rys. Inv. Co. (preferred)	*67	*67
Washington Ry. & Electric Company (common)	*40	a39½
Washington Ry. & Electric Company (preferred)	*90½	a91
West End Street Railway, Boston (common)	a94½	a92
West End Street Railway, Boston (preferred)	a106	a106
Westinghouse Elec. & Mfg. Company	a70	64
Westinghouse Elec. & Mfg. Company (1st pref.)	*125	*125

aAsked. *Last Sale.

New York State Railways Reorganization

The Public Service Commission of the Second District of New York has authorized the New York State Railways in carrying out its plans of financial reorganization to increase its capital stock from $25,140,200 to $25,860,200 and to issue the increased amount of $720,000 for the following purposes:

1. To purchase and acquire 3340 shares of preferred stock of Rochester & Suburban Railway, $334,000.

2. To purchase and acquire 668 shares of common capital stock of Rochester & Suburban Railway, $66,800.

3. To purchase and acquire 1739 shares of stock of the Rochester Railway, $173,900.

4. To purchase and acquire 1000 shares of stock of Ontario Light & Traction Company, $100,000.

The stocks above described being now owned by the Mohawk Valley Company and the purchase thereof being made by exchanging stock of the New York State Railways to the amount of $674,700, par value, for the same.

5. To purchase and acquire 160 shares preferred stock of the Rochester & Suburban Railway, $16,000.

6. To purchase and acquire 32 shares of common stock of Rochester & Suburban Railway, $3,200.

7. To purchase and acquire 261 shares of stock of the Rochester Railway, $26,100.

The stocks described under conditions 5, 6 and 7 are owned by persons or corporations other than the Mohawk Valley Company and with the stocks owned by that company make up the entire stocks of the companies named. The stock of the New York State Railways to the amount of $43,500, par value, may be exchanged for said other stocks par for par or may be sold at par and the proceeds used for such purposes.

The New York State Railways is authorized to purchase, acquire and hold the entire capital stocks of the Rochester & Suburban Railway, Rochester Railway and Ontario Light & Traction Company.

The New York State Railways is authorized to execute and deliver a first consolidated and refunding mortgage upon all its property, to secure not more than $35,000,000 of 50-year 5 per cent gold bonds.

The New York State Railways is authorized to issue its bonds upon the security of this mortgage to the amount of $2,435,000, the bonds in question to be used for the following purposes:

a. To refund the outstanding bonds of the Rochester & Eastern Rapid Railway, $1,500,000.

b. To discharge certain notes of the Rochester Railway, $200,000.

c. For the purchase and acquisition of Rome City Railway bonds, $200,000.

d. For the purchase and acquisition of certain promissory notes or their renewals of Utica & Mohawk Valley Railway, $300,000; or Oneida Railway, $235,000.

The bonds in question shall not be sold or disposed of at less than par.

The commission has also authorized the New York State Railways to issue bonds to the amount of $2,073,634 for the following purposes:

a. For the acquisition of certain obligations of the Syracuse Rapid Transit Railway, $1,460,000.

b. Of Rochester & Suburban Railway obligations, $613,634.

The bonds in question are not to be sold or exchanged for these obligations at less than par.

This latter authorization is upon the express condition that upon any consolidation or merger of the Syracuse Rapid Transit Railway and the Rochester & Suburban Railway, or either of them with the New York State Railways the capitalization of the expenditures represented by the obligations of these companies may be taken up with the same force and effect as upon an application by each of the debtor companies to capitalize the same, and the authorization shall not have any force or effect until the New York State Railways shall have filed with the commission an acceptance of the authorization order containing said condition.

There are some remaining matters now before the commission for consideration, which when disposed of will complete the commission's action on the reorganization plan of the New York State Railways.

Chicago City & Connecting Railway, Chicago, Ill.—Participants in the syndicate which underwrote the $22,000,000 of 5 per cent bonds of the Chicago City & Connecting Raliway, it is stated, have been requested to pay about one-third of their subscriptions.

Johnstown (Pa.) Passenger Railway.—The stockholders of the Johnstown Passenger Railway on March 16, 1910, ratified the lease of the property of the company for 18 years to the Johnstown Traction Company, effective as of Jan. 5, 1910. The lessee agrees to pay all charges and guarantees dividends as follows: First year, 7 per cent; second year, 7¼ per cent; third year, 7½ per cent; fourth year, 7¾ per cent; thereafter, 8 per cent, and, in addition, to spend $200,000 in improvements within the next three years and maintain the property in good condition. The lessee has the privilege of purchasing the road at any time within five years. The incorporation of the Johnstown Traction Company was recorded in the Electric Railway Journal of March 5, 1910.

Joplin & Pittsburg Railway, Pittsburg, Kan.—The Harris Trust & Savings Bank, Chicago, Ill., and E. H. Rollins & Sons have purchased $1,750,000 of first mortgage 5 per cent bonds of the Joplin & Pittsburg Railway.

Lehigh Valley Transit Company, Allentown, Pa.—It is stated that the holders of about $2,000,000 of the $2,500,000 of consolidated 4 per cent bonds of the Lehigh Valley Transit Company have assented to the refinancing plan, which gives 5 per cent bonds out of the new $15,000,000 issue to be authorized on April 21, 1910, for 90 per cent and common stock for 10 per cent of par of the present bonds.

Mahoning & Shenango Valley Railway & Light Company, New Castle, Pa.—The stockholders of the Mahoning & Shenango Valley Railway & Light Company will vote on May 16, 1910, on increasing the capital stock of the company from $10,000,000 to $11,000,000 by issuing $1,000,000 of additional 5 per cent cumulative preferred stock, the proceeds to be used for improvements. There will then be outstanding $6,000,000 of common stock and $5,000,000 of preferred stock.

Metropolitan Street Railway, New York, N. Y.—Judge Lacombe, in the United States Circuit Court, has signed an order directing Adrian H. Joline and Douglas Robinson, as receivers of the Metropolitan Street Railway, to expend out of the moneys in their possession $313,900 to rehabilitate the property of the Fourth & Madison Avenue Railway.

Ocean Shore Railway, San Francisco, Cal.—V. G. Bogue, A. W. Foster and W. H. Heuer, who constitute the board of engineers appointed by Judge Van Fleet of the United States District Court to investigate the physical condition of the Ocean Shore Railway, asked the court on March 10, 1910, for $750, and announced that their report would be rendered by April 1, 1910. Although notice was served by the Mercantile Trust Company, as trustee of the first mortgage bonds of the Ocean Shore Railway, that the sale of the property under foreclosure would take place on March 9, 1910, the sale will be delayed until after the court receives the complete report of the board of engineers.

Pittsburg & Allegheny Valley Railway, Leechburg, Pa.—George W. Hosack, Pittsburgh, representing the bondholders of the Pittsburgh & Allegheny Valley Railway, purchased the property of that company under foreclosure at Kittanning on March 21, 1910, for $50,000.

Toledo & Indiana Traction Company, Toledo, Ohio.—The property of the Toledo & Indiana Railway was formally conveyed to the Toledo & Indiana Traction Company on March 25, 1910. As noted in the Electric Railway Journal of Jan. 29, 1910, the property of the Toledo & Indiana Railway was sold under foreclosure on Jan. 18, 1910, to S. C. Schenck in the interest of the bondholders. Mr. Schenck, who has been elected president of the Toledo & Indiana Traction Company, has announced the appointment of the following officers: H. C. Warren, general manager; C. B. Kleinhaus, auditor; King, Tracy, Chapman & Wells, counsel. The company has increased its capital stock from $10,000 to $400,000.

Twenty-eighth & Twenty-ninth Street Crosstown Railroad, New York, N. Y.—The sale of the property of the Twenty-eighth and Twenty-ninth Streets Crosstown Railroad under foreclosure was postponed from March 23, 1910, to March 30, 1910.

Traffic and Transportation

Ohio Electric Railway Beneficial Association

At the annual meeting of the grand council of the Ohio Electric Railway Beneficial Association, held at Newark, Ohio, on March 17, 1910, as mentioned briefly in the Electric Railway Journal of March 26, 1910, page 550, the following officers were elected for the ensuing year: E. J. Kisler, Lima, grand president; William Robinson, Newark, first grand vice-president; John Maier, Zanesville, second grand vice-president; F. L. Boyer, Dayton, third grand vice-president; George Heckethorn, New Paris, grand secretary-treasurer; W. E. Weghorst, Dayton, sergeant-at-arms.

The report of the grand secretary-treasurer showed that since the organization of the association on Feb. 5, 1908, more than $18,000 had been received by donation from the Ohio Electric Railway and through the collection of initiation fees, dues and death assessments, and that more than $14,000 had been disbursed in operating expenses, sick benefits and death claims, leaving a surplus on hand of $4,177. The association has 1103 members in good standing.

The organization is formed exclusively of officers and employees of the Ohio Electric Railway. It has local chapters at Hamilton, Dayton, Columbus, Newark, Zanesville and Lima, each with its own president, vice-president, secretary and treasurer. The four officers of each chapter compose the grand council, which meets in March and September of each year. The March meeting is the annual meeting for the election of officers. Every employee of the Ohio Electric Railway is eligible to membership. The cost is $3 per year for dues, payable quarterly; $1 must accompany each application for initiation, and $1 must be advanced as a death assessment. The association pays a sick or disabled member $7.50 a week for the first 16 weeks, $3.75 per week for the next 16 weeks, and $2 per week for 16 weeks thereafter within a period of one year from the time of notice of his sickness. It also pays a death benefit of $800.

The Ohio Electric Railway makes a liberal contribution each year to the support of the association. At the meeting of the association on March 18, at which more than 500 members were present, W. Kesley Schoepf, president of the Ohio Electric Railway, proposed to the association that for every $20,000 it accumulated in the reserve fund the company would contribute $5,000 and give the association $5 per annum for each member, based on the number of members in good standing on March 17.

A buffet lunch was served after the meeting. Special cars of the company from all parts of the system transported the members to Newark. The car from Lima, with more than 50 members, left Lima at 1:05 p. m., arrived at Springfield—65 miles—at 2:50 p. m.; Columbus—150 miles—at 4:10 p. m.; Newark—37 miles—at 5:55 p. m., making a total of 132 miles in 4 hours and 50 minutes. This car was operated through Lima, Bellefontaine, Urbana, Springfield, Columbus and Newark, in all of which care had to be exercised not to exceed the speed limits.

Subway Station and Car Lighting Order Modified

The Public Service Commission of the First District of New York has adopted the following order which modifies a previous supplementary order regarding the lighting of its cars and stations by the Interborough Rapid Transit Company:

"An order known as supplementary order having been duly made in the matter of the lighting of the cars and stations of the Interborough Rapid Transit Company on Feb. 15, 1910, which provided among other things

"'Ordered, That the Interborough Rapid Transit Company shall hereafter install and maintain in every subway passenger car operated by it, except those now or heretofore operated by it, a storage battery lighting appliance of sufficient capacity to operate four 12-cp lamps at their rated candle power for at least three hours, such storage battery lamps to be instantly and automatically available whenever the other lamps in the car shall for any reason fail to furnish light.'

"And the Interborough Rapid Transit Company having applied to the commission in writing under date of March

16, 1910, for a modification of the terms of the foregoing paragraph of said order, and sufficient reason for the modification of said supplementary order having been made to appear, now, therefore, it is

"Ordered, That said supplementary order of Feb. 15, 1910, be, and the same hereby is, amended and modified so as to read as follows:

"Ordered, That on or before April 1, 1910, the Interborough Rapid Transit Company shall so illuminate by electricity its subway stations that passengers may read conveniently therein, such illumination to be not less than the present illumination over the east platform of the Brooklyn Bridge Station; and it is further

"Ordered, That the Interborough Rapid Transit Company shall hereafter install and maintain in every subway passenger car operated by it, except those now or heretofore operated by it, a storage battery lighting appliance of sufficient capacity to operate two 12-cp lamps at their rated candle power for at least three hours, such storage-battery lamps to be instantly and automatically available whenever the other lamps in the car shall for any reason fail to furnish light;

"And it is further ordered, That this order shall take effect immediately and shall continue in force until modified or abrogated by the commission."

Accidents in New York During February

The Public Service Commission of the First District of New York has issued the following summary of accidents which occurred in February, 1908, 1909 and 1910, on the railways within its jurisdiction:

February.	1908.	1909.	1910.
Car collisions	203	102	113
Persons and vehicles struck by cars	945	855	922
Boarding	412	511	551
Alighting	286	421	559
Contact electricity	36	15	28
Other accidents	2069	1676	1772
Totals	3951	3580	3945
INJURIES.			
Passengers	1219	1391	1545
Not passengers	462	407	403
Employees	476	390	457
Totals	2157	2188	2405
SERIOUS (INCLUDED IN ABOVE).			
Killed	26	27	23
Fractured skulls	15	7	2
Amputated limbs	5	2	1
Broken limbs	24	15	24
Other serious	69	115	95
Totals	139	166	145

Communication from Indiana Commission on Crossing Signs

The Railroad Commission of Indiana has addressed the following communication on signs at highway crossings to all the railroads in Indiana:

"On Feb. 3, 1908, this commission issued its Circular No. 21 requesting and directing the companies to put up highway crossing signs.

"Some of the carriers promptly complied. Others are still engaged in this work, while some have failed altogether to follow the directions of our circular.

"For the year ended June 30, 1908, 70 travelers on the highway crossings of the railroads were killed; for the year ended June 30, 1909, 55 were killed. We are inclined to attribute the decrease, partly at least, to the effect of such warning signs as were erected.

"The commission has come to the conclusion after full consideration to enforce the putting up of these signs at every one of the unprotected crossings outside of incorporated towns and cities in this State. This expense is not great, and that much protection at least should be offered at these dangerous places.

"The commission again requests and directs the carriers to commence at once the work of putting up highway crossing signs, substantially similar to the blue print enclosed with this circular. The words "Danger" and "Two Crossings" must be used, adding them to the old signs which do not contain them. The best and most durable paints should be used.

"And the commission gives notice that it has directed its inspectors to report all carriers who do not promptly proceed with this work, and to report all crossings not so protected, the purpose being to make formal orders and recommendations, in all such cases, and to enforce these orders in the courts wherever it may be necessary.

"The commission requests a response from each company, as to what it will do to carry out this order."

Increase in Wages in Easton.—The Easton (Pa.) Transit Company has increased the wages of all motormen and conductors who have served the company four years or more from 22 to 23 cents an hour.

Buffalo Southern Railway Fare Modifications.—On April 1, 1910, the Buffalo Southern Railway, with the consent of the Public Service Commission of the Second District of New York, placed on sale 60-trip commutation tickets, good between Hamburg and Orchard City and the city line of Buffalo at Seneca Street, for $3.50, a reduction of $1 over the previous rate. On the same date the company also placed on sale 46-trip school tickets, good between the same points, for $3, a reduction of 50 cents over the previous rate.

New Wage Scale in Allentown.—On April 1, 1910, the Lehigh Valley Transit Company, Allentown, Pa., increased the wages of all who have served the company for more than five years from 22 cents to 23 cents an hour. In October, 1909, the company increased the pay of employees who have served one, two, three and four years a cent an hour. R. P. Stevens, president of the company, announced the increase in a communication addressed to the men on March 18, 1910, as follows: "A new wage scale for conductors and motormen will take effect April 1, making the new scale as follows: Nineteen cents the first year, 20 cents the second year, 21 cents the third year, 22 cents the fourth year, 23 cents the fifth year. We wish to take this opportunity to express our appreciation of your good work and conscientious co-operation during the hard winter just passed."

Toronto Railway Negotiating for New Contract for Carrying Postmen.—R. J. Fleming, general manager of the Toronto (Ont.) Railway, and Chief Post Office Superintendent Ross interviewed Rodolphe Lemieux, postmaster-general, in Ottawa, on March 21, 1910, in reference to the payments made by the department to the Toronto Railway for carrying postmen upon the cars. The present rate of $400 per month has been in force for some time. Mr. Fleming thinks the service worth $25,000, while Mr. Ross believes $6,000 per annum to be a sufficient sum. There are 200 postmen in Toronto. It has been estimated that 75 men cover the business district and that in riding to and from their routes six times a day, together with 125 men who ride three times a day, a total of 516,450 trips are taken during the 313 days in the year. At 4 cents per ride the cost of this transportation would total $20,658 per year.

As a part of the work of converting the suburban lines of the Southern Pacific Company on the east side of San Francisco Bay for electrical operation, a force of engineers from the engineering department of the company has been set to work completing surveys and estimates for the electric railway which is to be built between Elmhurst and San Leandro and which will be a part of the electric loop system planned by the Southern Pacific Company to tap the newly annexed district of Oakland on the north and south sides. It is not known whether the company will build a complete loop system embracing San Leandro or extend the loop as far as Stonehurst where a right of way has been secured. Several pieces of property between the Stonehurst terminal and San Leandro have not been secured. The Southern Pacific Company has already secured a right of way to the north of Melrose, Fitchburg and Elmhurst for the continuation of its line which now ends in Melrose. Work is being rushed on the power plant at Fruitvale, from which the electric system will be operated. The Southern Pacific Company has let the contract for the tunnel through Northbrae, in its Berkeley loop, connecting the western and eastern sections of the city, through North Berkeley and Albany. The building of this tunnel will complete the last link in the construction of the loop, the tracks of which are all laid as far as it has been possible to do so, until the tunnel is finished.

Personal Mention

Mr. B. J. Fallon, heretofore engineer of maintenance of way of the Metropolitan West Side Elevated Railway, Chicago, Ill., has been appointed assistant general manager of the company.

Mr. O. H. West, formerly a division electrician with the Indiana Union Traction Company, Anderson, Ind., has been placed in charge of the construction of a 20,000-kw station for the Indiana Steel Company, Gary, Ind.

Mr. E. F. Stone has been appointed superintendent of light and power distribution of the Pueblo & Suburban Traction & Light Company, Pueblo, Col. Mr. Stone was formerly superintendent of distribution of the Norfolk & Portsmouth Traction Company, Norfolk, Va.

Mr. Mason B. Starring, president of the Northwestern Elevated Railroad, Chicago, Ill., has been appointed a member of the committee of six employers and six employees authorized by the Legislature of Illinois to consider the question of employers' liability and report not later than Sept. 15, 1910.

Mr. L. H. McCray has been appointed general manager and purchasing agent of the Atlantic Shore Line Railway, Kennebunkport, Me., to succeed Mr. E. B. Kirk, who sailed recently for London, Eng., to become connected with the operating department of J. G. White & Company, Ltd., as announced in the Electric Railway Journal of March 12, 1910.

Mr. William H. Wadsworth, whose resignation as master mechanic of the Boston & Worcester Street Railway, South Framingham, Mass., was announced in the Electric Railway Journal of Feb. 26, 1910, has become connected with the Chickasha (Okla.) Street Railway, which has been incorporated to construct a 6-mile electric railway in Chickasha.

Mr. A. A. Anderson has resigned as general manager of the Indianapolis, Columbus & Southern Traction Company, Columbus, Ind., to become general manager of the Springfield (Ill.) Consolidated Railway, in which position he will succeed Mr. Emil G. Schmidt, whose resignation from the Springfield Consolidated Railway was announced in the Electric Railway Journal of March 5, 1910. Mr. Anderson will assume his duties some time before June 1, 1910. In the meantime he will visit various places where public service properties are operated by Hodenpyl, Walbridge & Company, New York, N. Y., who control the Springfield Consolidated Railway.

Mr. James Walker, consulting engineer of the Metropolitan West Side Elevated Railway, Chicago, Ill., has been appointed chief engineer of the company. Mr. Walker was graduated from the Sheffield Scientific School, Yale College, in 1894. For two years following graduation he was engaged in consulting engineering work in New Haven, Conn., and from 1896 to 1899, inclusive, he had charge of mining engineering work in Maryland. For five years, beginning in 1900, Mr. Walker was advisory engineer for the Michigan Board of State Tax Commissioners. In 1905 he took up consulting engineering work in Chicago, and since 1907 has been engaged in general railway engineerig work, particularly an investigation of the capacity of the Union Elevated Loop, which is used jointly as a downtown terminal by the elevated railways of Chicago.

Mr. Franklin P. Wood has been appointed general manager of the Colorado Railway, Light & Power Company, which has succeeded the Southern Colorado Power & Railway Company, Trinidad, Col. Mr. Wood was graduated from the University of Colorado in 1898 with the degree of electrical engineer. Immediately thereafter he became electrician for the Cripple Creek District Electric Railway. In 1899 and 1900 he served as electrician of the La Bella Mill, Water & Power Company, Cripple Creek, Col., and from 1901 to 1903 he was engaged in contracting work. During 1904 and 1905 Mr. Wood held the position of electrical engineer of the Liberty Bell Gold Mining Company at Telluride, Col. In 1907 Mr. Wood re-entered electric railway work as manager and superintendent of the Black Hills Traction Company, Deadwood, S. D., with which he continued until March 1, 1910, when his appointment as general manager of the Colorado Railway, Light & Power Company became effective.

Mr. Clarence P. Hayden, who for the last eight years has been connected with the New Hampshire Electric Railways, Haverhill, Mass., as superintendent, has resigned, effective on April 15, 1910. Mr. Hayden has purchased the Island House, at Oak Bluffs, Mass., formerly owned and managed by his father, and in the future will devote all his time to that property. Mr. Hayden entered street railway service with the Union Street Railway, New Bedford, Mass., in 1891 as a conductor, under Mr. Franklin Woodman, who is now general manager of the New Hampshire Electric Railways. He was afterward promoted to the position of stable foreman, and was transferred to Haverhill soon after Mr. Woodman assumed the management of the Haverhill & Groveland Street Railway in 1892. Mr. Hayden was appointed superintendent of the Hampton, N. H., division of the New Hampshire Electric Railways in 1902, and continued in that position for five years. He was next transferred to the Salem division of the company.

Mr. Charles H. Hile was elected president of the New England Street Railway Club at the annual meeting of the club held at the Hotel Somerset, Boston, Mass., on March 24, 1910. Mr. Hile is assistant to Mr. C. S. Sergeant, the vice-president of the Boston Elevated Railway, which position he has held for five years. Previous to that time he was superintendent of wires for the Boston Elevated Railway for about eight years, and previous to holding that office he was for about three years engineer in charge of underground conduit construction. Mr. Hile was graduated from Pennsylvania State College in 1892, as a mechanical engineer. He then took a post-graduate course at the University of Wisconsin, making street railway engineering the chief subject of his studies. After completing his work at the university Mr. Hile became connected with the Philadelphia Traction Company as an engineer in the work of electrifying the company's horse car lines. After serving this company one year he entered the employ of the Boston Elevated Railway.

C. H. Hile

Mr. James R. Chapman, who retired as chief engineer of the Underground Electric Railway, London, Eng., at the recent semi-annual meeting of the company, has been connected with engineering work in the United States and in England for more than 35 years. Mr. Chapman was associated with the late Chas. T. Yerkes in the management of the Union Traction Company, Chicago, Ill., and went to London in 1901 when Mr. Yerkes became connected with the Metropolitan District Railway. The organization of the Metropolitan District Electric Traction Company with a capital of £1,000,000 followed, and in 1902 the Underground Electric Railways Company, Ltd., capitalized at £5,000,000, was organized as the successor to this company. Then began the development of the underground lines of London, the details of which all devolved upon Mr. Chapman. He was a witness in the arbitration between the District Railway and the Metropolitan District Electric Traction Company, Ltd., as to what system of electric traction should be adopted on the Inner Circle Railway, which is partly owned by the District Railway and the Metropolitan District Electric Traction Company. Mr. Chapman advocated the direct-current system as against the three-phase system, and Mr. A. Lyttleton, K. C., the arbitrator, decided in favor of the direct-current system. The erection of the Chelsea power station was begun in 1902, and with it was carried on simultaneously the work of electrifying the District Railway and the construction of the tunnels of the three tube railways. Mr. Chapman expects to return to the United States shortly.

Construction News

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

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

RECENT INCORPORATIONS

***Maryland & Washington Traction Company, Washington, D. C.**—Application has been made in Maryland by this company for a charter to build a 12-mile electric railway between Washington, Baltimore and Ellicott City. Capital stock, $1,000,000. Incorporators: Harold Hardinge, F. O. Rapanier, J. B. Clark and James Clark.

Charles City & Western Railway, Charles City, Ia.—Incorporated in Iowa to build a 40-mile electric railway in Charles City and extending into the surrounding country. Capital stock, $300,000. C. W. Hart, Charles City, president and A. W. Dennis, Charles City, is interested. [E. R. J., Feb. 5, '10.]

***Garrett County Railway, Annapolis, Md.**—Application has been made by this company for a charter to construct an electric railway from Oakland to Mountain Lake Park, Deer Park, Thayerville, Accident, Grantsville and Frostburg, Md.; also from Accident to Friendship and from Grantsville to the Pennsylvania line. Capital stock, $200,000. The bill was introduced in the Legislature by Senator Speicher.

***Elkton, Fair Hill & Oxford Electric Railway & Power Company, Elkton, Md.**—Application has been made in Maryland to build an electric railway from Elkton, Cherry Hill and Fair Hill to the Pennsylvania line. Capital stock, $60,000, which may be increased to $500,000. Incorporators: C. P. Canriet, Geo. E. L. Hess, John Lungren, H. Eugene Mackin and Heister Hess.

Ottawa, Rideau Valley & Brockville Railway, Ottawa, Ont.—Incorporated in Ontario to build an electric railway from Chelsea to Hull and across the interprovincial bridge and on to Brockville. Directors: A. McDiarmid, R. G. Elliott, Montreal; F. E. Henning, E. N. Clark, G. E. Kidd and D. H. McLean, Ottawa, and James Gilmour, Brockville. [E. R. J., Dec. 18, '10.]

***Buckhannon & Clarksburg Traction Company, Clarksburg, W. Va.**—Application has been made for a charter by this company in West Virginia to build an electric railway from Clarksburg to Buckhannon. Capital stock, $100,000. Incorporators: U. G. Young, E. W. Martin, W. H. Fisher, G. O. Young and R. I. Perine, Buckhannon.

***East Thermopolis (Wyo.) Power Company.**—Application has been made in Wyoming by this company for a charter to build an electric railway in Thermopolis. Incorporators: H. P. Rothwell, Martin McGrath and Ira E. Jones.

FRANCHISES

***Coalinga, Cal.**—The Town Council has granted a franchise to C. L. Morrill to build a 6-mile railway in Coalinga. It is planned to extend this proposed railway 15 miles beyond Coalinga north and east to the oil territory.

***Donaldsonville, La.**—John Marks and associates have been granted a 99-year franchise to build an electric railway on the batture of Bayou Lafourche from Donaldsonville to Lockport.

Mount Vernon, N. Y.—The Public Service Commission, Second District, has given its approval to the Westchester Electric Railroad to exercise franchises granted by the Board of Aldermen of Mount Vernon on Sept. 27, 1909, and by the Board of Trustees of Pelham Manor on Nov. 8, 1909.

***Stillwater, Okla.**—The City Council has granted a franchise to L. J. Lampke, who is said to represent New York capitalists, to build an electric railway over certain streets in Stillwater. This is part of a plan to build a line between Stillwater, Yale, Morrison and Perkins.

***Medford, Ore.**—The American Development Company has applied to the County Court for a franchise to build an electric railway along roads of Jackson County.

Sherbrooke, Que.—The ratepayers have granted a 28-year franchise to the Sherbrooke Street Railway, in return for which the company will spend $500,000 in doubling the present system of 7 to 14 miles in Sherbrooke and in developing a water power on the Magog River.

Regina, Sask.—The City Council has granted a 20-year franchise to J. W. D. O'Grady, J. A. Anderson and John Geddes, Winnipeg, to build an electric railway over the principal streets in Regina. The city is to have the privilege of taking over the system at the date of the franchise expiration. [E. R. J., Feb. 12, '10.]

***Greenville, Tex.**—S. A. Price, H. J. Meyers and their associates have applied for a franchise to build a five-mile electric railway in Greenville.

Fair Haven, Vt.—Application has been made by the Rutland Railway, Light & Power Company, Rutland, for a franchise to extend its electric railway through Fair Haven and over the Evergreen road to Poultney.

TRACK AND ROADWAY

***Florence, Ala.**—Thurston H. Allen, Florence, is actively interested in promoting a 75-mile electric railway between St. Floridan, Bailey Springs, Muscle Shoals Canal, Rogersville, Athens and Huntsville.

Little Rock Railway & Electric Company, Little Rock, Ark.—This company advises that it will soon rebuild and pave 2 miles of track. D. A. Hegarty, general manager.

Power, Transit & Light Company, Bakersfield, Cal.—This company reports that it has recently laid 2½ miles of 60 and 87-lb. steel rails, and that it will rebuild 2½ miles of new track. Harry S. Jastro, purchasing agent.

Bayboro Investment Company, St. Petersburg, Fla.—This company has begun building its railway from Bayboro to St. Petersburg. It is reported that Snell & Hamlet are negotiating to secure a 2½-mile extension of this line from St. Petersburg through the Bay Shore and North Shore subdivisions. A. Welton, superintendent. [E. R. J., Feb. 12, '10.]

Atlanta (Ga.) Northeastern Railroad.—This company is planning to begin actual construction within two weeks on its proposed electric railway which will connect Atlanta, Roswell and Alpharetta. At Alpharetta two lines will diverge, one to Cumming, 42 miles, and the other to Creighton, 18 miles. J. B. Brooke, Alpharetta, president.

Macon Railway & Light Company, Macon, Ga.—This company advises that it will soon place contracts for building a 2-mile extension. J. H. Hertz, Macon, secretary and treasurer.

Hammond, Whiting & East Chicago Electric Railway, Chicago, Ill.—Preparations are now being made by this company to begin active construction on its proposed extension between Hammond and Harvey. D. M. Cummings, Chicago, president.

Illinois Oil & Coal Belt Railway, McLeansboro, Ill.—This company advises that the contract is awarded and preliminary survey will begin shortly by the Western Indiana Construction Company on the projected 170-mile electric railway which is to connect Terre Haute, Ind., Robinson, Olney, Fairfield, McLeansboro, Marion and Cairo, Ill. Construction of the road is scheduled to begin in about four months. Maximum grade will be 1 per cent and the maximum curvature 4 deg. The line will operate through 120 miles of coal fields and 50 miles of oil fields. Two bridges will be constructed. It will be bonded at $20,000 per mile. The company plans to build a power plant and repair shops at McLeansboro. Several amusement parks are also contemplated. Capital stock, $1,000,000. Officers: James R. Campbell, McLeansboro, president; Joseph B. Crowley, Robinson, vice-president; I. H. Webb, McLeansboro, secretary; J. H. Lane, McLeansboro, treasurer, and Allen T. Russell, McLeansboro, general manager and chief engineer. [E. R. J., March 12, '10.]

Dixon, Rock Falls & Southwestern Electric Railway, Tampico, Ill.—This company has increased its capital stock from $50,000 to $300,000. This railway is now being built from Sterling to Moline. Track has been laid from Tampico to Yorktown.

Evansville (Ind.) Electric Railway.—This company has begun work surveying the proposed extension of its electric railway from Rockport to Grandview. Construction will begin in a few weeks.

Centerville Light & Traction Company, Centerville, Ia.—This company has resumed work on the 7-mile extension to Mystic.

Kansas Union Traction Company, Altamont, Kan.—This company advises that it will commence construction this summer and that engineering work will begin in a few days on its proposed 40-mile electric railway between Parsons, Altamont, Edna, Valeda and Coffeyville. Barney McDaniel, Altamont, secretary. [E. R. J., Jan. 8, '10.]

Union Traction Company, Coffeyville, Kan.—This company states it expects to build a 5-mile city line in Independence. D. H. Siggins, Coffeyville, president.

Portland, Gray & Lewiston Railroad, Lewiston, Maine.—W. S. Libbey and H. M. Dingley, Portland, who have purchased the controlling interest in this company from E. L. Gross, Auburn, and L. A. Goudy, Portland, announce that work will be started on the proposed railway between Auburn and Portland during the next few weeks. Preliminary arrangements have been completed. [E. R. J., Sept. 25, '09.]

Hagerstown (Md.) Railway.—This company has made surveys for an extension of its railway into the northern suburbs of Hagerstown. W. C. Hepperle, Hagerstown, purchasing agent.

***Ortiz, Chihuahua, Mex.**—A. R. Cadena and Serveriano Calderon have obtained a concession from the government to build a three-mile electric railway between Ortiz and Meoqui, and also on the principal streets of these towns.

Electric Traction Construction Company, Kansas City, Mo.—This company is in the market for 2,550 tons of 60-lb. relaying rails, also spikes, bolts and nuts, for work on 25 miles of railway work in Kansas.

Buffalo, Lockport & Rochester Railway, Rochester, N. Y.—Press reports state that this company is planning an extension of its line to Niagara Falls.

Ashtabula (Ohio) Electric Street Railway.—Preliminary surveys have been completed and contracts let to A. F. De Mayo & Company, New York, N. Y., to build this proposed 6-mile electric railway over the principal streets of Ashtabula. Connection will be made with interurban lines to Cleveland, Erie and Jefferson. Local and Eastern capital are interested. Chapin & Bryson, Ashtabula, engineers. [E. R. J., Jan. 22, '10.]

Ohio & Southern Traction Company, Columbus, Ohio.—This company advises that it will place contracts during the next few weeks for building 2½ miles of track. W. J. Baker, Columbus, purchasing agent.

Niagara Falls, Welland & Dunnville Electric Railway, Welland, Ont.—This company which was recently incorporated to build an electric railway from Niagara Falls through Stamford, Thorold, Crowland, Welland, Humberstone, Wainfleet, Moulton and Sherbrooke, elected the following officers at its first meeting: F. R. Lalor, Dunnville, president; George Arnold, Ridgeville, vice-president; F. E. Misener, Marshville, secretary; George H. Burgar, treasurer; H. A. Rose, Welland, solicitor. J. C. Gardiner, Niagara Falls, will begin making surveys at once, starting at the Dunnville end. [E. R. J., March 26, '10.]

Austin (Tex.) Electric Railway.—This company advises that it will build 2½ miles of track during the year. W. J. Jones, president.

Toronto & York Radial Railway, Toronto, Ont.—It is reported that this company will extend its Scarborough division to Markham. W. H. Moore, Toronto, general manager.

***Denton-Fort Worth Interurban Railway, Denton, Tex.**—This company recently effected formal organization with the election of the following directors and officers: A. C. Owsley, president; W. B. McClurkan, vice-president; H. F. Schweer, treasurer, and C. E. Scruggs, secretary. Directors: A. C. Owsley, J. C. Colt, B. H. Davenport, U. B. McClurkan, J. N. Rayzor and B. W. Blewett. The proposed railway is to connect Denton and Fort Worth.

San Benito (Tex.) Interurban Railway.—This company is said to have financed its projected 50-mile gasoline-motor railway from San Benito to the Rio Grande, and work has been started by the Hidalgo Construction Company, which has been awarded the contract for grading, bridging and track-laying. S. A. Robertson, San Benito, engineer and contractor. [E. R. J., Jan. 29, '10.]

Twin City Light & Power Company, Centralia, Wash.—This company has awarded a contract to A. M. Hewes, Monadnock Building, Chicago, Ill., for the construction of a 5-mile electric railway between Centralia and Chehalis, and also for the reconstruction of its water and electric lighting plants. The railway company has recently been reorganized by Guy M. Walker, 15 Wall Street, New York City. [E. R. J., Jan. 29, '10.]

Sparta-Melrose Electric Railway & Power Company, Sparta, Wis.—This company reports that it has completed grading to Trout Falls, and will start construction during the summer on its projected 30-mile electric railway from Sparta to Melrose. The work is being done by the Western Transportation Company. [E. R. J., March 19, '10.]

Wisconsin Southern Railway, Fond du Lac, Wis.—This company has secured right-of-way and completed surveys for its proposed 119-mile electric railway which is to connect Madison, Sun Prairie, Columbus, Beaver Dam, Juneau, Horicon, Mayville, Knowles, South Byron, Brownsville, and Fond du Lac, and from Knowles will connect Lomira, Ashford, Campbellsport and Plymouth. Capital stock authorized, $3,500,000 preferred, $1,500,000 common. Bonds authorized, $25,000 per mile, not to exceed $5,000,000. Officers: Charles D. Smith, Fond du Lac, president, manager and contract agent; M. A. Jacobs, Beaver Dam, vice-president; M. W. Smith, Fond du Lac, secretary. Headquarters, 16 South Main Street, Fond du Lac.

Middle Island Railroad, Middlebourne, W. Va.—This company has been formed for the purpose of building an electric railway from Sistersville to Middlebourne, McElroy Creek and Clarksburg. Incorporators: T. Moore Jackson and C. P. Stout, Clarksburg; I. M. Underwood, T. P. Hill and J. E. Shore, Middlebourne. [E. R. J., Jan. 8, '10.]

***Clarksburg & Weston Traction Company, Clarksburg, W. Va.**—This company has been organized in Clarksburg to build an electric railway from Clarksburg to Weston. S. G. Monroe, Clarksburg, is said to be interested.

SHOPS AND BUILDINGS

Little Rock Railway & Electric Company, Little Rock, Ark.—This company advises that it will build an extension to its car house in Little Rock to be used as a club room for its employees. The repair shop will be equipped with complete set of wood-working machines. D. A. Hegarty, Little Rock, general manager.

Los Angeles & Mt. Washington Railway, Los Angeles, Cal.—This company expects to place during the next two months contracts for building a repair shop in Los Angeles. John A. Rivers, superintendent.

Vicksburg (Miss.) Traction Company.—This company advises that it will soon place contracts for constructing a new car house in Vicksburg. W. B. Moorman, Vicksburg, general manager. [E. R. J., Oct. 2, '09.]

POWER HOUSES AND SUBSTATIONS

Los Angeles & Mt. Washington Railway, Los Angeles, Cal.—This company advises that during the next 60 days it will place contracts for building a small power plant. John A. Rivers, superintendent.

Chicago, Aurora & De Kalb Railroad, Aurora, Ill.—This company states it intends soon to purchase an electrically driven gravel loader with a capacity of 100 yd. per hour. W. J. Cram, Jr., general manager.

Tri-City Railway & Light Company, Davenport, Ia.—This company has let the contract to the Westinghouse Electric & Manufacturing Company for the installation of a 12,000-hp turbo-generator at its power plant in Moline.

Winona Railway & Light Company, Winona, Minn.—This company states it has just completed the installation of an additional 600 boiler at its Winona power house.

Delta Electric Light, Power & Manufacturing Company, Greenville, Texas.—This company has purchased and will install at once a 150-kw. General Electric belted generator.

La Crosse & Winona Traction Company, La Crosse, Wis. This company, it is stated, will soon call for bids for the erection of a dam 33 ft. high, with a 350-ft. spillway. W. J. Ferris, president. [E. R. J., March 12, '10].

Manufactures & Supplies

ROLLING STOCK

Guthrie (Okla.) Railway expects to buy fenders for its nine cars.

Austin (Tex.) Electric Railway is in the market for two open and three closed cars.

Williamsport (Pa.) Passenger Railway is in the market for two cars, it is reported.

Elmira Water, Light & Railroad Company, Elmira, N. Y., is planning to purchase six cars.

Mobile Light & Railroad Company, Mobile, Ala., is building three open trailers in its shops.

Cumberland Railway, Carlisle, Pa., is said to have ordered three cars from The J. G. Brill Company.

Birmingham Railway, Light & Power Company, Birmingham, Ala., is in the market for nine cars.

Ohio & Southern Traction Company, Columbus, Ohio, is in the market for one 60-ft. combination car.

British Columbia Electric Railway, Vancouver, B. C., has ordered 100 trucks from The J. G. Brill Company.

Los Angeles & Mt. Washington Incline Railway, Los Angeles, Cal., expects to buy some brakes within the next 60 days.

Little Rock Railway & Electric Company, Little Rock, Ark., is rebuilding 15 open cars as semi-convertible and closed-side cars.

Columbus, Urbana & Western Electric Railway, Columbus, Ohio, has ordered one interurban car from the Jewett Car Company, Newark, Ohio, to be mounted on McGuire-Cummings trucks.

Georgia Railway & Electric Company, Atlanta, Ga., mentioned in the Electric Railway Journal of Jan. 29, 1910, as contemplating the erection of 18 cars in its shops, is now constructing 20 cars.

New Orleans Railway & Light Company, New Orleans, La., reported in the Electric Railway Journal of March 26, 1910, to be in the market for 25 cars, has decided to purchase from 35 to 50 cars.

Cleveland (Ohio) Railway, reported in the Electric Railway Journal of March 26, 1910, under the name of its predecessor, the Municipal Traction Company, to be in the market for 100 new cars, will order 50 cars at once.

Pittsfield (Mass.) Electric Street Railway reported in the Electric Railway Journal Feb. 19, 1910, to be in the market for a number of motor cars, has placed an order for two cars with J. M. Jones Sons' Company, Watervliet, N. Y.

Interborough Rapid Transit Company, New York, N. Y., which was reported in the Electric Railway Journal of Feb. 19, 1910, to be in the market for 75 side-door cars, has ordered 75 all-steel car bodies from the Pressed Steel Car Company.

New Paltz, Highland & Poughkeepsie Traction Company, New Paltz, N. Y., which was stated in the Electric Railway Journal of March 26, 1910, to have ordered 10 open cars from The J. G. Brill Company, has only purchased one 10-bench open car.

Winona Interurban Railway, Warsaw, Ind., reported in the Electric Railway Journal of March 19, 1910, to be in the market for a number of new cars, is having the Jewett Car Company, Newark, Ohio, build six 13-bench open and two closed city cars and one 60-ft. baggage car.

Danbury & Bethel Street Railway, Danbury, Conn., recorded in the Electric Railway Journal of March 12, 1910, to be in the market for two cars, has contracted with The J. G. Brill Company for three 30-ft. closed cars with trucks and two 14-bench Narragansett cars with No. 39-E trucks.

Peoria (Ill.) Terminal Company, reported in the Electric Railway Journal of March 19, 1910, to have ordered five interurban cars from McGuire-Cummings Manufacturing Company, has prepared the following specifications:

Seating capacity..... 60	Hand brakes ..... Peacock
Weight .....30,000 lb.	Headlining ..... Composite
Wheel base.....6 ft. 6 in.	Board Co.
Length of body.....55 ft.	Heating system .... Cooper
Length over all.....56 ft.	Headlights ... Crouse-Hinds
Width inside .....8 ft. 5 in.	Journal boxes ...Symington
Width over sill.....9 ft. 2 in.	Motors .. Westinghouse 302
Height inside.....9 ft.	Sanders...Elec. Service Sup.
Sill to trolley base..9 ft. 11 in.	Co.
Height rail to sills..3 ft. 6 in.	Sash fixtures...Edwards No.
Body ..... wood	13-o-1.
Underframe ..... steel	Seats ..... Walkover
Air brakes ...Allis-Chalmers	Trolley retrievers .....Earll
Brakes ..McGuire-Cummings	Trucks ..... McGuire-Cum-
Car trimmings .. pol. bronze	mings heavy interurban.
Control sys. ..Westinghouse	Varnish ... Globe Paint Co.
Curtain fixtures .. Schroyer	Vestibule ..... one end only
Curtain material.. Pantasote	

Central Kentucky Traction Company, Frankfort, Ky., has ordered four cars from The J. G. Brill Company of the combination passenger and baggage type which will have the following details:

Seating capacity..... 52	Gongs.....E. S. S. Co.
Weight with trucks.26½ tons	Hand brakes ..... Peacock
Wheel base.....6 ft. 6 in.	Heaters ..... Consolidated
Length of body....46 ft. 1 in.	Headlights.....G. E. arc
Length over vest..51 ft. 8 in.	Journal boxes....Symington
Length over all....52 ft. 8 in.	Lavatory fittings....A. & W.
Sill to trolley board.9 ft. 1 in.	No. 6.
Height rail to sills..3 ft. 7 in.	Motors.....4; GE-210
Body ..... wood	Registers ..... Ohmer
Underframe .. wood, I-beam	Sanders .....Ohio Brass Co.
stringers.	Sash fixtures ..... Brill
Air brakes..Nat'l A-4, M. S.	Seats ..... Winner
A., Type C.	Springs ..... Brill
Car trimmings..... bronze	Trucks...Brill 27 M.C.B., E2
Couplers....Van Dorn No. 8	Vestibule...round end, drop
Curtain fix....Curtain S. Co.	sash, folding door.
Curtain material ..Pantasote	

TRADE NOTES

Lord Electric Company, New York, N. Y., has changed its name to the Lord Manufacturing Company.

William Welling, for 14 years connected with The Hunter Illuminated Car Sign Company, New York, N. Y., as superintendent, is dead.

Consolidated Car Heating Company, Albany, N. Y., will move its New York office on May 1, 1910, to the 31st floor of the Singer Building.

Burton W. Mudge & Company, Chicago, Ill., are handling exclusively the Garland ventilator and the Garland heating and refrigerating appliances, for both passenger and freight equipment.

Railway Brake Shoe Company, Washington, Pa., has been incorporated by J. L. Cohnagan, G. O. De Vaughan and Eli Gray, of Washington, to manufacture a patent brake-shoe for railways.

Griffin Wheel Company, Chicago, Ill., will move its general office from the Western Union Building to the McCormick Building at Michigan Avenue and Van Buren Street on May 1, 1910.

Heywood Bros. & Wakefield Company, Wakefield, Mass., announce the appointment of R. F. Fowler as their representative for railway car seats, with headquarters at 1415 Michigan Avenue, Chicago, Ill.

Van Dorn & Dutton Company, Cleveland, Ohio, has absorbed the Van Dorn Electric & Manufacturing Company, and the latter company will be known hereafter as the Electric Department of the Van Dorn & Dutton Company.

Cortland F. Ames, Chicago, Ill., has been elected vice-president and manager of the Railway & Traction Supply Company, under which names the business of Cortland F. Ames will be conducted hereafter at 404 Rector Building, Chicago, Ill.

O. M. Edwards Company, Syracuse, N. Y., announces that hereafter it will manufacture gates, globes, angles, hoes, checks and radiator valves in brass, but that it expects in the near future to engage extensively in the manufacture of iron and steel valves.

Peter Smith Heater Company, Detroit, Mich., announces the second successful test of the Peter Smith hot-air forced-draft heater in Detroit on March 19, 1910. A large number of heaters has been ordered by the Detroit United Railway, to be installed as rapidly as possible.

McCord & Company, Chicago, Ill., have purchased the window fixture and accessory business of the Grip Nut Company, Chicago, Ill., and will in future conduct the business. The Grip Nut Company, however, will continue the manufacture of grip nuts, the demand for which is so great that its plant is overtaxed.

Wonham, Sanger & Bates, New York, N. Y., report the receipt of orders from Edmonton (Alta.) Radial Railway and the Long Island Railroad for the equipment of their new cars with "H. B." life guards; also from the Roanoke Railway & Electric Company, Roanoke, Va., for equipping all of its cars with this appliance.

Hobart-Allfree Company, Chicago, Ill., announces that the following officers were elected at its annual meeting on March 7, 1910; B. F. Hobart, president; J. B. Allfree, vice-president and general manager; Frank P. Smith, second vice-president, and W. H. England, secretary. The company has opened a New York office in room 1824, at 50 Church Street.

Titan Steel Castings Company, Newark, N. J., will be represented by R. B. Clark, Jr., in Chicago with offices at 757 Monadnock Building. Mr. Clark was formerly assistant general manager of the Merchants' Despatch Transportation Company, and later was sales agent of the Scullin & Gallagher Iron & Steel Company, St. Louis, Mo., in Chicago and New York. Mr. Clark represents several other companies in Chicago.

Cambria Steel Company, Philadelphia, Pa., advises that at its annual meeting on March 15, 1910, Charles S. Price, vice-president, was elected president to succeed Powell Stackhouse, who retired after 53 years connection with the company. A. P. Robinson has been elected to succeed Mr. Price as first vice-president, and G. Leon Replogle, heretofore assistant to the general manager, has been appointed assistant to the president.

Massachusetts Chemical Company, Walpole, Mass., for the convenience of workmen and to meet the demands of those who desire a smaller quantity of tape in an individual package, is packing 20 feet of its Walpole brand in a small round tin box labelled "Walpole Junior." This tape is identical in quality with that bearing the same brand name put up in 80-ft. length, and is subject to the same guarantee. The company is building an addition to its factory at Walpole, which, when completed, will increase the capacity of the plant 40 per cent.

Francis A. Vaughn has resigned from the engineering department of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., and has become associated with Hans J. Meyer under the firm of Vaughn & Meyer, with headquarters in Milwaukee, who will act as consulting engineers. Mr. Vaughn was graduated from the University of Wisconsin as an electrical engineer in 1895. He immediately entered the employ of the testing department of the Standard Telephone Company's factory at Madison, Wis. Later he became connected with the Gibbs Electric Company, Milwaukee, Wis., in the design of motors. For the last 14 years Mr. Vaughn has been identified with the Milwaukee Electric Railway & Light Company in the electrical engineering department. Mr. Meyer began his career as an apprentice with the Milwaukee Electric Railway & Light Company and advanced through the various electrical departments of the company until, after seven years of service, he had charge of the drafting department under Mr. Vaughn. Subsequently he became associated with the Bullock Electric Company and the Wagner Company in Chicago. He was then appointed superintendent of the Shreveport Gas, Electric Light & Power Company, Shreveport, La., and entirely remodeled the power plant of the company. Since 1906 Mr. Meyer has been associated with the Westinghouse Electric & Manufacturing Company as commercial engineer in its New Orleans office.

Walter M. McFarland, who has been associated with the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., since Jan. 1, 1899, has resigned to accept an official position with the Babcock & Wilcox Company in New York. Mr. McFarland has been acting vice-president of the Westinghouse Electric & Manufacturing Company for more than 10 years, having supervision of the large contracts of the company and being the advisory head in all the co-operative movements of the company with the associated Westinghouse companies involving literature, advertising and exhibition work. Mr. McFarland was born in Washington, D. C., in 1859, and was educated in the public schools of that city, the preparatory department of Columbia University and the United States Naval Academy, which he entered as a cadet engineer in 1875 and from which he was graduated second in his class. In 1881, Mr. McFarland was commissioned as assistant engineer; in 1891 as past assistant engineer, and 1898 as chief engineer. In 1899 he resigned from the navy to enter the employ of the Westinghouse Electric & Manufacturing Company. He was detailed for service while in the navy to the bureau of steam engineering in 1882, and as assistant professor of mechanical engineering at Cornell University from 1883 to 1885. From 1889 to 1894 he was again attached to the bureau of steam engineering. Mr. McFarland was vice-president of the American Society of Mechanical Engineers in 1907 and is vice-president of the Society of Naval Architects and Marine Engineers. He is also a member of the Engineers' Club of New York, Duquesne Club of Pittsburgh, the Army and Navy Club of Washington, and the Army and Navy Club of New York.

ADVERTISING LITERATURE

Graphite Lubricating Company, Bound Brook, N. J., is mailing a circular letter calling attention to its graphite and bronze bushings.

Northern Engineering Works, Detroit, Mich., has issued Booklet No. 93, in which its foundry machinery and equipment are described and illustrated.

Joseph Dixon Crucible Company, Jersey City, N. J., is distributing a circular in which attention is called to the merits of Dixon's solid belt dressing.

Scully Steel & Iron Company, Chicago, Ill., has issued its Blue Book, which is a complete catalog for 1910. It contains 304 pages and is bound in flexible leather.

Arnold Company, Chicago, Ill., is mailing a post-card on which is a map of the United States showing points where it was engaged in construction work for various railroads in 1909.

James G. Biddle, 1114 Chestnut Street, Philadelphia, Pa., has published a 20-page bulletin (No. 710) entitled "Evershed Meggers and Bridge-Meggers," written by Prof. A. J. Rowland, Drexel Institute. The Evershed instruments are direct-reading for resistance just as a voltmeter indicates e.m.f.

Snow Steam Pump Works, Buffalo, N. Y., and the **Power & Mining Machinery Company, Milwaukee, Wis.,** have issued jointly catalog No. 104, entitled "Gas Power Plants," which covers Snow gas engines and Loomis-Pettibone gas producers. The publication is profusely illustrated with views which show gas power installations in various parts of the country. It is printed on coated paper and contains 64 pages.

Lagonda Manufacturing Company, Springfield, Ohio, has issued a 16-page booklet, entitled "The Weinland Quick Repair Head," devoted mainly to a discussion of the merits of the new Weinland head which the company has recently placed on the market. Directions are also given for taking the head apart quickly and installing the new sharp cutter wheels. The publication also contains a brief description of the various other appliances built by the company.

J. G. Brill Company, Philadelphia, Pa., in *Brill's Magazine* for March, publishes the third of a series of biographical sketches of prominent street railway officials in the United States. C. Loomis Allen, president of the Syracuse & Suburban Railroad and director of the New York State Railways, is the subject of the present sketch. The article is accompanied by an excellent portrait of Mr. Allen. The magazine also contains the fifteenth of a series of articles on the type of car adopted for use in large cities of the world. In the March issue, conditions are described in Milan, Italy. The following articles also appear: "Equipment for Elevated Service for the Interborough Rapid Transit Company," "Cars for the Northern Texas Traction Company," "New Equipment for Detroit," "Interurban Equipment for the Pittsburgh Railways," "Two All-Steel Baggage Cars," "Cars for Elevated Service in Chicago" and "Single-End Pay-as-You-Enter Cars for Topeka, Kansas."

TABLE OF MONTHLY EARNINGS.

Notice:—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table sh be used in connection with our Financial Supplement, "American Street Railway Investments," which contains the annual operating reports to the ends of the various finar years. Similar statistics in regard to roads not reporting are solicited by the editors. *Including Taxes. †Deficit. xIncludes other income received.

Company	Period	Gross Income	Operating Expenses	Gross Income Less Operating Expenses	Deductions From Income	Net Income
AKRON, O. Northern Ohio Tr. & Light Co.	1m., Feb. '10	146,207	*92,513	53,693	43,292	10,402
	1 " " '09	136,504	*80,541	55,963	43,731	12,232
	2 " " '10	311,151	*187,014	124,137	86,583	37,554
	2 " " '09	284,399	*165,251	119,148	87,683	31,465
BANGOR, ME. Bangor Ry. & Elec. Co.	1m., Feb. '10	39,921	*18,805	21,116	13,102	8,014
	1 " " '09	35,518	*19,730	15,788	13,085	2,703
	8 " " '10	383,422	*162,045	221,377	104,901	116,476
	8 " " '09	362,386	*167,992	194,394	97,698	96,696
BELLINGHAM, WASH. Whatcom Co. Ry. & Lt. Co.	1m., Jan. '10	36,202	22,741	13,460	8,957	4,503
	1 " " '09	33,348	19,749	13,599	8,820	4,779
	12 " " '10	409,721	231,085	178,636	99,936	78,700
	12 " " '09	363,062	209,646	153,416	100,214	53,201
BINGHAMTON, N.Y. Binghamton St. Ry.	1m., Jan. '10	27,180	16,724	10,456	8,921	1,535
	1 " " '09	26,293	14,415	11,878	8,904	2,974
CHARLESTON, S. C. Charleston Con. Ry., Gas & Elec. Co.	1m., Feb. '10	63,260	41,325	21,935	13,859	8,075
	1 " " '09	59,024	37,658	21,366	13,992	7,375
	12 " " '10	782,689	503,367	279,322	166,942	112,380
	12 " " '09	756,327	489,512	266,815	165,800	101,015
CHICAGO, ILL. Aurora, Elgin & Chicago Railroad.	1m., Jan. '10	101,784	77,998	23,786	31,964	†8,178
	1 " " '09	99,637	61,938	37,699	28,190	9,510
	7 " " '10	959,791	522,900	436,890	209,539	227,351
	7 " " '09	880,682	470,689	409,993	194,668	215,326
CLEVELAND, O. Cleveland, Painesville & Eastern R.R.	1m., Feb. '10	18,702	*11,183	7,519	8,640	†1,121
	1 " " '09	16,482	*10,587	5,895	8,134	†2,239
	2 " " '10	39,786	*22,677	17,109	17,369	†260
	2 " " '09	35,468	*21,110	14,358	16,246	†1,888
Lake Shore El. Ry.	1m., Feb. '10	70,877	*47,276	23,601	34,847	†11,246
	1 " " '09	60,471	*44,019	16,452	34,520	†18,068
	2 " " '10	149,871	*95,815	54,056	69,118	†15,062
	2 " " '09	134,062	*89,594	44,469	68,912	†24,443
DALLAS, TEX. Dallas Electric Corporation.	1m., Jan. '10	118,721	80,752	37,969	26,407	11,562
	1 " " '09	102,252	65,799	36,454	28,839	7,615
	12 " " '10	1,336,591	836,444	500,146	335,379	164,767
	12 " " '09	1,183,619	784,569	399,050	347,567	51,483
DETROIT, MICH. Detroit United Ry.	1m., Feb. '10	619,979	398,422	221,557	159,140	62,417
	1 " " '09	530,314	348,711	181,603	154,457	27,146
	2 " " '10	1,291,733	824,183	467,550	317,798	119,752
	2 " " '09	1,101,322	703,408	397,914	308,159	89,755
DULUTH, MINN. Duluth-Superior Traction Co.	1m., Feb. '10	73,077	*45,723	27,354	14,417	12,937
	1 " " '09	66,353	*43,659	22,694	13,417	9,277
	2 " " '10	155,628	*96,134	59,494	28,833	30,661
	2 " " '09	138,558	*91,084	47,474	26,833	20,641
EAST ST. LOUIS, ILL. East St. Louis & Suburban Co.	1m., Feb. '10	175,234	*94,765	80,469	49,602	30,867
	1 " " '09	148,833	*83,343	65,490	49,235	16,255
	2 " " '10	363,427	*193,082	170,345	99,477	70,868
	2 " " '09	302,373	*175,892	126,481	98,295	28,186
EL PASO, TEX. El Paso Elec. Co.	1m., Jan. '10	57,958	29,489	28,469	8,633	19,836
	1 " " '09	51,512	30,282	21,230	7,903	13,327
	12 " " '10	607,404	359,310	248,094	98,955	149,139
	12 " " '09	538,933	383,035	155,898	87,593	68,305
FT. WAYNE, IND. Ft. Wayne & Wabash Valley Tr. Co.	1m., Jan. '10	123,255	68,863	54,392	43,759	10,634
	1 " " '09	109,673	64,273	45,401	41,149	4,252
FORT WORTH, TEX. Northern Texas Elec. Co.	1m., Jan. '10	105,849	61,134	44,715	18,190	26,525
	1 " " '09	88,938	54,543	34,394	17,183	17,211
	12 " " '10	1,276,463	699,326	577,137	205,145	371,991
	12 " " '09	1,095,313	641,240	454,073	192,652	261,421
GRAND RAPIDS, MICH. Grand Rapids Ry. Co.	1m., Feb. '10	78,468	40,170	38,298	19,756	18,542
	1 " " '09	71,452	35,656	35,796	18,937	16,859
	2 " " '10	164,820	84,556	80,264	40,483	39,781
	2 " " '09	149,040	74,076	74,964	37,883	37,081
HARRISBURG, PA. Central Penn. Trac. Co.	1m., Feb. '10	58,146	46,122	12,024	.....	.....
	1 " " '09	52,871	42,039	10,832	.....	.....
	2 " " '10	120,233	94,416	25,817	.....	.....
	2 " " '09	110,196	86,012	24,184	.....	.....
HOUGHTON, MICH. Houghton County Trac. Co.	1m., Jan. '10	25,340	15,156	10,183	6,341	3,824
	1 " " '09	23,561	15,737	7,824	5,297	2,527
	12 " " '10	321,745	171,971	149,775	74,369	75,405
	12 " " '09	270,459	151,354	119,105	60,098	59,007
JACKSONVILLE, FLA. Jacksonville Elec. Co.	1m., Jan. '10	46,880	24,976	21,904	9,223	12,681
	1 " " '09	37,936	22,222	15,714	9,400	6,314
	12 " " '10	495,722	271,950	223,772	112,740	111,082
	12 " " '09	435,914	255,335	180,579	111,301	69,278
KANSAS CITY, MO. Kansas City Ry. & Lt. Co.	1m., Jan. '10	611,919	324,451	287,468	155,405	132,063
	1 " " '09	550,948	329,157	221,791	155,562	66,229
	8 " " '10	4,785,616	2,720,656	2,064,960	1,264,931	800,029
	8 " " '09	4,418,573	2,520,190	1,898,383	1,262,135	636,248
LIMA, OHIO. Western Ohio Ry.	1m., Feb. '10	35,341	*19,964	15,377	15,276	
	1 " " '09	30,551	*19,736	10,815	15,301	†
MILWAUKEE, WIS. Milwaukee Elec. Ry. & Lt. Co.	1m., Jan. '10	386,716	285,388	101,328	45,415	5
	1 " " '09	344,636	232,671	111,966	45,816	6
Milwaukee Lt., Ht. & Traction Co.	1m., Jan. '10	112,483	48,044	64,438	55,648	
	1 " " '09	103,207	39,392	63,815	50,454	1
MINNEAPOLIS, MINN. Twin City Rapid Transit Co.	1m., Feb. '10	536,955	281,618	255,337	140,229	11
	1 " " '09	483,101	273,785	209,317	133,963	7
	2 " " '10	1,120,917	584,250	536,668	280,458	25
	2 " " '09	1,008,762	559,610	449,152	267,926	18
MONTREAL, CAN. Montreal St. Ry.	1m., Feb. '10	303,977	204,256	99,722	39,875	5
	1 " " '09	284,090	196,912	87,178	35,037	5
	5 " " '10	1,656,040	996,194	659,845	171,911	48
	5 " " '09	1,514,615	945,752	568,863	159,142	40
NASHVILLE, TENN. Nashville Ry. & Lt. Co.	1m., Feb. '10	136,439	76,417	60,022	33,690	
	1 " " '09	131,313	76,514	54,799	32,450	
	2 " " '10	285,038	160,578	124,460	67,380	
	2 " " '09	270,283	160,100	110,183	64,900	
PADUCAH, KY. Paducah Traction & Light Co.	1m., Jan. '10	22,741	14,476	8,266	7,070	
	1 " " '09	19,048	12,253	6,795	7,043	
	12 " " '10	231,037	137,975	93,062	81,671	
	12 " " '09	225,746	132,944	92,803	82,573	
PENSACOLA, FLA. Pensacola Electric Co.	1m., Jan. '10	20,608	12,158	8,450	4,785	
	1 " " '09	19,784	11,591	8,193	4,407	
	12 " " '10	247,488	141,905	105,583	53,009	
	12 " " '09	210,811	144,253	66,558	51,402	
PHILADELPHIA, PA. American Rys. Co.	1m., Feb. '10	268,455	.....	.....	.....	
	1 " " '09	248,714	.....	.....	.....	
	8 " " '10	2,124,508	.....	.....	.....	
	8 " " '09	1,997,892	.....	.....	.....	
PLYMOUTH, MASS. Brockton & Plymouth St. Ry. Co.	1m., Jan. '10	6,875	6,861	14	1,799	
	1 " " '09	7,086	6,074	1,012	2,156	
	12 " " '10	130,575	93,735	36,840	21,311	
	12 " " '09	122,765	87,187	35,578	26,563	
PORTLAND, ORE. Portland Ry., Lt. & Power Co.	1m., Feb. '10	393,075	170,616	222,439	130,778	
	1 " " '09	335,002	167,376	187,606	119,986	
	2 " " '10	824,087	352,661	471,426	259,773	
	2 " " '09	694,229	353,254	340,975	236,755	
POTTSVILLE, PA. Eastern Penn'a Ry.	1m., Jan. '10	51,048	30,772	20,276	.....	
	1 " " '09	43,246	27,606	15,640	.....	
ST. JOSEPH, MO. St. Joseph Ry., Lt., Ht. & Power Co.	1m., Feb. '10	79,271	43,419	35,852	22,067	
	1 " " '09	73,251	38,665	34,586	20,938	
	2 " " '10	168,579	90,325	78,254	44,084	
	2 " " '09	152,686	80,503	72,183	41,575	
ST. LOUIS, MO. United Rys. Co. of St. Louis.	1m., Feb. '10	807,439	562,924	244,515	233,276	
	1 " " '09	808,161	531,779	276,382	234,917	
	2 " " '10	1,693,221	1,159,068	534,153	467,063	
	2 " " '09	1,637,197	1,076,531	560,666	470,486	
SAN FRANCISCO, CAL. United Railroads of San Francisco.	1m., Jan. '10	627,666	363,751	263,915	.....	
	1 " " '09	566,373	348,215	218,158	.....	
SAVANNAH, GA. Savannah Elec. Co.	1m., Jan. '10	48,898	31,068	17,831	17,818	
	1 " " '09	49,986	32,256	17,730	17,509	
	12 " " '10	602,725	391,162	211,563	210,002	
	12 " " '09	599,484	383,400	216,084	207,009	
SEATTLE, WASH. Seattle Elec. Co.	1m., Dec. '09	481,893	289,036	192,858	103,709	
	1 " " '08	415,079	253,801	161,278	95,313	
	12 " " '09	5,854,175	3,394,538	2,459,638	1,242,663	1,
	12 " " '08	4,520,489	2,670,252	1,850,237	1,090,646	
TACOMA, WASH. Puget Sound Electric Ry.	1m., Jan. '10	144,369	*105,824	38,545	50,236	
	1 " " '09	122,858	*98,441	24,417	44,054	
TAMPA, FLA. Tampa Elec. Co.	1m., Jan. '10	53,361	30,309	23,051	4,566	
	1 " " '09	50,978	29,965	21,014	4,509	
	12 " " '10	598,685	346,449	252,237	56,025	
	12 " " '09	558,259	368,039	190,219	42,167	
TOLEDO, OHIO. Toledo Rys. & Lt. Co.	1m., Feb. '10	237,544	138,757	98,787	76,083	2,
	1 " " '09	214,813	117,889	96,294	70,911	5,
	2 " " '10	496,014	290,520	205,494	151,296	4,
	2 " " '09	439,500	247,949	191,551	141,924	9,